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A. B. Yeszhanov[1], Z. Z. Sayakova[1], V. P. Sadovskaya[1], S. T. Nurtazin[2], N. P. Kabysheva[1], A. S. Zhunusova[1], A. A. Abdirasilova[1], A. K. Rysbekova[1], B. B. Atshabar[1]

[1]RSE "Kazakh scientific center for quarantine and zoonotic diseases named after Masgut Aikimbayev" MH RK, Almaty, Kazakhstan,
[2]al-Farabi Kazakh national university, MES RK, Almaty, Kazakhstan.
E-mail: aidyn.eszhanov@gmail.com; zzsayakova@mail.ru; versad@mail.ru; nurtazin.sabir@gmail.com; nailya.kabysheva@gmail.com; aigul700@mail.ru; aigul.abdirassilova@mail.ru; rysbekova23@mail.ru; batshabar@gmail.com;

SOME MORPHOLOGICAL PECULIARITIES OF A GREAT GERBIL (*Rhombomys opimus* Licht 1823) FROM THE MIDDLE ASIA DESERT PLAGUE FOCUS

Abstract. (*Rhombomys opimus* Lichtenstein, 1823) - the main host of the plague microbe (*Yersinia pestis*) in the Central Asian desert focus of the plague. Despite the large number of scientific papers on various aspects of the biology of this species, its population differences remain poorly studied. The material for the study was the collection of skulls of the great gerbil of the Kazakh Scientific Center for Quarantine and Zoonotic Infections named after M. Aykimbaev. More than 600 great gerbil skulls were investigated in total. The purpose of the study was to clarify the differences in the main signs of the structure of the head bones of a great gerbil from different parts of its range. The article provides information on the main craniometric properties of gerbils from different parts of the range.

Key words: population, area, craniometry, host.

Introduction. The great gerbil (*Rhombomys opimus* Lichtenstein, 1823) belongs to the order *Rodentia*, the family *Cricetidae*, the subfamily *Gerbillinae*. Thirteen subspecies of this rodent are described in the literature, while according to some data it is believed that only a typical great gerbil is found in Kazakhstan - *Rhombomys opimus opimus* (Figure 1), according to other sources there are three [1, 2]. A significant part of the range of this species runs through the territory of Kazakhstan [3]. Family lifestyle and complex underground burrows, determine the important role of this species in desert ecosystems, as well as close ecological ties with other members of biocenoses [4]. However, without in-depth study of hosts, as well as their population differences, an understanding of the general patterns occurring in natural plague foci seems impossible. Despite the fact that a large number of works were devoted to various aspects of the biology of a great gerbil, there are still many issues to be studied. One of which is the population variability of gerbils. This issue is of great academic and practical importance, since it is believed that different populations may have different susceptibility to the plague microbe [5, 6].

The study of the characteristics of the structure of the bones of the skull, can provide a key to the question of how great the differences between representatives of the same species in different parts of the range [7]. Craniometry is one of the main methods in systematics and population ecology for establishing the taxonomic identity of a species, subspecies, or population. Despite the emergence of new molecular genetic methods, morphological methods, in particular, craniometry, have been successfully used to this day to determine the systematic affiliation of various species [8-12]. The study of differences in the linear dimensions of the bodies of animals, as well as craniometric indicators, makes it possible to identify the discontinuity between populations, as well as regional groups [13-17].

In this article, the authors provide information about the collection material of the skulls of the great gerbil of the zoological museum of the Kazakh Scientific center for quarantine and zoonotic diseases named after M. Aykimbaev.

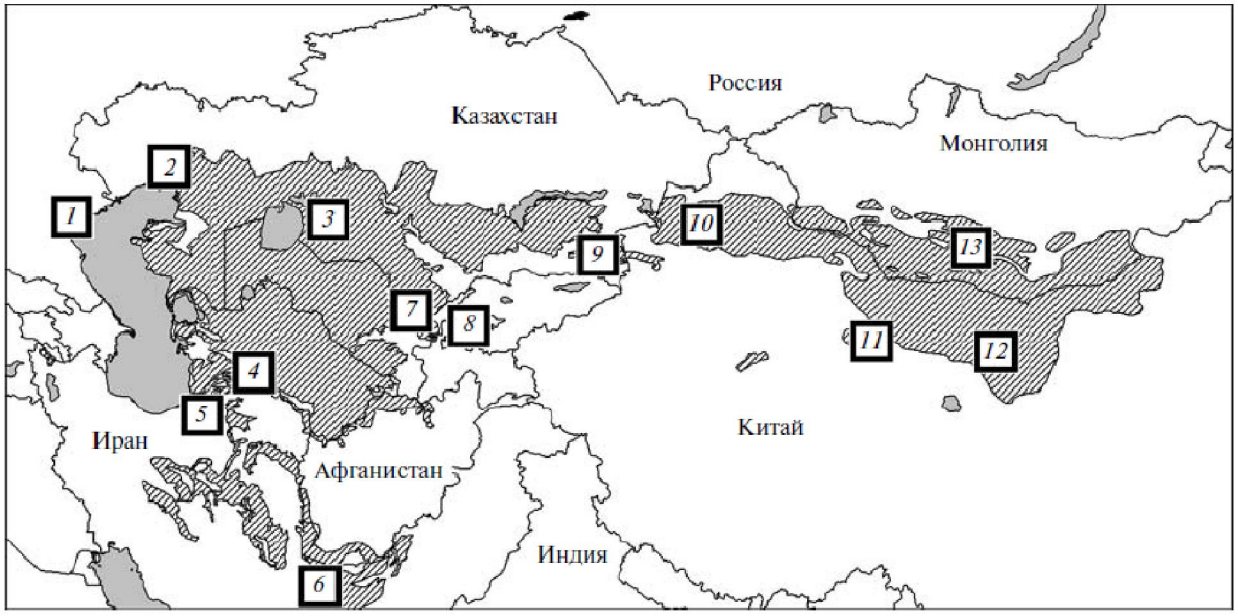

Figure 1 – The location description scheme of 13 great gerbil (Rhombomys opimus) subspecies within the range: 1 - R. o. obolenskii, 2 - R. o. pallidus, 3 - R. o. opimus, 4 - R. o. minor, 5 - R. o. sodalis, 6 - R. o. sargadensis, 7 - R. o. dalversinicus, 8 - R. o. fumicolor, 9 - R. o. major, 10 - R. o. giganteus, 11 - R. o. pevzovi, 12 - R. o. alaschanicus, 13 - R. o. nigrescens [1]

Materials and methods. The authors investigated skulls of great gerbil from the museum collection of the Kazakh Scientific center for quarantine and zoonotic diseases named after M. Aykimbaev.

The studied gerbil skulls were mined from the following places: Taukum desert, Zhalanashkol, Northern Karakum (Turkmenistan), Moyynkum desert, Fergana depression, Panfilov district (now Almaty region), Mangyshlak, Kalmykovo, Bakanas ancient delta plain, Northern Pre-Aral. It should be noted that the collection materials were the 60-70-ies of the last century, moreover, the exact coordinates of the location of the gerbil were not indicated. In this regard, we have used only available data.

623 skulls were measured, according to 5 characteristics, and only mature individuals were examined. Such parameters were measured as the total length of the skull, the condylobasal length of the skull, the length of the cerebral part of the skull, the maximum width of the skull, the maximum height of the skull. Males and females were measured and recorded separately, due to the presence of sexual dimorphism in great gerbils. Skulls were measured with caliper (SHC-1 GOST 166-89). All parameters of the measured skulls were entered into the MC Excel electronic database.

Below are tables with craniometric data for representatives of various populations of great gerbil (tables 1 and 2).

Results. In general, the most significant indicators in the ***total and condylobasal length of the skull*** are found in gerbils from Taukum, Zhalanashkol, Bakanas ancient delta plain (BAP). Then were gerbils from the Panfilov region, the Northern Karakum (Turkmenistan) and the Northern Pre-Aral. Gerbils from the Fergana depression, Kalmykovo region of West Kazakhstan oblast, are even less long, but they are larger than the gerbil from the Moynkum desert and Mangyshlak (figure 2).

The maximum width of the skull was greatest by males from the Northern Karakum, Zhalanashkol, Taukum, Panfilov region, and Bakanas ancient delta plain. Then, followed gerbils from Kalmykovo and Northern Pre-Aral, Fergana depression and Mangyshlak. Gerbils from the Moynkum desert had the smallest width of the cerebral part.

The length of the cerebral part. Males from Bakanas ancient delta plain, Taukum desert, Zhalanashkol, Northern Karakum, Panfilov district, Northern Pre-Aral, Fergana depression and Kalmykovo had the

Table 1 – Craniometric parameters (mm) of males of great gerbil
from different parts of the range, above limits, below average

Parameter	Taukum desert	Zhalanashkol	Northern Karakum (Turkmenistan)	Moyynkum desert	Fergana depression	Panfilov district	Mangyshlak	Kalmykovo (West Kazakhstan region)	Bakanas ancient plain	Northern Pre-Aral
Total length of the skull	42.8-47.6 **44.8**	42.1-46.5 **44.7**	41.5-46.5 **43.9**	35.9-44.2 **41.4**	41.9-45.1 **43.3**	43-46.3 **44.3**	32.3-42.1 **38.3**	40.9-45.5 **43**	42.1-47.5 **44.5**	42.8-44.5 **43.6**
Condylobasal length of the skull	40-44.8 **42.3**	39.4-44.2 **42.3**	39-43.8 **41.5**	32.2-42.1 **39**	38.8-42.1 **40.6**	40.8-44.1 **41.8**	29.9-40 **36.1**	38.9-43.6 **40.8**	40.6-44.2 **42.2**	40.5-42.1 **41.3**
Length of the cerebral part	17.2-20.8 **18.9**	17.1-20.1 **18.8**	17.2-20 **18.6**	14.5-18.9 **17.5**	17.2-19.2 **18.3**	17.5-19.6 **18.5**	13.3-18 **16.1**	17-19.5 **18.3**	17.9-20.8 **19.2**	17.8-19.2 **18.4**
Maximum skull width	22.5-26.8 **24.4**	22.5-26.2 **24.8**	23.9-25.7 **24.8**	20.8-24.8 **23**	21.6-24.2 **23.1**	22.2-25.6 **24.2**	17.5-23.5 **21.3**	22.1-25.2 **23.7**	22.6-26.3 **24.1**	22.8-24.2 **23.7**
Maximum skull height	14.5-16.7 **15.5**	14.6-16.2 **15.4**	14.2-15.5 **15.1**	13.8-15.6 **14.7**	14.6-15.6 **15.2**	14.1-16.2 **15.4**	12.9-15.6 **14.3**	14.2-16 **15**	14.8-16.2 **15.4**	14.9-15.8 **15.3**

Table 2 – Craniometric parameters (mm) of great gerbil females
from different parts of the range, above the limits, below the average

Parameter	Taukum desert	Zhalanashkol	Northern Karakum (Turkmenistan)	Moyynkum desert	Fergana depression	Panfilov district	Mangyshlak	Kalmykovo (West Kazakhstan region)	Bakanas ancient plain	Northern Pre-Aral
Total length of the skull	40.1-43.5 **42.2**	39.9-46.9 **43**	40-45.4 **42.7**	36.9-43 **39.6**	40.8-41.5 **41.2**	38.5-42.9 **41.4**	31.5-41.5 **37.9**	40-44.5 **41.9**	38-43.5 **40.9**	40.1-42.5 **41.6**
Condylobasal length of the skull	37.9-41.2 **39.9**	38.2-43.9 **40.4**	38.2-42.8 **40.6**	34.1-40.9 **37.3**	38.7-39.5 **39.1**	36.2-41.8 **39**	29.5-38.9 **35.5**	37.5-41.2 **39.7**	35.9-42.1 **38.8**	37.1-39.9 **38.8**
Length of the cerebral part	17-18.8 **17.8**	16.5-19.1 **17.6**	17-18.9 **17.9**	15.5-18.4 **16.6**	16.8-17.8 **17.4**	16.2-18.3 **17.1**	12.8-17 **15.4**	16.7-18.6 **17.7**	16-18.8 **17.5**	16.1-17.9 **17.4**
Maximum Skull width	22.5-24.4 **23.4**	22.2-26.5 **24**	23-25.4 **24.1**	20.6-24.1 **22.2**	22.1-23 **22.6**	21.1-25.2 **23.2**	17.8-23.1 **21.2**	14.5-25.1 **22.7**	21.2-25.1 **22.9**	22.1-23.8 **23.1**
Maximum skull height	14.1-15.5 **14.9**	14.1-16.8 **15.1**	14-15.5 **14.7**	13.6-15.2 **14.3**	14.6-15.2 **14.9**	14-15.5 **14.7**	12.3-15.5 **13.9**	12.2-15.7 **14.6**	13.8-15.8 **14.6**	14.5-15.1 **14.8**

most long-cerebral part, while gerbils from Moyynkum shorter, but longer than gerbils from Mangyshlak. A similar trend was found in relation to the maximum height of the skull (figure 3).

Females from the Zhalanashkol, Northern Karakum, Taukum, Kalmykovo, Northern Pre-Aral regions possessed the greatest total length of the skull. Then followed samples from the Panfilov district, the Fergana basin and the Bakanas ancient plain. While the gerbils from Moynkum and Mangyshlak were significantly smaller.

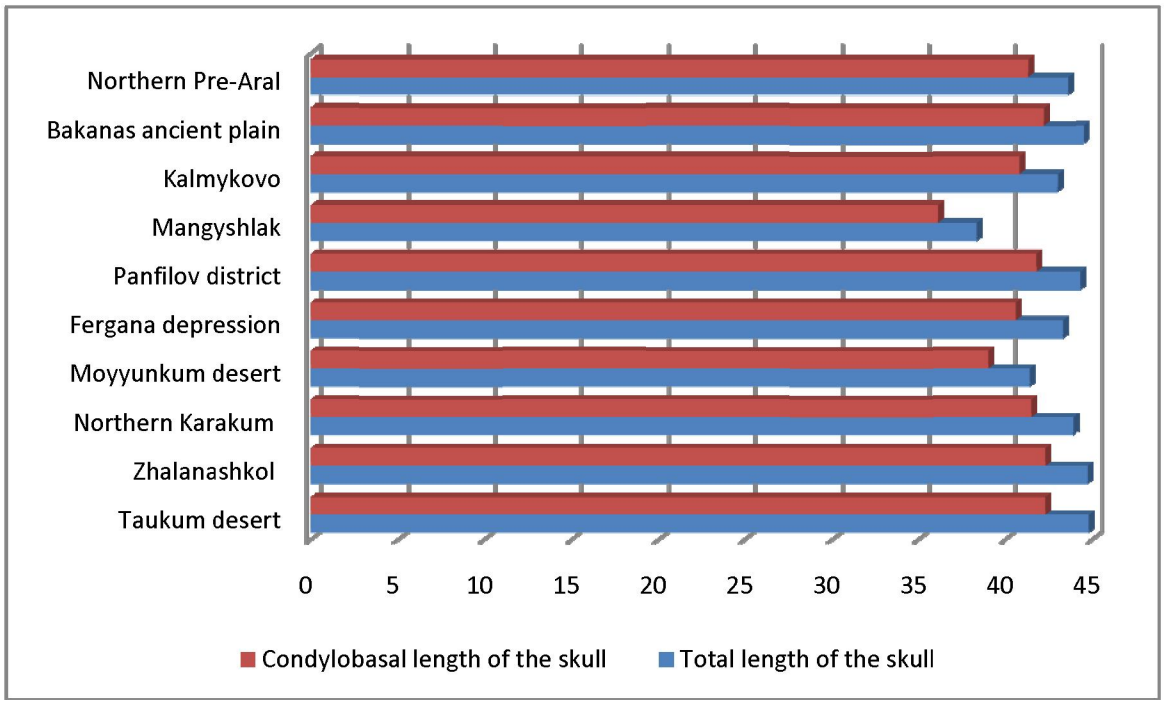

Figure 2 – Total and condylobasal length of the skull in males of great gerbils from different habitats

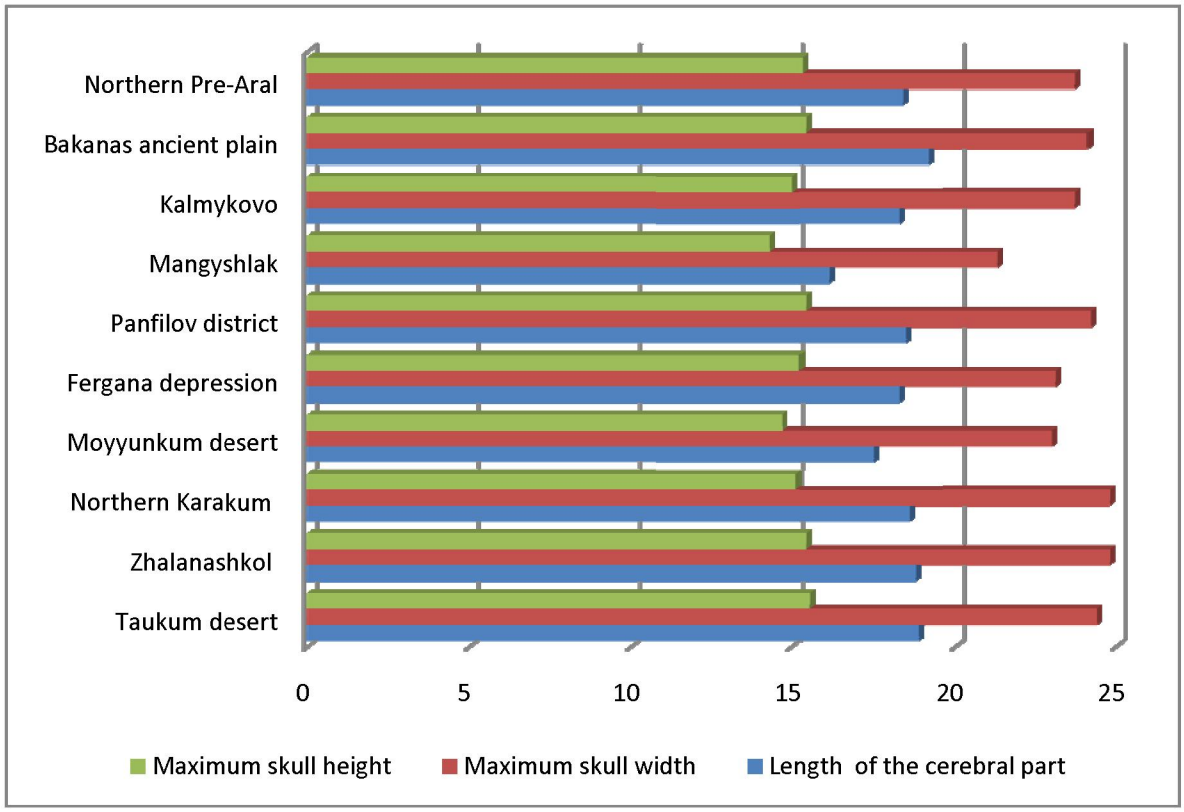

Figure 3 – The length of the cerebral part, the maximum width and maximum height of the skull in males of great gerbils from different habitats

As for the **condylobasal length**, the Northern Karakum and Zhalanashkol prevailed here. While females from the Taukum desert and Kalmykovo were slightly inferior to the above-mentioned places, while the Panfilov district, the North Pre-Aral region, the Bakanas ancient plain, and the Fergana depression were similar. Skulls from Moiynkum and Mangyshlak were characterized by the smallest length (figure 4).

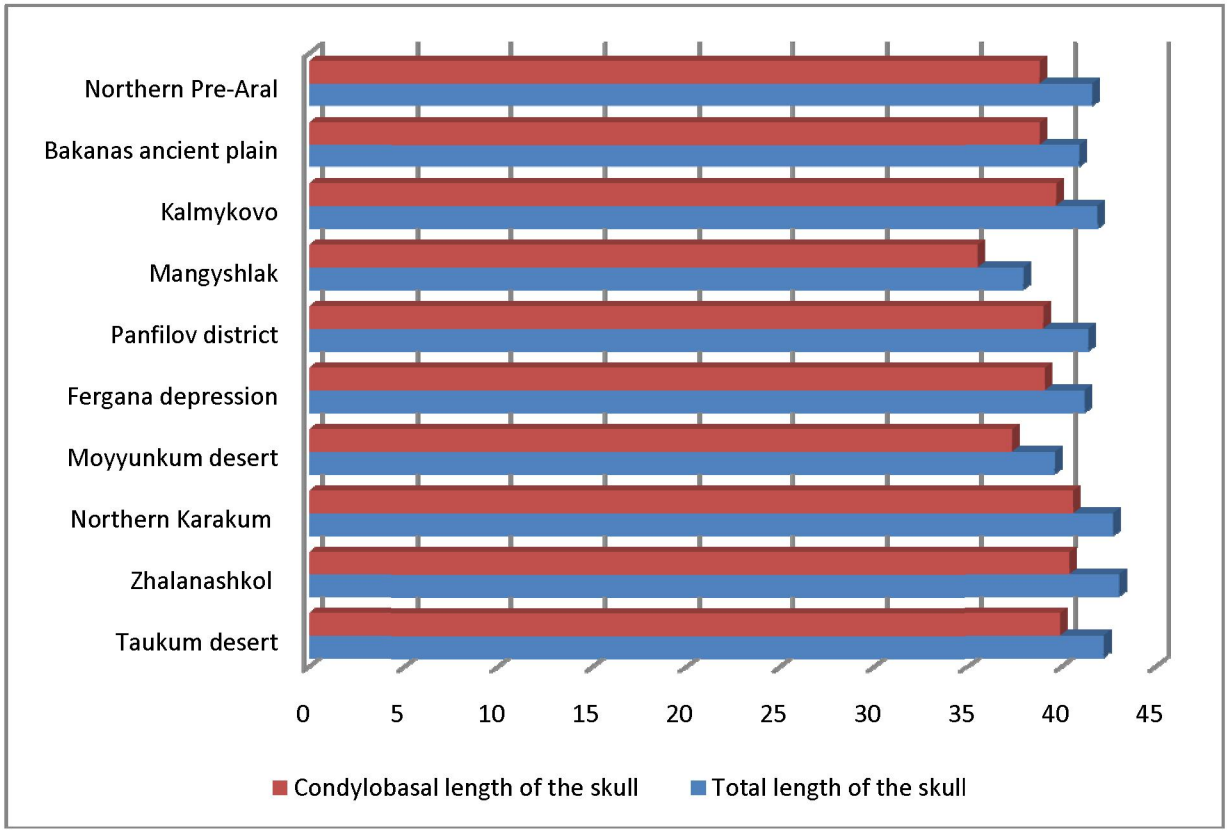

Figure 4 – General and condylobasal length of the skull in females of great gerbils from different habitats.

The **maximum width of the skull** was greatest for skulls from the Northern Karakum and Zhalanashkol, then from Taukum, Panfilov region and Northern Pre-Aral region. The Bakanas ancient plain, Kalmyokovo and Fergana depression followed after, and the skulls from Moyynkum and especially Mangyshlak had the smallest width.

Significant differences in the **maximum height of the skull** were not found, we can only select a few large parameter in gerbils from Zhalanashkol, Fergana depression, Taukum, Northern Pre-Aral, Panfilov, Kalmykovo, Bakanas ancient plain and Northern Karakum. Skulls from Moynkum and Mangyshlak also had the lowest height.

The **length of the cerebral part** was the largest by gerbils from the Northern Karakum, Taukum desert, Kalmykovo, Zhalanashkol, Bakanas ancient plain, Northern Pre-Aral and the Fergana depression. Skulls from Panfilov region had a slightly smaller length, the most modest indicators were those of the Moyynkum desert and Mangyshlak (figure 5).

Findings. Considering the results of the study, it can be said that there are differences in some parameters of the skull between gerbils from different populations of its range. The distinction between the gerbils from Moynkum and Mangyshlak in particular is striking. Perhaps this is due to habitat conditions and food resources. Despite the fact that all studied gerbils from its Kazakhstan part of the range live at the same latitude and belong to the so-called subzones of the northern deserts [18], it is still likely that the Bergman's rule comes into force here [19]. What is indirectly confirmed by other researchers [20-22].

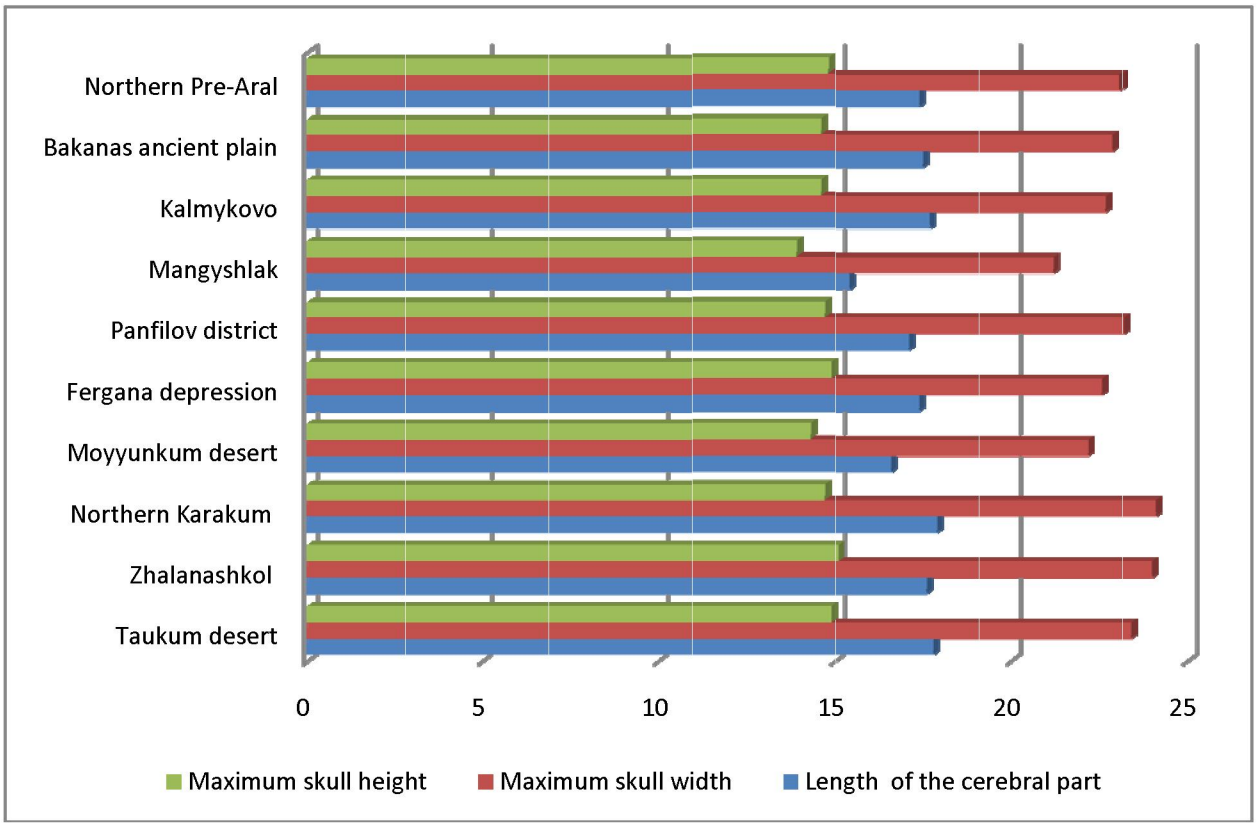

Figure 5 – The length of the cerebral part, the maximum width and maximum height of the skull in females of great gerbils from different habitats

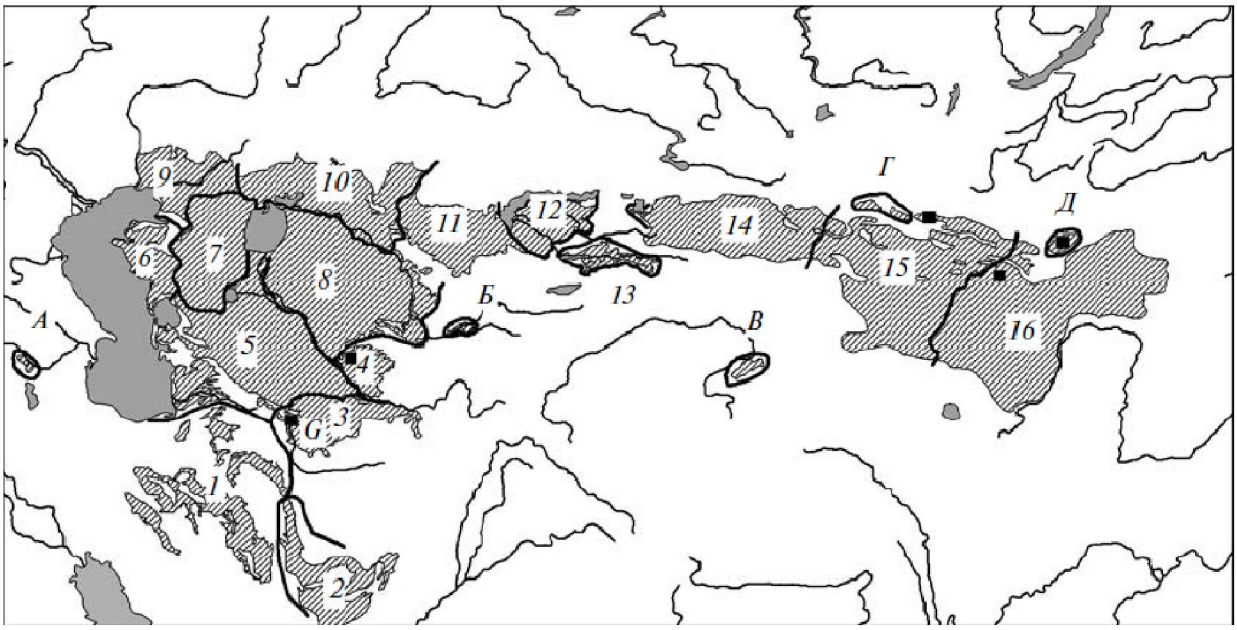

Figure 6 – The location description scheme of regional complexes and autonomous groups of populations within the range of a great gerbil (*Rhombomys opimus*). Regional complexes:
1 - Central Iranian, 2 - Sistan-Balochistan, 3 - Southeast Karakum, 4 - Karshi, 5 - Turkmen, 6 - Mangyshlak, 7 - Ustyurt, 8 - Kyzylkum, 9 - Northeast Pre-Caspian, 10 – Pre-Aral, 11 - Betpakdala-Muyunkum, 12 – Pre-Balkhash, 13 - Ilian, 14 - Dzhungarian, 15 - Gobi-Beyshan, 16 – Gobi-Alashan,
Autonomous population groups: A - Prearaksinsk, B - Ferganian, B - South Tarim, G - Oroknur, D - Bayandov [18]

The total and condylobasal length of the skull in both females and males had differences between populations. Parameters such as the maximum width of the skull and the length of its cerebral part varied greatly between representatives of different habitats, in both sexes. What is probably associated with different body weight in representatives of different populations. At the same time, the maximum height of the skull varied slightly, which is probably not related to the body weight of the animals.

Perhaps the explanation for the fact that the skulls of the gerbils from Mangyshlak differed most strongly from others lies in the fact that they belong to another regional complex [23], namely, the Ustyurt (figure 6). In this case, how to explain the similarity of representatives of other regional complexes among themselves? This question remains open. It is obvious that without complex studies involving morphological and molecular genetic methods, it is not possible to find an explanation for this phenomenon.

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А. Б. Есжанов[1], З. З. Саякова[1], В. П. Садовская[1], С. Т. Нуртазин[2], Н. П. Кабышева[1], А. С. Жунусова[1], А. А. Абдирасилова[1], А. К. Рысбекова[1], Б. Б. Атшабар[1]

[1]ҚР ДСМ «Масғұт Айқымбаев атындағы Қазақ карантиндік және зооноздық инфекциялар ғылыми орталығы» РМҚК, Алматы, Қазақстан,
[2]«Әл-Фараби атындағы Қазақ ұлттық университеті» ҚР БҒМ, Алматы, Қазақстан

ОРТААЗИЯЛЫҚ ШӨЛДІ ОБА ОШАҒЫНДАҒЫ ҮЛКЕН ҚҰМТЫШҚАНЫНЫҢ (*Rhombomys opimus* Licht 1823) КЕЙБІР МОРФОЛОГИЯЛЫҚ ЕРЕКШЕЛІКТЕРІ

Аннотацияю (*Rhombomys opimus* Lichtenstein, 1823) – Ортаазиялық шөлді оба ошағындағы негізгі оба микробын (*Yersinia pestis*) тасмалдаушысы. Осы түрдің биологиялық аспектілеріне арналған ғылыми еңбектердің көп болғанына қарамастан, оларың популяциялық айырмашылықтары аз зерттелген. Зерттеу материалы М. Айқымбаев атындағы Қазақ карантиндік және зооноздық инфекциялар ғылыми орталығының коллекциялық материалынан алынды. Барлығы 600-ден астам үлкен құмтышқаны зерттелді. Зерттеудің мақсаты әртүрлі аймақтық бөлімдерде таралған үлкен құмтышқандарының бас сүйектері құрылысының негізгі белгілерін анықтау болды. Мақалада әртүрлі аймақтық таралу бөлімдеріндегі үлкен құмтышқандарының негізгі краниометриялық ерекшеліктеріне анықтама берілді.

Түйін сөздер: популяция, аймақ, краниометрия, тасымалдаушы.

А. Б. Есжанов[1], З. З. Саякова[1], В. П. Садовская[1], С. Т. Нуртазин[2], Н. П. Кабышева[1], А. С. Жунусова[1], А. А. Абдирасилова[1], А. К. Рысбекова[1], Б. Б. Атшабар[1]

[1]РГП «Казахский научный центр карантинных и зоонозных инфекций им. Масгута Айкимбаева» МЗ РК, Алматы, Казахстан,
[2]«Казахский национальный университет им. аль-Фараби» МОН РК, Алматы, Казахстан

НЕКОТОРЫЕ МОРФОЛОГИЧЕСКИЕ ОСОБЕННОСТИ БОЛЬШОЙ ПЕСЧАНКИ (*Rhombomys opimus* Licht 1823) ИЗ СРЕДНЕАЗИАТСКОГО ПУСТЫННОГО ОЧАГА ЧУМЫ

Аннотация. (*Rhombomys opimus* Lichtenstein, 1823) – основной носитель чумного микроба (*Yersinia pestis*) в Среднеазиатском пустынном очаге чумы. Несмотря на большое количество исследований, посвященных различным аспектам биологии данного вида, его дифференциация на отдельные природные популяции, ввиду недостаточной изученности, остается не до конца ясной. В последние годы появились единичные работы по изучению генома различных внутривидовых группировок большой песчанки, однако, методы, основанные на сравнительном исследовании краниометрических показателей у представителей данного вида из различных изолированных популяций, остаются актуальными. Материалом для исследования послужила коллекция черепов большой песчанки Казахского научного центра карантинных и зоонозных

инфекций им. М. Айкимбаева. Всего было исследовано более шестисот черепов большой песчанки из различных регионов Среднеазиатского пустынного очага чумы. Целью исследования было выяснение различий в основных признаках строения головных костей большой песчанки из различных частей ее ареала. В статье дается информация об основных краниометрических показателях песчанок из различных частей ареала.

Ключевые слова: популяция, ареал, краниометрия, носитель.

Information about authors:

Yeszhanov A. B., PhD, Leading researcher of the Laboratory of Zoology and Parasitology with the Museum and Insectarium of M. Aykimbaev's KSCQZD, Almaty, Kazakhstan; aidyn.eszhanov@gmail.com; https://orcid.org/0000-0001-6572-5668

Sayakova Z. Z., PhD, Head of the Laboratory of Zoology and Parasitology with the Museum and Insectarium of M. Aykimbaev's KSCQZD, Almaty, Kazakhstan; zzsayakova@mail.ru; https://orcid.org/0000-0003-1107-6345

Sadovskaya V. P., Head of the GIS Laboratory of M. Aykimbaev's KSCQZD, Almaty, Kazakhstan; versad@mail.ru; https://orcid.org/0000-0001-8389-9362

Nurtazin S. T., DR, Professor of the Department of Bioresources and Biodiversity, Al-Farabi Kazakh National University, Almaty, Kazakhstan; nurtazin.sabir@gmail.com; https://orcid.org/0000-0002-4969-6323

Kabysheva N. P., PhD, Microbiologist, Laboratory of Molecular Diagnostics and Genetics of M. Aykimbaev's KSCQZD, Almaty, Kazakhstan; nailya.kabysheva@gmail.com; https://orcid.org/0000-0002-5507-4045

Zhunusova A. S., Microbiologist, Laboratory of Molecular Diagnostics and Genetics of M. Aykimbaev's KSCQZD, Almaty, Kazakhstan; aigul700@mail.ru; http://orcid.org/0000-0003-3569-0569

Abdirasilova A. A., PhD, Head of the Laboratory of Molecular Diagnostics and Genetics of M. Aykimbaev's KSCQZD, Almaty, Kazakhstan; aigul.abdirassilova@mail.ru; https://orcid.org/0000-0001-7308-2113

Rysbekova A. K., Microbiologist, Laboratory of Molecular Diagnostics and Genetics of M. Aykimbaev's KSCQZD, Almaty, Kazakhstan; rysbekova23@mail.ru; https://orcid.org/0000-0002-8684-3425

Atshabar B. B., Dr, Chief Researcher of M. Aykimbaev's KSCQZD, Almaty, Kazakhstan; batshabar@gmail.com; https://orcid.org/0000-0002-5533-8805

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