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A PASTURE OF BIG UNGULATE ANIMALS AS KEY ECOLOGICAL FACTOR INFLUENCING ON THE FLUCTUATION OF NATURAL HABITAT OF STEPPE HERBIVOROUS MAMMALS

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A Pasture of Big Ungulate Animals as Key Ecological Factor Influencing on the Fluctuation of Natural Habitat of Steppe Herbivorous Mammals. Tokarsky, V. — The objective laws of the natural habitat structure of European subspecies of the steppe marmot over the period of the 20–21st centuries in Rostov Region have been analyzed. Essential changes in the way of usage of nature and foremost the decrease of number of stock-raising capacities and pasture areas took place all over the territory of European subspecies of the steppe marmot natural habitat. There is no doubt that the agricultural usage of land contributed to the inhabitation of big quantity of steppe marmots, namely keeping big quantities of horses and cattle which had large territories used as pasture areas. During these periods, we can see the substantial decreases of the steppe marmot's population despite full prohibition of hunt (since 1929 there has been no industrial hunting for steppe marmots). In first case, over a 30-year period, the steppe marmots completely disappeared from the territory of Rostov Region. The second period is not over yet. Here we can foresee two variants of the situation development. At present the period of the steppe marmot disappearance has reached its midpoint. If the quantity of cattle and horses remains the same we can surely make forecasts of continued decrease of marmot's population. However, if a cattle breeding increases the population of steppe marmots will be able to restore its natural habitat to previous size.

Key words: the steppe marmot, distribution, Rostov Region, pasture territories, pasture ecosystems.

Выпас крупных копытных животных как ключевой экологический фактор, влияющий на колебания естественной среды обитания степных травоядных млекопитающих. Токарский В. — Рассмотрена структура ареала европейского подвида степного сурка на протяжении 20–21 веков в Ростовской области. Существенные изменения в характере природопользования и, в первую очередь, сокращение животноводческого сектора и выпасаемых площадей происходили повсеместно, по всему ареалу европейского подвида степного сурка. В периоды упадка животноводства мы наблюдаем резкое снижение численности степного сурка несмотря на полный запрет охоты (с 1929 г. промышленная добыча байбаков не велась). В первом случае вначале 20 в. на протяжении 30 лет сурок исчез с территории Ростовской области. Второй период ещё продолжается. И здесь можно предвидеть два варианта развития событий. Сейчас середина отрезка времени до очередного исчезновения байбака. Если численность КРС и лошадей останется на прежнем уровне, можно смело прогнозировать дальнейшее снижение численности популяции. В том случае, если сельское хозяйство и, в первую очередь животноводство, будут развиваться, популяция сурка способна к восстановлению своего ареала в его прежних границах.

Ключевые слова: степной сурок, распространение, Ростовская область, пастбищная нагрузка, пастбищная экосистема.

Introduction

Now the natural habitat of the steppe marmot includes the western area of the European part of the former USSR, Povolzhe, South Ural, North and Central Kazakhstan.

Now three subspecies of the steppe marmot are described: *M. bobak bobak* Muller, 1776 — western or European subspecies, *M. b. schaganensis* Bashanov, 1930 — eastern or Kazakh and *M. b. kozlovi* Fokanov, 1966 — near Volga subspecies. The place of description of typical form (*M. bobak bobak*) is unknown. Separation of *M. b. kozlovi*, both to our opinion and to the opinion to other researchers (for example B. E. Zarubin,

V. V. Kolesnikov and V. I. Mashkin (1996) is arguable. The Privolzhskiy subspecies is possibly just a geographical population with small natural habitat (Brandler et al., 2008; Shubin et al., 1978; Zarubin et al., 1996). The European subspecies sporadically occurs in steppe between Dnepr, Don and Volga. Privolzhskiy subspecies is widespread on Volga left bank and South Ural, Tatarstan, Bashkortostan and Orenburg area. The Kazakhstan subspecies occurs from Obshij Syrt and farther in North and Central Kazakhstan.

At present in the European part, just separate colonies on the limited territories of virgin soil, wild land, fallow land, flanks of gorges and ravine have survived in the Lugansk and Kharkiv Regions in Ukraine and in the Voronezh, Saratov, Ulyanovsk Regions and in Chuvashia in the Russian Federation.

During last decades of the 20th century, there was an intensive growth of natural habitat and population of the steppe marmot in the Rostov Region; but in the beginning of the 21st century, we can see a rapid decrease in the process. In specialized literature, there is a lack of information, concerning the steppe marmot presence in the Region mentioned. In 1970 several thousand individuals were indicated. In the Red Book of RSFSR (1983) more than ten thousands are noted. In 1984, the materials of the "first all over Russia assessment" of steppe marmots the quantity of 92,300 was indicated.

During the 19th century, the steppe marmot had already completely disappeared from the steppe zone between the Dnipro and Don rivers. In the 1930's, steppe marmots had completely disappeared from the Region between the Don, Bitug and Ikorets rivers where it had been represented in high quantities during the 18th century.

Up to the beginning of the 20th century on the territory of present Rostov Region, the population of the steppe marmot decreased greatly and in some areas it was on the edge of extinction (Bogachev, 1918). The present distribution of the steppe marmot is just a very small remainder of the wide geographical area, which had been peculiar to this species.

One factor that affects marmot population is direct or indirect anthropogenic influence. It includes hunting, poaching, grazing, and civil works. In Ukraine, all open fiat areas have been ploughed up and are under crops now. This, a number of specialists believe, has led to the marmots' mortality. There is also an opinion that it is incorrect to conclude that plowing up virgin steppes was the main reason for the bobak to disappear from the steppes of Eastern Europe. According to D. I. Bibikov and A. V. Dezhkin (1988), plowing up the virgin lands was one of the factors that contributed to its disappearance, while the main reason for that was said to be the hunting for bobaks (Bibikov, Dezhkin, 1988). The revival of marmot can also be explained by its protection due to the overall prohibition to hunt them. But according to V. I. Mashkin (1993) and in our opinion, it was insufficient for its revival (Mashkin, 1993). During several decades the European bobak acquired features non-peculiar to this species in terms of both ecology and etiology that explain European marmots revival phenomena.

At the beginning of the 21st century a population of this species decreased sharply in Ukraine. The dynamics of the populations in some kinds of animal breeding in the Don Region of the post-revolutionary period had experienced a number of serious changes that influenced the population of the steppe marmot in the Rostov Region. It is perfectly clear that borders of areas of these or those species are defined by the quality of food plants. The changes in floral cover resulted from anthropogenic or climatic changes which area companied by changes in the quality of fodder crops and are always accompanied by fluctuations (pulsations) of the relative areas borders or by oscillations of quantities of the area-inhabiting animals.

A sharp decrease in the bobak population is also related to the changes of vegetation in the gullies. A major part of gully steppes underwent a strong depression. O. Grebenshikov (1973) singled out five stages of the depression (Grebenshikov, 1973). We can name one more stage; this is a stage of ruderal plant expansion. Justin the Velikoburluk District (the Kharkov Province) the number of cattle was reduced by 2.4 times during the last decade. This has had a negative effect on bobak population. In 2003–2004, the gullies, where a cattle grazing was stopped, were very overgrown with vegetation. Also, we cannot ignore predators. When herbs grow too tall, the young animals, particularly during the first months of life, become easy prey for foxes, polecats, dogs and wolf. And finally, it's due to epizootics. Bobaks repeatedly died of rabbit-fever (for example, during the autumn of 2004).

Unfortunately, the structure of the area of the European subspecies of the steppe marmot, its dynamics and the reasons of a pulsation of an area during 20–21st centuries in other parts of the area, including in the Rostov area, remained poorly studied until now.

Material and methods

Natural and geographical description of Rostov Region

Rostov Region is located in the south-west portion of the Russian Federation between 50°14'–45°51' N. lat. and 38°14'–44°20' E. long., and borders with the Voronezh Region in the north, the Volgograd Region and the Kalmykiya Republic in the east, the Stavropolskiy and Krasnodarskiy Regions in the south, and Ukraine — in the west; in the farsouth-west it borders the waters of the Taganrog bay, and in the east — of the Tsimlyanskiy storage pool. The area of the Rostov Region territory is 100,000 km². Its size from the north to the south and from the west to the east is 475–455 km.

The territory of Rostov Region, located in the south of the East-European (Russian) plain, is an acclivous-

squiggly locality (absolute marks of heights are from 0 to 253). In the north, north-west and south-east there is a number of mountains (Kalachskaya, Ergeni and the Donetsk ridge), which have the plateau forms of relief, disjointed intensively by the valleys of the rivers, beams and ravines. The lowlands (Nizhnedonskaya, Donogorlykskaya) are located in the central and south-west parts. Thus, in the Region there are three mountains (Srednerusskaya, Donetskaya, Ergeninskaya) and three low-elevation (Azov-Kubanskaya, Nizhnedonskaya, Manychskaya) plains.

The climate is moderately-continental. Temperatures average from -9°C to -5°C in January and from $+22^{\circ}\text{C}$ to $+24^{\circ}\text{C}$ in July. Precipitation averages 400–650 mm per a year. The Vegetative period is 170–190 days. The Rostov Region is subjected to hot winds. Annual relative humidity in the region averages 72 % (its heightened values are usual for the coast of the Taganrog bay). There is an average of 122 days per year with precipitation for this region.

In the Rostov Region there are 4991 rivers and watercourses. The largest water system is Don with the basic influx of the Severskiy Donets. The north-western part of the region is drained with right influxes (Tuzlov, Severskiy Donets, Chir and other), and the southern one — with left ones (Sal, Western Manych). Also in the territory of this region there are rivers, flowing into the Azov Sea (Kagalnik, Mius and others). The density of river network averages $0.26\text{ km}^2/\text{km}^2$. More than five thousand storage pools are counted in the Rostov Region, the largest one is the Tsimlyanskoe (in Lower Don valley and areas of mouths of its influxes); there are also 3,000 others near that area.

The soil cover is represented mainly by black earth (64.2 %), chestnut soils (20.8 %), meadows and meadow-bog soils due to river overflow deposits (7.7 %), there are also saline soils from time to time. In the overflow lands of the rivers there are alluvial meadow soils.

In a botany-geographical relation the area is located within the limits of Near black sea-Kazakhstan sub region of the Eurasian steppe area. The region is divided into 3 zonal sub types: motley grass-*Festuca*-feather-grass, *Festuca*-feather-grass (real steppes) and sagebrush-*Festuca* (deserted steppes). Over six million hectares of steppes of the territory are cultivated and nearly two and a half million hectares are used as pastures, and hay growing areas. Narrow leafed grass-like cereals (feather-grasses, *Festuca*, *Poa*) are widely represented, as well as rhizome xerophytes (*Leumus*, couch-grass). There are also efemeroid cereals (*Poa bulbosa* L.) and ephemeras. The area of the forest of the region is about 344 thousand ha (on average about 6 % of the area of this territory). The tree breeds characteristic for the region are oak, maple, ash, aspen, and elm. From the general area of the Rostov Region forests, the share of natural ones is no more than 30 %.

The settlements of marmot of the band (beam) type prevail in the district of research: it means that the separate colonies of animals are dissociated from each other with uninhabitable territory. Marmots prefer to settle mainly on southern slopes or on the declivous northern slopes and practically do not inhabit the steep north slopes. In beams, the family areas of marmots are disposed across a slope and have a form elongated in direction “slope-thalweg”. They are easily differentiated on locality by paths laid on the territory of every family area. Therefore, counties carried out mainly by family areas and corrected, when it is possible, by visual observation of the animals. The family burrows are observed by sight practically without errors.

As a basic large scale map of district and land-tenure with the net of administrative division was obtained. Research was conducted in the locations of the expeditionary work of V. Gorbunov in 1990, which allowed tracing the dynamics of quantity and spatial structure of the steppe marmot in this district. In this connection the numbers of grounds of registrations are stored appropriated by author at that time. Except quantitative route registrations motor-car inspections of the territory in the Chertkovskiy District with a quality determination of marmots (“much”, “little”) was conducted both on the territory of former collective farms the “World” and out of its boundaries.

Statistical calculations and graphs were obtained with the use of the program Microsoft Excel.

Description of the area of investigation

Therefore, before 1926 the steppe marmots inhabited 44 districts of Rostov Region and in 1926. 42,890 skins were obtained, but in 1927–1928 7,428 skins were obtained. From 1929, the data on the industrial hunt for steppe marmots has not been provided. Near Donetsk, in the Veshansky and Meshkovsky Regions, on the right bank of the Tshir river (the northern part of North Caucasus in the past), near the Yablonev, Bokov and Kon'kov villages the unplowed areas of steppe along with the colonies of marmot have still survived. From 1926–1927 more than 40 thousand marmot hides were provided here.

The steppe marmot survived in the North Caucasus only in indicated areas of the district of Chertkov cossack village and in the Tarasovskiy district of the Donetsk Region and in the Askayska steppe on virgin soil. Near Chertkov, a small steppe preserve has already been declared before; Askayska virgin soil is now going to be declared as a preserve.

As to N. I. Kalabukhov's and V. V. Raevskiy's (1930) data, the steppe marmot is a usual inhabitant of the Donetsk Region; just in the Tarasovsky District there were found up to 9 colonies of this rodent. Later the authors note, “the colonies of steppe marmots in Donetsk Region studied by them in 1925–1926 has already been plowed and from the 15 inhabited holes only 4 have left. The quantity of the animals has rapidly decreased everywhere”. P. A. Sviridenko (1938) wrote about 30 colonies marked by him in 1929 in different

parts of Shakhtinsky Region with a total area of 672 Ha. The number of rodents in these colonies decreased so that some of them do not exist anymore. The marked colonies were located on the right bank of the Don River (Sviridenko, 1940).

By the middle of the 20th century, the steppe marmot has almost disappeared from the Rostov Region. The investigation by the specialists of the Rostov Administration about the number of cases of hunt in the lower and middle part of the Don in 1949 showed that in the region there had been several inhabited by the steppe marmot places in ten districts of the region, where 577 animals lived. In the Katar Region, the steppe marmot was caught (Ral, 1960). During the following years, the quantity and regions of the steppe marmot inhabitation continued to decrease, and by the time of settling it had left only a few colonies in the Millerskiy and Chertkovskiy Regions of the Rostov Region.

In the mid 1950's steppe marmots disappeared from the Rostov Region. However, as per the opinion of V. A. Minarskiy and V. V. Sidelnikov (2004) this rodent had never disappeared from the Rostov Region completely in the 20th century. In the available literature about vertebral animal fauna of the Don Land it was always pointed out that the presence of this species on the Rostov Region territory (Ral, 1960; Sviridenko, 1940; Zverozomb-Zubovskiy, 1924). The growth of quantity of the steppe marmot in the Lugansk Region of Ukraine at the end of the 1960's and in the beginning of the 1970's resulted in its distribution to other regions including the bordering territory of the Rostov Region (Brandler, Tokarsky, 1996; and others). It influenced the Don population positively and lead to its growth in numbers (Minarskiy, Sidelnikov, 2004).

The revival of the previous quantity and previous inhabitation area began at the end of the 1960's and in the beginning of the 1970's in the Millerskiy and Chertkovskiy Regions. So, in 1987 the eastern part of the Bokovskiy Region was inhabited by 100 animals and in the state farm "Krasnaya Zarya" there were about 10 of them. It is suspected that they came here from the Kasharskiy and Chertkovskiy Regions (Minarskiy, Sidelnikov, 2004).

Results and discussion

Thanks to the protection of the steppe marmot and to the development of cattle breeding in chernozem (black earth) steppes in the mid-1950's, the population of the marmots began to rebound. The specialists considered that this species had developed new ecologic qualities that allowed it not only to survive but also to reproduce itself despite life conditions being changed (Bibikov, Dezhkin, 1988).

It is a pity that we do not have data concerning the population of marmot in the beginning of 20th century. But data about industrial hunt for this kind allow us to suppose that the population was higher than 150–200 thousand. So before 1926 the animals inhabited 44 regions and in year 1926 42,890 were killed, but one year later (in years 1927–1928) there were only 7,428 killed (Minarskiy, Sidelnikov, 2004). In 1970, the local hunt inspection estimated the population of the steppe marmot as several thousand animals (personal impression of B. L. Kazakov). In the beginning of the 1980's the steppe marmots in the Rostov Region were detected in the following Regions: Chertkovskiy, Millerovskiy and Kosharskiy.

The first results of the steppe marmot density were received in 1990 and they were mentioned in semester work of Y. Gorbunov — a student of the geographical faculty of M. V. Lomonosov Moscow state university "Condition and population of the steppe marmot in the Rostov Region". Registered works were carried on in the Chertkovskiy Region near Rostov in the summer of 1990. The density at that period varied from 0.14 to 0.43 families per ha including plowed field.

Because we do not have our own data about sizes of families in the beginning of the 90's, it is impossible to estimate the quantity of animals precisely. There are data about the sizes of marmot families for the Melovskiy Region, the region that borders Chertkovskiy Region near Lugansk in Ukraine, namely, for the steppe marmot preserve called "Strelets-kaya Step" located within 60–70 kilometers from the Chertkovskiy Region. According to T. A. Seredneva the family of marmot there consists of an average of 3–4.5 (4) animals (Seredneva, 1985; Seredneva, Nezgovorov, 1977).

Therefore, because this territory is inhabited by the same population, the natural and historical features of the steppe marmot inhabitation here are also the same, we can suppose that the data obtained for the Melovskiy Region are valid for the Chertkovskiy Region.

Using these data the author estimated the quantity of steppe marmots in the Chertkovskiy Region from 200,000 to 220,000 animals in 1990.

The field research in the Chertkovskiy Region of Rostov in summer 2007 resulted in fixation that during the period mentioned in this natural habitat the changes in dimensional structure of the steppe marmot population occurred. At present, the steppe marmot is not observed in fields because farmers eliminate it. That is why it is not rational to make calculations for all the territory and estimation areas were made only in pastures and other unusable areas. In the beginning of the 21st century in the Chertkovskiy district, as in the whole Region also, the intensive decrease of the steppe marmot population is seen (table 1, fig. 1).

The dynamics of the population in estimation areas is shown in table 2.

So in the estimation territory, one of the counted areas (N 14) had only 12 families of 19 left, i. e. 63 %. In this natural habitat, the restoration of wild steppe after intensive usage of pastures at the end of 20th century goes on. Almost half of the natural habitat was covered with flowered feather grass in the end of May 2007. Also low quantities of iris and *Ornithogalum* sp. are observed there.

Table 1. Population density and quantity of the steppe marmot family members in the hunting areas of Chertkovskiy Region of Rostov in 2007

Таблица 1. Плотность населения и численность семей байбака в охотхозяйствах Чертовского района Ростовской области в 2007 г.

N of ranges	Square of the estimation area (Ha)	Density of families per area	Total families	Families with breeds	Families without breeds	Quantity of animals in one family, min	Quantity of animals in one family, max	Quantity of animals less than 1 year old	Total number of marmots in the estimation territory
Minkovo-Kalitvenskoye									
1	20	1	20	10	10	2	7	41	78
2	20	0.6	12	5	7	2	6	18	41
3	20	0.7	14	6	8	2	6	14	45
4	20	0.3	6	1	5	2	3	3	13
Chertkovskoe									
5	10	0.5	5	5	-	2	8	19	31
6	10	0.2	2	2	-	6	10	10	16
7	10	0.3	3	2	1	2	7	8	15
8	10	0.2	2	2	-	4	6	6	11
9	10	0.1	1	1	-	8	8	5	8
Schedrovskaya									
10	20	1.35	27	19	8	2	9	81	135
11	21	0.57	12	8	4	2	6	26	50
12	21	0.76	16	6	10	2	6	21	52
13	20	0.45	9	3	6	2	6	9	25
14	20	0.35	7	2	5	2	5	6	19
Lozovskoye									
15	10	1.6	16	4	12	2	7	20	38
16	10	0.6	6	4	2	2	6	13	19
17	10	1.5	15	4	11	2	7	16	34
18	10	0.4	4	2	2	2	5	6	12

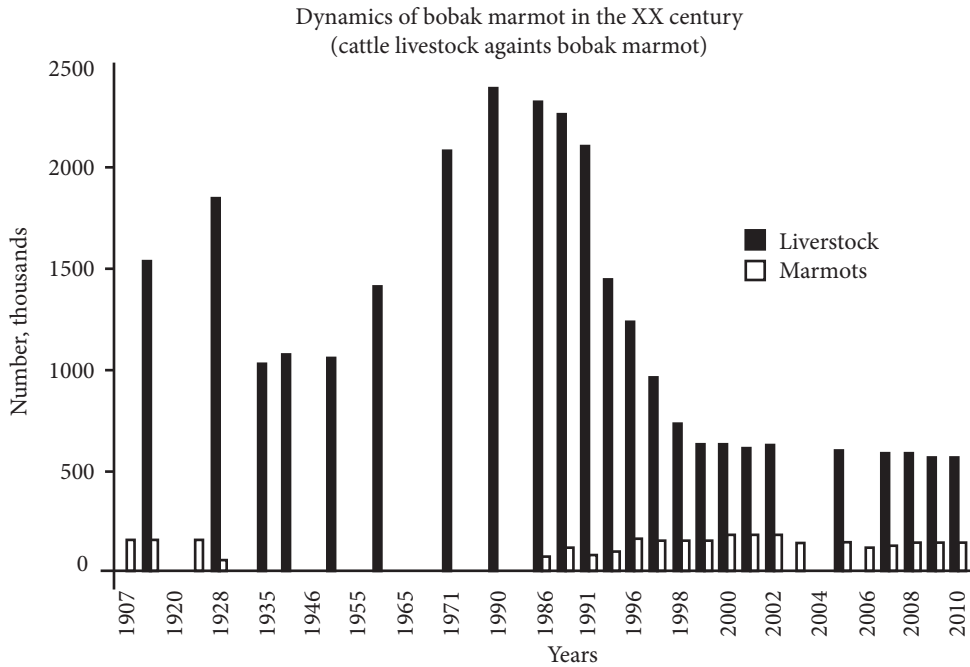


Fig. 1. The steppe marmot quantity dynamics in the 20th century (cattle against the steppe marmot) of the Chertkovskiy Region of Rostov.

Рис. 1. Динамика степного сурка в 20 в. (зависимость численности степного сурка от численности крупного рогатого скота) в Чертовском районе Ростовской области.

On the other areas (N 15) the gulch overgrows with high grass with the domination of cereals every year. During the hot (the temperature went up to 35 °C) and dry spring of 2007, this territory, like many others, was burnt. From 11 families of the steppe marmot only 10 have remained.

In area N 9 in 1990, there were detected 30 family areas with an average density of 0.8 families per hectare. There is a lake in the center of the pond. At present, cattle pasture takes place here and contributes to the survival of steppe marmots in this natural habitat. 23 families have remained i. e. 77 %. In area N 11 of 20 hectares 9 family ranges were detected. Up to this moment, the dimensional structure of the population has not changed. Relatively low density of 0.3—0.4 families per hectare can be explained by the geographical location of the gulch that has steep slopes. In the beginning of 21st century, the steppe mar-

Table 2. Dynamics of the population in estimation areas ("Myr" collective farm)

Таблица 2. Динамика численности на учётных площадках (на территории бывшего колхоза «Мир»)

N by the range	N by the map	Area (hectares)	Quantity of families in 1990 (Gorbunov, 1991)	Density of families per hectare in 1990	Quantity of families per hectare in 2007 (our data)	Density of families per hectare in 2007
1	14	19	19	0.9	12	0.6
2	15	11	11	1.0	10	0.9
6	9	40	30	0.8	23	0.57
7	11	20	7-9	0.3-0.4	9	0.45
8	16	15	12	0.8	8	0.53

not inhabits all the botanic-geographical regions around Rostov except the Don Valley and Mynych Valley— this animal had never inhabited these areas. The animal is also absent in the Ergenskaya highland. The nearest area inhabited by marmots is the Starikovskiy part of the “Rostovskiy” preserve (Minarsky, Sidelnikov, 2004).

The present condition of the steppe marmot colonies in relatively recently inhabited areas can be shown using the sample of the Kamenskiy Region. So, approximately all the gulch-clough system of the hunting area “RK ShV ltd.” of the Kamenskiy District in the Rostov Region is randomly inhabited by marmots with low density. In total, the territory of the hunting area is inhabited by about 70 families of the steppe marmot (300–350 animals).

In the end of the 17th century and in the beginning of 18th century, the steppe marmot was a usual animal species here. S. G. Gmelin (1806) pointed out that: “Everywhere along the Don river there are uncountable quantities of them” (p. 47). In 1908, V. Troitskiy visited Provalskiy Military Plant (the region of Don Cossack Army). The results of his expedition called “Preliminary report about the trip to the territories of the Provalskiy Military Plant” were published in the Book of works of the student society of Russian nature research of the Moscow Royal University. Taking into account the historical value of this work and the limited access to it for the specialists, I represent in this work detailed extracts from the article of V. Troitskiy: “The territories of the Provalskiy Military Plant are at the most northern part of the Cherkassy District of Don Cossack Army Region. The territories mentioned border with the Donetsk Region in the north and east and with the Taganrog Region in the west, in another words, the territories of the plant are stretched from 48°1' to 41°11' of the north latitude and from 9°19' to 9°38' of the east longitude (from Pulkov). This entire territory equal to 22,883 dessiatines is situated in the southern part of the Donetsk plateau, which is the end of the Donetsk ridge. In accordance with the Tillo map the average elevation for this area is about 70–80 sazhenes above the sea level.

In the area of the Plant, three small rivers (the Burgusta, Grushevaya, and the Derevechka) have their beginning. The first one is directed to SE and falls into the tributary of the Donets River called Cunduryuchya. The two others are directed to NNE and fall into the Kamenka River that is also Donets river tributary. As I have already said above, in the territory of the Provalskiy Military Plant there is a big area, densely inhabited by steppe marmots (*Arctomys bobac*). These animals themselves are not dangerous for agriculture, but their presence prevents field work from being done in the proper way. Steppe marmots dig very deep holes throwing out a lot of soil, sometimes up to 1, 2 or more carts. It is quite understandable that these heaps, located, by the way, very closely to each other, make problems for mowing. This is the explanation for the administration of the plants' desire for destruction of the steppe marmot. That is why industrial hunters on these animals are admitted to the territories of the Provalskiy Plant.

The hunting season lasts from the middle or the beginning of June (it depends on animals hair shedding) to the 10th of August. During this period in 1907, more than 2000 steppe marmots were killed by industrial hunters and in summer of 1908, by the 10th of July, 800 steppe marmots were killed, and 23 poods of lard had been produced. As to the question of the steppe marmot distribution on the territory of Provalskiy Military Plant it should be said that currently they inhabit the southern part of the area to the south of the Ekaterininskaya railway station “Provalye”.

Comparatively very small quantity of them is located to the north from this station. However, before, and, by the way, not such long time ago, the territory inhabited by steppe marmots was much larger than the current one. The locals say that just 4–5 years ago families of the steppe marmot could only be met in the northern mountain part of the Plant. Indeed, in this part of the area often my attention was paid to the big heaps of soil that, when looked at in detail, were determined as old half-demolished holes of steppe marmots. Regardless, I could not find the answers for the following actual questions: is the present area inhabited by the steppe marmot a part of the territory of the old big Region that previously included also the northern part of the plant or is this area a recent conquest of the animals that have come here from the north?

It seems that northern border of the steppe marmot distributions, without any doubt, has been moving and still move from the north to the south; it is clearly seen from the rest of the holes located from the north to the railway up to the first mountains. Even with some confidence it can be said that in several years the northern border of the area inhabited by steppe marmots will be the railway to the north of which in present a small quantity of still inhabited holes. I cannot completely agree with the opinion that the reason for the moving of the northern border of the steppe marmot distribution is the industrial hunt. Probably it is just one of the reasons for the decrease of the quantity of animals. However, firstly, steppe marmots had left the northern half of the plant territory before the industrial hunt was established and, secondly, the industrial hunters do not hunt to the north of the railway where the movement or disappearance of animals is detected. It is possible that the steppe marmots left the northern part of the territory for the southern one because it is more convenient for their inhabitation. The layer of the sand under the soil layer is located more deeply here and it allows to dig more deep holes; and the plants are much better here than in the northern part of the area. But the reason for the steppe marmot retreat, even before the industrial hunt began, along all the border of the southern part of the Plant territory remains unknown; and it causes us to guess that there are some reasons (except industrial hunt

for the animals) for migration or gradual decrease in number of the steppe marmots. To uncover these reasons seems to be of very high interest for biology (Troitsky, 1909). In my opinion, most likely, the quantity of the horses decreased or the mode of pasture had been changed in this territory. To find out if this is so in presently impossible, but the fact that the quantity decreased despite the absence of industrial hunting as V. Troitskiy affirms, allows us to suppose this.

According to the data of E. V. Zverozomb-Zubovskiy (1924) in the beginning of twenties of the 20th century steppe marmots survived in the Don Region in a mosaic way: "At present a great number of steppe marmots inhabit the Donetsk Region, around the Provalskiy Military Plant, in the Region of Kurnikovo-Lipovskoe (at present — Kurno-Lipovka bowery of Tarasovskiy Region), Koshary and also in Cherkasskoe, the so called, Aksay virgin soil (in 12 versts to the north from Aksay bowery (Aksay town)) and in the steppe near Persianovka bowery (shooting range). Their presence is also possible in others places of the Region, where parts of virgin soil steppe are kept, like: 1st Donskoy (Ermakovskaya (the steppe marmot holes) and Chertkovskaya boweries), in 2nd Donskoy (Kalach bowery (also the steppe marmot holes)), in U. Medveditskoye (Kletskaya cossacks village, Mikhaylovskaya dacha), in Taganrogskoye (near to Makeevka and Kuteynikovo cossacks village), in Cherkasskiy (Zlodeyskaya cossacks village (Region of Zelenograd, Mechetka village) and in upper reaches of Maly Nesvitay, and also in different places of Salskiy Region; but there are no data about this yet" (Zverozomb-Zubovsky, 1924).

Pallas in 1774 met them in high quantities in the Khoperskiy Region on the left bank of the Koper river (from the Pravotorovskaya station and higher). At present there are no significant parts of virgin soil and if the steppe marmots inhabit this territory is unknown, but just in the first half of the last century, according to the data of the author of "Statistic description of the Don Cossacks land" (1822), here and in the Ust-Medveditskiy Region they were numerous (p. 72)" (Pallas, 1778).

At present there are parts in Aksakay virgin soil (in 17 versts from Rostov in direction of NovoCherkassk by Grushevskaya road) where inhabited the steppe marmot holes are located in 20–30 steps from each other, and in the morning (from 5 to 10 o'clock) and than from 3 p.m. up to the sunset all the steppe, everywhere you see, is covered by animals standing and calling to one another. From here, they run to the closest environs of Rostov. For example, on 17.04.1921 we saw one the steppe marmot within three versts from the city (near Armyanskiy monastery (Monastery Surb-Hach on the territory of the Northern living Region of Rostov city)).

As it has already been mentioned, there is no doubt that the presence of high quantity the steppe marmot resulted from the agricultural usage of the land, namely from the presence of high quantities of horses and cattle that had been provided by large pasture squares.

It is well known that in the beginning of the 20th century steppe marmots survived mainly on the territories of the commercial stud-farms. It seems to be explained by the well-known ability of horses to eat low nutritive cereals that are usually avoided by ruminant animals. Further, I quote B. D. Abaturov (2005). "In specialized experiment with comparing pastures of horses and sheep on the mat-grass and wormwood with feather-grass (*Stipa capillata*) — the most low-quality mat-grass is devoid of nutrition — domination the sheep pasture in summer and autumn periods (from June to September) was accompanied by the negative balance of energy (Madiyev, 1973). Sheep ate feather-grass badly and after wormwood had been eaten they decreased in body weight quickly (107–126 grams per animal per day). In the same conditions, horses ate feather-grass actively and had a great weight gain (510 B. D 1,630 grams per animal per day). Remarkably, that during the pasture in the early spring period (May) the feather-grass in the early stages of vegetation was eaten successfully not only by horses but also by sheep. Pasture of animals at this time was accompanied by positive energy balance and by weight increase (93 grams per sheep per day and 890 grams per horse per day). This experiment shows that typically steppe inhabitance areas with domination of feather-grasses are appropriate for the inhabitance of even such well-adaptive to rough plant food ruminant animals like sheep during the short period of first vegetation stages only, but for non-ruminant animals (horses) they are available as food resources throughout the year" (Abaturov, 2005).

Before 1825, in the Region of Don Cossacks Army there were 385 stud farms that counted about 83,000 horses. But that time there were no general military stud-farms in the Don River Region. In 1844 the decree by Tsar Nikolay Ist it was ordered to organize four horse plants in the Don Cossacks Army Region to raise military horses there. However, only one plant was organized. Its basis consisted of 34 stallions and 250 mares of the best Great Russian, Don and Caucasus stocks. By the statement in 1853, it was ordered to organize herds in each cossacks village of the Don Cossacks Army Region.

During 1960–1970's on Don Territory, there was: one military stud-farm, cossacks villages' horse herds, private Don stud-farms and the Kalmyk stud-farms. Private stud-farms were concentrated in the steppes behind Don (the Zadonskaya steppe) in the area of about 8,000 dessiatins. In accordance with the data of 1876 the highest quantity of horses was raised by cossacks of Ust-Medveditskiy, Khoper, Second Donskoiy and the Miussky Regions. In general, by the end of the 19th century the development of the Don horse breeding had given a satisfaction possibility of the growing horses needs of the Don Cossacks Army. Up to the beginning of the 20th century except private stud-farms, there were cossacks villages' stables and military horse stables. Private horse stud-farms occupied for their needs about 755 thousand dessiatins of the military land, in the Salsky Region mainly. All this territory was divided into 332 parts, which was in usage by 96 horse stud-farms whose herds contained around 75 thousand of horses.

Before 1917 each Don cossacks village had its own horse herd that had a total of more than 1,600 stallions, about 25 thousand mares and more than 30 thousand in litter.

The dynamics of the total number of separate kinds of animal breeding in the Don Region in the post-revolutionary period suffered a number of serious changes that influenced the steppe marmot number in Rostov Region. The detailed analysis of these processes will be provided below.

In experiment with rodents of different food specialization it was shown that the decrease of food plants quality during different stages of maturity is accompanied by lowering of digestibility and, consequently, to the lowering of the quantity of digested (ingested) energy. The second influence of the horse pasture is in the change of the species structure of biological diversity of the steppes and in the formation of optimal conditions for the steppe marmot inhabitation in this territory. In the post-war period, the total number of horses decreased rapidly. During 90's this trend became even stronger and in 2000 the quantity of horses totaled just 25.6 thousands, for comparison in 1995 it was equal to 53.5 thousand.

Like in other place of its previous inhabitation, marmot settlements in the Don Region are formed in wild grasslands with relatively high relief — downhill, gulches, valleys of small rivers, but the present distribution of marmots is not more than a small residue of that wide geographical natural habitat that was characteristic to this species. The borders of natural habitats of any species is defined by the quality of feeding plants and the relative for the first sight, welfare of the feeding basis for some species is often mistaken. The comparison of food availability for saigas in several pasture territories with different types of feeding plants showed that pasture in steppe territories with domination of greensward cereals especially of feather grass was accompanied with negative energy balance (Abaturov et al., 1998; Abaturov, 2005). At present, it is well known that many species of steppe marmots prefer to inhabit areas of feeding of cattle and avoid preserve areas (Nikolsky, Ulak, 2005; Seredneva, 1985; Seredneva, Nezgovorov, 1977 and others). The reasons for this phenomenon were more or less convincingly explained relatively recently (Ronkin, 2003; Ronkin, Savchenko, 2000; Tokarsky et al., 2006).

B. D. Abaturov emphasizes that saigas successfully inhabit distorted habitats (fallow lands, territories disturbed by cattle pasture) and natural steppe greensward cereal flora in these conditions changes to phytocenosis of ruderal plants, mainly the goosefoot family. This possibly can explain wide distribution of saigas in the European part of steppe Region in historical past, when this territory was inhabited by tribes of nomads-stockbreeders (Dinesman, Savinetsky, 2000). This is also typical for the steppe marmot. The regions where steppe marmots are still present, in the territories of wild grasslands and fallow lands remained on the slopes of gulches and other areas inconvenient for cultivation, represents from 11 % to 23 % of the total area of agricultural lands. The «gulch steppe» became the only relic of steppe flora and only here, species of steppe plants and animals that have already disappeared from other territories, still remained (Grebenschikov, 1973). A major part of gulch steppes had suffered strong digression to some extent. The most typical modern biotypes of the steppe marmot are grasslands and pasture territories of domestic

animals. It may look very surprising, but here their food demands are almost completely satisfied. The territory of pastures totals 2.3 million ha which his 27 % of the agricultural area of the Rostov Region.

Recently methods of ecosystems preservation and rejuvenation by introduction of key edificatory species in natural environments are developing. Later, conclusions based on factual materials concerning the patterns of natural habitat structure of the European the steppe marmot sub species during the 20–21st centuries were made. Substantial changes in the way of natural resources usage and first of all the decrease of livestock breeding and pasture areas took place everywhere, all over the territory of the natural habitat of the European the steppe marmot sub species.

Starting from 1960s, marmots from the Velikoburluk district have begun to penetrate and live in all neighboring districts forming new centers of resettlement. At the end of 20th century the marmot habitat expanded 15–25 km every 20 years. In 1987, marmot population only in the Melovsk district alone made up 29,000 animals. A density of baibak population in this area made up 3–10 animals per one ha, sometimes falling to one animal (in the Melovoy Gully), while growing in the others up to 15 animals per one ha (the Glinyanni gully). The 1992 studies showed that compared to a period with maximum population (the beginning of 1980s — over 0.4 families per ha at 5.4 animals in one family, on the average) no redistribution of the area between families took place but reproduction decreased significantly (density — 0.4 families per ha at 3.5 animals in one family).

The dynamics of livestock population of separate kinds of livestock breeding in the Don in the post-revolutionary period suffered a number of serious changes and influenced the steppe marmot population in the Rostov Region. Therefore, before the beginning of reconstruction processes the quantity of all species of livestock animals, except horses, had increased significantly (fig. 2).

During this period, one can see substantial decreases of the steppe marmot population despite full hunting prohibition (from 1929 industrial hunting of steppe marmots did not

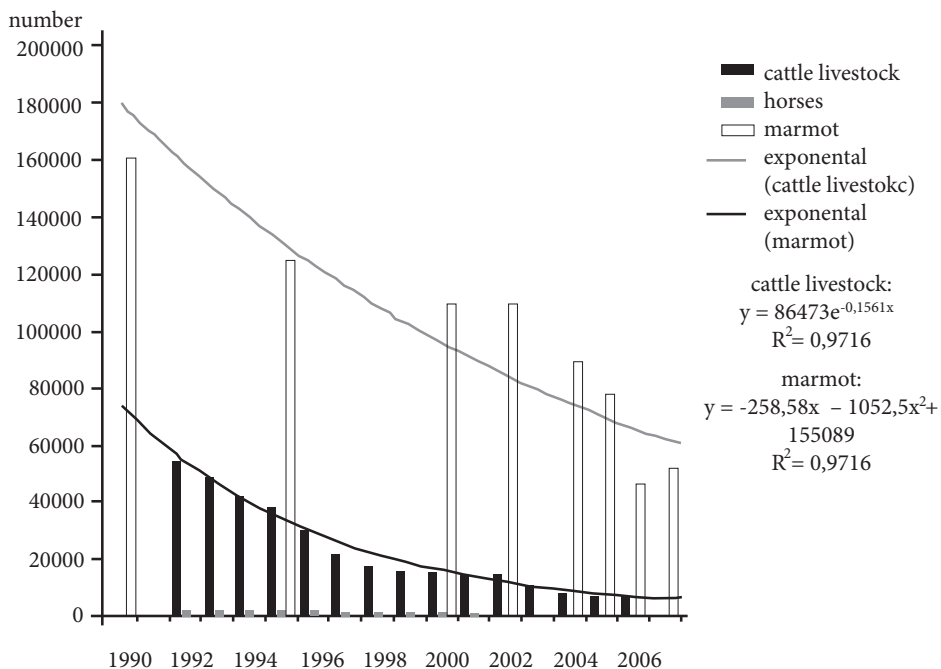


Fig. 2. The steppe marmot quantity dynamics in the 20–21th century (cattle vs the steppe marmot).

Рис. 2. Динамика степного сурка в 20–21 вв. (зависимость численности степного сурка от численности крупного рогатого скота).

take place). During a 30 year period the steppe marmots had completely disappeared from the territory of the Rostov Region. The next period is not over yet. Here we can foresee two variants of the development of this situation. We are in the middle of the next period of the steppe marmot disappearance process. If the quantity of cattle and horses remains the same we can surely make predictions of a continued decrease of the marmot population. However, if cattle livestock breeding increases the population of steppe marmots will be able to restore its natural habitat to previous size.

As it is seen from the figure, the decrease of the population of animals, which had begun during 80's, peaked during 90's. So in the period from 1991 to 2001 the quantity of cattle in the Region decreased by 3.5 times and the quantity of sheep decreased by 8 times (Khrustalev et al., 2002). At present districts which have about 10 animals per 100 ha against average 7.2 for the Region have the highest density of cattle livestock. It should be mentioned that before World War II this index was 12 animals per 100 ha, and in the middle of 80's it was about 28 animals. In the end of 80's — the beginning of 90's when pasture load was 2–3 animals per each 10 ha one can see the high increase in the steppe marmot population. Taking into account relatively high quantities of horses (still in 1995 it totaled 53.5 thousands), one can define optimal pasture load for the existence of steppe marmots.

At the same time, the progressive growth during some periods (collectivization, World War II) was accompanied by the decrease of quantity of domestic animals. The most remarkable was the substantial decrease of quantity of domestic animals during the World War I, during the collectivization and in the middle of 80's that was connected to the transition to the market economy relations. During these periods, we see substantial decreases in the population of steppe marmots despite full hunting restriction. However, our opinion is that domestic animals pasture accompanied by the gulch-type of phytocenoses is the key ecological factor forming the natural habitat of many species of grass fed steppe animals.

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