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Rodents in Mongolian steppe ecosystem				

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SMALL MAMMALS AND THEIR HABITATS IN THE ARID STEPPE OF CENTRAL EASTERN MONGOLIA *

In 1977-1978 investigations were carried out on the effect of small mammals on the steppe ecosystem in the region of arid steppes of Central eastern Mongolia. Using various methods of catchment and observation a list of most important species was completed, their distribution was ascertained and population numbers of certain species were assessed as well as some biometric data. The presence of 8 species of small mammals was noted, out of which most abundant were: Brandt vole (Microtus brandti Radde, 1861) (approx. 22 ind. x ha⁻¹) and bobac marmot (Marmota bobac Müller, 1776, Marmota ssp., M. sibirica Radde, 1861) (approx. 10 ind. x ha⁻¹).

1. INTRODUCTION

Within Mongolian-Polish Physical-Geographic Expedition in 1977-1978 a study was initiated of the role of small mammals in

*Contribution to the Mongolian-Polish Physical-Geographic Expedition No. 87.

functioning of the steppe ecosystems of Central eastern Mongolia. The whole expedition lead by Mongolian and Polish Academies of Sciences aimed at estimation of natural-geographical environment resources in this economically important region of Mongolia, where the cattle, sheep, goats as well as camels and horses culturing is concentrated (K l i m e k and T s e r e n s o d n o m 1977). Numerous rodents, especially Brandt vole (Microtus brandti Radde, 1861) and also occurring there bobac marmot, (Marmota bobac Müller, 1776, ssp. sibirica Radde, 1862), apparently the most important game animal in Mongolia, compete there with domesticated animals.

The mammals of Mongolia are relatively well investigated in the faunistic and zoogeographical aspects as well as their epidemiology (F o r m o s o v 1929, B a n n i k o v 1953, 1954, D a v a a 1967, S t u b b e and C h o t o l c h u 1968, D a v a a, N i c h t and S c h ü n t z e l 1971, T o p a l 1973, Z e v e g m i d and D a v a a 1973, D a v a a and N i c h t 1974, and others). On the other hand there is a shortage of ecological elaborations. The present investigations performed within the expedition aimed to fill this gap at least partially.

2. STUDY AREA

Studies were carried out in the region of Scientific Station Gurwan Turuu, situated in Central eastern Mongolia (lat. $47^{\circ}03'N$, long. $107^{\circ}38'E$, alt. 1371 m a.s.l.), about 120 km south of Ulan Bator in the belt of uppland arid steppes (K l i m e k and T s e r e n s o d n o m 1977).

The study area is located in the temperate climatic zone with typical continental character. Annual precipitation amounts to 150-250 mm, out of which majority falls in summer. Mean temperature of January is 249 K ($-24^{\circ}C$) with mean temperature of July 289 K ($+16^{\circ}C$), annual amplitude of temperature ranges from 228 to 309 K (-45 to $+36^{\circ}C$). Mean temperature of the ground surface ranges from about 249 K ($-24^{\circ}C$) in January to 293 K ($+20^{\circ}C$) in July. Through this area the southern boundary of permafrost runs thus in some places soil is frozen at a small depth all the year round. Even there where permafrost is absent, the soil is frozen for half a year. The vegetation period [mean daily temperature =

= 278 K (5°C)], lasts only 141 days (5 May - 23 September - Kovanez and Olecki 1980).



Fig. 1. Arid steppe of Central eastern Mongolia (a fragment of study area) covered with clumps of Caragana microphylla (Pall.) Lam.

The study area is situated in the zone of Stipa-Artemisia steppes (Murzaiev 1952). At present, detailed data on physiography and botany of this region are lacking in the literature. The types of vegetation can be roughly characterized as follows: a considerable part of the steppe area in the vicinity of Gurwan Turuu is covered by bushy steppe with Caragana microphylla (Pall.) Lam. (Fig. 1) as a predominant plant. In some smaller areas arid, lotic Stipa-Artemisia steppe with Caragana pygmaea (L.) DC. occurs. In the vicinity of temporary lakes halotrophic vegetation and strongly altered pasture communities with Iris sp. and sedges develop in small stretches. Still smaller plots in more humid spots are overgrown with somewhat more prolific vegetation with Lasiagrostis splendens (Trin.) Kunth.

The whole area is somewhat undulated with bazalt hills scattered here and there, forming habitats rich in fissures and rock crevices. The hill tops are often crowned with stone mounds of cult significance ("obo") (Fig. 2). The whole area is periodically grazed by large nomadic herds of cattle, horses, camels, sheep and goats.



Fig. 2. Cult mound of stones "obo" - a habitat preferred by Alticola argentatus Severtzov

3. SCOPE AND METHODS OF FIELD STUDIES

Due to reconnaissance character of this investigation, the scope of studies was rather ample but the quantity of materials gathered rather small. However, at present there is no possibility to continue those studies in Mongolia. The works covered foremostly compilation of a list of small mammals species that occur most often, and estimation of numbers of main species (this study), recognition of food composition and an estimate of digestibility and balance of biogenes in chosen species of mammals (G ó r e c k i, W e i n e r and Z e m a n e k 1982). The energy requirements of several species were determined by the method of respirometry (W e i n e r and G ó r e c k i 1981). In the

field the supply and production of above-ground parts biomass of plants was assessed with considering the impact of rodents on quantity, chemical composition and digestibility of biomass produced (Weiner et al. 1982, Zieliński 1982). The effect of rodents on soil properties was also studied (Borzyński 1978). The results of this field studies were used in synthetic estimation of the role of two most important rodent species in steppe ecosystem functioning in Central eastern Mongolia (Weiner, Górecki and Zieliński 1982).

4. CATCHES OF RODENTS

During the whole period of field sampling (13 June - 25 August 1977) catches of rodents were made with different intensity. The following 3 kinds of snap-traps were used: wire traps, commercial wooden traps of two sizes: "mice" and "rats" and three kinds of live traps: wooden box traps 9 x 10 x 17 cm and 20 x 22 x 60 cm and metal tunnel traps 5 x 5 x 20 cm. The metal pitfalls 10 x 30 cm were also used.

For trapping voles best were wire traps, metal tunnel traps and small wooden traps. Large wooden snap-traps were adequate for catches of siberian jerboas (Allactaga sibirica Forster, 1778). Large wooden live traps were good for trapping dahurian pika (Cochotona daurica Pallas, 1776) and mongolian gerbils (Meriones unguiculatus Milne-Edwards, 1867), small wooden live traps were useful for catching high mountains voles (Alticola argentatus Severtzov, 1879).

As a bait in snap-traps thick cotton tape, fried in oil with flour were used, in live traps seeds of sunflower and dry fruits were exposed.

Catches were usually done in traps situated along a straight line whereas during an intense catching of voles from colonies the traps were placed on well perceivable paths of rodents and at their burrows exits.

The killed animals were measured, their sex identified and the reproductive state of females ascertained. External parasites were also collected and transferred to specialists. Of the majority of specimens skulls and stomachs, sometimes skins, were collected. The collection of skulls and skins transferred to the

Institute of Systematic and Experimental Zoology, Polish Academy of Sciences in Cracow was used for verification of species identification, done in field according to external features described in the key by B a n n i k o v (1953). Stomachs were used for analysis of natural food composition.

Live animals captured for respirometric and feeding experiments were reared in metal cages under outdoor conditions, supplied mainly with natural plant food and water ad libitum.

5. ESTIMATES OF NUMBERS

Circumstances in the field restricted to a greater degree the possibility of direct and accurate estimates of numbers in rodent populations. Reconnaissance characters of these studies, limited number of equipment (number of traps) and the lack of water for using the burrow flooding method, all these accounted for research limitation. That is why only rough estimates were made for two most numerous species: Brandt vole and bobac marmot. The two species live in large colonies, easily perceivable and discernible from burrows of other species. In bobac marmot it is relatively easy to discern the system of dwelling burrows from smaller, protective ones. The colonies of Brandt voles cover vast areas including both plots intensely exploited at the very moment and those already abandoned by these animals with clearly changed vegetation.

The estimate of numbers of these two species has been based on census of bobac marmot burrows and Brandt vole colonies. For this reason 8 transects (in haphazardously chosen direction, 15 m of width each) were determined. A total surface of all transects was about 11 ha of a uniform area of Caragana microphylla steppe. Surveying along these transects the protective burrows, and dwelling burrow systems of bobac marmot were counted with simultaneous estimation of areas covered by the vole colonies. From this mean density of bobac marmot burrows and mean percentage of steppe area covered with Brandt vole colonies, were estimated.

Further on, 9 colonies of Brandt voles were chosen at random with surfaces from 50 to 580 m² each (a total of 1 623 m²); they were drawn on a map with details, surface being calculated and

the number of all exits counted. In several chosen colonies an intense catch-up of voles was performed with the use of a larger number of traps, and its efficacy was checked by closing burrow exits with paper twists.

Assuming that the number of adult voles captured corresponds to number of all adults in the colony the number of exits per individual was calculated. By knowing average density of burrows inside the colony and the percentage of steppe area covered with vole colonies it was possible to estimate average density of these animals. These estimates were done in the second half of August, thus after the period of most intense reproduction.

6. SMALL MAMMALS OF GURWAN TURUU VICINITY

Three months of catching and observation permitted to procure a list of the most important species occurring in the region of Gurwan Turuu. This list was prepared according to the taxonomic sequence (W a l k e r 1964).

1. Ochotona daurica Pallas, 1776 - dahurian pika.

It occurs infrequently in small colonies at hilly surroundings, often nearby "obo", where at the end of vegetation season a considerable storage of hay collected by these animals can be found. In Gurwan Turuu it occurs also at the base of railway embankment. Out of 4 individuals captured 3 adults were measured (Table 1).

2. Marmota bobac Müller, 1776, Marmota ssp. M. sibirica Radde, 1862 - bobac marmot.

One of the commonest and rather numerous species of rodents occurring in the area of studies. This large mammalian species (up to 7.8 kg in weight during autumn; J a n u š e v i č et al. 1972) forms colonies especially in a bushy steppe with Caragana microphylla, digging gigantic systems of burrows. It seems that bobac marmot, plays the most important role besides Brandt vole among herbivorous consumers of the steppe. The body size of this species is beyond the trapping methods applied. Around Gurwan Turuu the southern boundary of this species geographical range is situated (M u r z a j e v 1952, and own data). Bobac marmot is a goal of traditional hunting as a valuable fur animal supplying also eatable in Mongolia meat and leaf lard. Mass huntings occur

T a b l e 1

Size and weight of body in small mammals of Gurwan Turuu region

Species	Sex	N	Body length	Tail	Hind foot	Ear	Body weight
			average (mm) \pm SD				average (g) \pm SD
<u>Ochotona daurica</u> Pallas	♂	1	178	12	30	21	115
	♀	2	144	10	29.5	17.5	88
<u>Phodopus sungorus</u> Pallas	♂	5	83 \pm 4.1	11.6 \pm 1.8	12.6 \pm 1.1	13.4 \pm 0.9	25.6 \pm 5.2
	♀	1	79	11	11	14	25.0
<u>Alticola argenta-</u> <u>tus</u> Severtzov	♂	4	120.5 \pm 10.8	31.8 \pm 1.7	23.0 \pm 1.4	18.0 \pm 2.3	48.8 \pm 7.8
	♀	4	103.8 \pm 6.7	29.8 \pm 2.3	21.0 \pm 1.4	17.5 \pm 1.7	34.4 \pm 3.9
<u>Microtus brandti</u> Radde	♂	9	109.6 \pm 9.2	23.3 \pm 5.0	19.1 \pm 1.2	10.9 \pm 2.1	34.9 \pm 6.9
	♀	13	111.4 \pm 8.8	24.9 \pm 2.1	19.0 \pm 1.8	11.5 \pm 1.7	40.0 \pm 8.3
<u>Meriones unguicu-</u> <u>latus</u> Milne- <u>Edwards</u>	♂	4	118 \pm 13.1	94.5 \pm 11.9	28.3 \pm 1.7	14.3 \pm 1.3	61.5 \pm 18.0
<u>Mus musculus</u> L.	♀	4	116 \pm 5.3	83 \pm 2.9	25.8 \pm 1.9	13.5 \pm 5.8	51.5 \pm 10.0
	♂	2	77	56	15.5	17.0	17.0
<u>Allactaga sibirica</u> Forster	♂	1	165	212	72	39	115
	♀	3	145.3 \pm 4.2	181.3 \pm 26.3	65.3 \pm 9.0	38.0 \pm 2.0	101.3 \pm 28.0

in August and September. In Mongolia, over one million of individuals are killed per year (G u n g a d a s z 1971), which, as it seems, evokes gradually reduction of numbers of this species (D a v a a, N i c h t and S c h ü n t z e l 1971).

In Caragana steppe around Gurwan Turuu average density of burrows amounted to $6.36 \times \text{ha}^{-1}$, out of which $2.17 \times \text{ha}^{-1}$ are dwelling systems, the remaining being protective burrows. Bobac marmot density was estimated from the number of burrows and biological data for this species. Our observations confirmed data by G r o m o v et al. (1965) that one dwelling system is occupied at least by two adults. In two thirds of burrows systems the presence of 3 to 5 young was observed. Total abundance of bobac marmot estimated in the end of August, thus just before start of hunting season amounted in summer $970 \text{ ind.} \times \text{km}^{-2}$ ($4.2 \times \text{ha}^{-1}$ adults inclusive). These data are comparable with analogous numbers given for bobac marmot in USSR, although this density was higher than that reported for this species in the Zabajkal region (G r o m o v et al. 1965, J a n u š e v i č et al. 1972).

3. Phodopus sungorus Pallas, 1770 - djungarian hamster.

This species, known all over the world as a laboratory animal exhibits center of its range just in the region of the expedition investigations (M u r z a j e v 1952). Djungarian hamsters occur almost exclusively in stony steppes with Caragana pygmaea, living in single burrows. They occur commonly but not numerously. A total of 15 specimens (size of 6 adults are given in Table 1) were captured.

4. Alticola argentatus Severtzov, 1879 - high mountain vole.

It is an alpine species, whose range reaches probably its southern and lower boundary of occurrence in the study area (B a n n i k o v 1953). It is a common but not numerous rodent occurring in rocky and stony areas, especially at high altitudes. It inhabits places of unscreened basalts, as well as the cult mounds of stones "obo" where it occurs regularly. A proof of an ancient inhabitation in "obo's" by high mountain vole are deposits of excreta cementing literally the stones as well as heaps of stored food. High mountain voles occur also in human dwelling, preferring the brick stone buildings. Ten individuals were captured (data on adults are given in Table 1).

5. Microtus brandti Radde, 1861 - Brandt vole.

It is the commonest and most numerous species, similarly as in whole east Mongolia (B a n n i k o v 1953). In this species similarly as in other voles mass appearance is observed every several years. The autochthons confirm this phenomenon also around Gurwan Turuu, however neither frequency nor intensity of such mass appearance was determined. It seems, however, that 1977 was a year of low or average numbers, which can be inferred among other symptoms from considerable number of abandoned colonies.

In Gurwan Turuu Brandt voles form large and numerous colonies all over the whole area except for stony steppes and basalt unscreens. The Brandt voles occurred most numerously in Caragana steppe and halotrophic-pasture habitats.

Listing the Brandt vole colonies in the Caragana steppe area, it was found that they covered about 12% of its total surface. Inside colonies the density of burrows ranges from 0.24 to 0.57 $\times \text{m}^{-2}$, $0.364 \pm 0.12 \text{ SD} \times \text{m}^{-2}$ on the average. Thus there were 436.8 burrows per ha of the steppe surface. By assuming from intense catching from chosen colonies that there are average 20 exits of burrows per individual (5.7-29.2) the total density of Brandt voles amounted to $21.8 \text{ ind.} \times \text{ha}^{-1}$. This density is clearly lower than that observed in voles of European agrocoenoses. The number of burrows per unit surface of the steppe during the year of studies was by an order of magnitude lower than that reported by M u r z a j e v (1952). Also analogous estimation of numbers of Brandt vole performed accurately in the same spot one year later by Z i e l i ń s k i (1982) showed five fold higher density. A total of 75 individuals were caught. Main biometric data for adults are given in Table 1. Since mid of June to mid of July 8 pregnant females were captured, with 5-11 embryos (average of $8.3 \pm \text{SD } 1.9$).

6. Meriones unguiculatus Milne-Edwards, 1867 - mongolian gerbil.

It is second species commonly known as laboratory species used all over the world and originating from this area. Mongolian gerbils occur often but not numerously, forming small colonies in areas where light sandy soils are present, also on railway embankment. Mongolian gerbils live also in association with Tatar

cottages. Nineteen individuals were caught, size of adults is given in Table 1.

7. Mus musculus L., 1758 - house mouse.

It occurs only in association with man in brick work houses, not numerously. Two individuals were caught (Table 1).

8. Allactaga sibirica Forster, 1778 - siberian jerboa.

It occurs commonly, but not in great numbers, digging single burrows in open steppe. It is typically nocturnal species. Five individuals were caught, out of which four were adults (Table 1). In one pregnant female two embryos were found.

In the study area Citellus sp. were not found although these rodents were encountered both to the north (zone of forest steppe and taiga forest) and to the south (dry grassland steppes margins of Gobi desert) of Gurwan Turuu (D a v a a and N i c h t 1974).

Around Gurwan Turuu three predacious mammals were observed: weasel (Mustela nivalis L. 1776) - one specimen was caught by live trap in the area of Brandt vole colonies, corsac fox (Vulpes corsac L. 1768) - this animal was seen twice in higher parts of the study area, and Pallas cat (Felis manul Pallas, 1778; Dżułyński, oral information).

The fauna of wild mammals in the region of Gurwan Turuu seems to represent well the fauna of steppes in Central eastern Mongolia, and the methods applied in field allowed to collect representative materials on commonest and most numerous species of small mammals.

The authors wish to thank Prof. K. Klimek (The Head of Expedition) for a devoted help in organization of field work, all participants of the expedition for their amiable assistance and Prof. K. Kowalski for verification of field identification of species.

7. STRESZCZENIE

Drobne ssaki

w środowiskach suchego stepu wschodniej Mongolii

1. W latach 1977-1978 prowadzono badania w Mongolii w rejonie Gurwan Turuu (szer. $47^{\circ}03'N$, dł. $107^{\circ}38'E$, wys. 1371 m npm),

około 120 km na południe od Ułan Bator, w pasie wyżynnych stepów. Znaczną część powierzchni pokrywa krzaczasty step z dominującym gatunkiem Caragana microphylla (Pall.) Lam.

2. Podczas badań w 1977 roku (od czerwca do sierpnia) prowadzono odłowy gryzoni używając różnych metod i typów pułapek. Złowione zwierzęta ważono i przeprowadzano pomiary ciała (tab. 1).

3. Do ssaków w okolicach Gurwan Turuu, zamieszkujących różnorodne środowiska należą:

Ochotona daurica Pallas, 1776,

Marmota bobac Müller, 1776, Marmota ssp., M. sibirica Radde, 1862,

Phodopus sungorus Pallas, 1770,

Alticola argentatus Severtzov, 1879,

Microtus brandti Radde, 1861,

Meriones unguiculatus Milne-Edwards, 1867,

Mus musculus L., 1758,

Allactaga sibirica Foster, 1778.

4. Przeprowadzono oceny liczebności dwu głównych gatunków: Microtus brandti i Marmota bobac, cpierając się głównie na oszacowaniu liczebności nor na hektar oraz odłowach (M. brandti) i obserwacjach nor (M. bobac). Zagęszczenie M. brandti wynosi około 22 osobniki na hektar, a M. bobac - około 10. Te dwa gatunki odgrywają najważniejszą rolę w ekosystemie stepu wśród wszystkich drobnych ssaków.

8. РЕЗЮМЕ

Я. Вайнер, А. Гурэцки

Фауна мелких млекопитающих сухих монгольских степей

I. В 1977-1978 гг., в районе Гурван Туруу в Монголии проводили исследования (lat. $47^{\circ}03'N.$, long. $107^{\circ}38'E.$, lat. 1371 м. а. с. 1.) на территории, расположенной, приблизительно 120 км. на юг от Улан Батор, в полосе высотных степей. Значительную часть поверхности покрывает кустарниковая степь с доминирующим видом Caragana microphylla (Pall.) Lam.

2. В 1977 г. (от июня до августа) животных отлавливали, применяя различные методы и разные типы ловушек. пойманных животных взвешивали и измеряли величину их тела (Табл. I).

3. Основными млекопитающими окрестности Гурван Туруу, обитающими в разных средах, являются:

Ochotona daurica Pallas, 1776,

Marmota bobac Müller, 1776, Marmota ssp., M. sibirica Radde, 1862,

Phodopus sungorus Pallas, 1770,

Alticola argentatus Severtzov, 1879,

Microtus brandti Radde, 1861,

Meriones unguiculatus Milne-Edwards, 1867,

Mus musculus Linnaeus, 1758,

Allactaga sibirica Foster, 1778.

4. Оценили количество двух главных видов Microtus brandti и Marmota bobac, основываясь на подсчёте количества нор на гектар и отловах (полёвки), а также на наблюдениях за норами (тарбаганы). Густота полёвок равняется, приблизительно, 10 особям на гектар. Эти два вида среди всех мелких грызунов играют основную роль в экосистеме степи.

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