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Article

Beetles (Coleoptera) from the burrows of the red-tailed gerbil *Meriones libycus* Lichtenstein, 1823 (Mammalia: Muridae) in the south-western Turkmenistan

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Abstract. Specific microbiocenoses are formed in the burrows of gerbils (Mammalia: Muridae). In these biocenoses, invertebrates are associated with the gerbils and the burrow/nest through trophic, topical, phoretic and fensive relationships. The burrows of gerbils perform a stabilizing function (environmental conditioning, microclimatic conditions) in arid areas and provide a place for the development of many invertebrates, e.g. beetles, whose numerical proportion in gerbil burrows is 10–20% and up to 40% of species diversity. In the unique material from the Western Kopet Dag (collected in the burrows of *Meriones libycus* in the spring of 1982 using trapping cylinders), 36 species of Coleoptera from 9 families were identified (another 3 taxa were identified to genus level). *Zabrus morio klapperichi* (geochortobiont phytophage of the family Carabidae) dominated in the burrows of the red-tailed gerbil in the foothills of the Western Kopet Dag. This species probably uses the burrows as a daytime hiding place or when searching for seeds, which gerbils can store in burrows. Nidicolous beetles included *Coprofilus dimidiatipennis* (Staphylinidae), *Cholevinus pallidus* (Leiodidae), *Pholioxenus phoenix* (Histeridae), *Onthophagus psychopompus* (for the first time for Turkmenistan) and *O. vlasovi* (Scarabaeidae), *Attagenus duplex* (Dermestidae), *Cryptophagus* cf. *quadrimaculatus* (Cryptophagidae) and *Netuschilia hauseri* (Tenebrionidae). Photographs of *Netuschilia hauseri*, *Reitterohelops steinbergi* (Tenebrionidae) and *Aphthona mohri* (Chrysomelidae) are provided for the first time.

Keywords: nidicoles, Western Kopet Dag, beetles, mammals, rodents

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Научная статья

Жесткокрылые (Coleoptera) из нор краснохвостой песчанки *Meriones libycus* Lichtenstein, 1823 на юго-западе Туркмении

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Аннотация. В норах песчанок формируются специфические микробиоценозы, беспозвоночные которых связаны с организатором консорции и норой/гнездом трофическими, топическими, фототическими и фензивными отношениями. Норы грызунов, выполняя стабилизирующие функции (кондиционирование среды, микроклиматические условия) в аридных областях, предоставляют место для развития многим беспозвоночным, в частности, жесткокрылым, доля которых в гнездах песчанок составляет от 10–20% до 40% видового разнообразия. Уникальные сборы при помощи ловчих цилиндров весной 1982 г. в условиях Западного Копетдага из гнезд краснохвостой песчанки позволили выявить 36 видов жесткокрылых из 9 семейств (еще 3 таксона определены только до рода). По численности в норах краснохвостой песчанки предгорий Западного Копетдага преобладал геохортобионтный фитофаг *Zabrus morio klapperichi* (Carabidae), который, вероятно, использует норы для дневного укрытия или поиска семян, которые песчанки могут запастись в норах. Среди нидиколов отмечены *Coprophilus dimidiatipennis* (Staphylinidae), *Cholevinus pallidus*

(Leiodidae), *Pholioxenus phoenix* (Histeridae), *Onthophagus psychopompus* (впервые для Туркмении) и *O. vlasovi* (Scarabaeidae), *Attagenus duplex* (Dermestidae), *Cryptophagus* cf. *quadrimaculatus* (Cryptophagidae) и *Netuschilia hauseri* (Tenebrionidae). В статье впервые приводятся фотографии *Netuschilia hauseri*, *Reitterohelops steinbergi* (Tenebrionidae) и *Aphthona mohri* (Chrysomelidae).

Ключевые слова: нидиколы, Западный Копетдаг, жуки, млекопитающие, грызуны

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Introduction

In the burrows of gerbils or jirds (Mammalia: Muridae), peculiar microbiocenoses are formed, whose invertebrates are directly (trophically) and indirectly – through the burrow as a biotope (by topical and fensive connections) – related to the consortium organizer. Rodents (especially gerbils) play an important role in the formation of natural foci of zoonotic infections. However, relationships within burrow consortia are not limited to species interactions at the predator–prey and/or host–parasite level (Yablokov-Khnzorian, 1964). Some invertebrate species, considered indifferent to others, may be vectors of epizootics or intermediate hosts of parasites. In addition, these species can play a sanitary role in the consortium, both with regard to the parasitic species complex (as predators) and the products of the niche organizer (saprophagous, necrophagous), removing waste and carrion that may contain pathogens. Thus, mammal burrows and nests are also of interest as sites of possible contact between different life forms (Udovikov et al., 2009). Unfortunately, not only the role of nidicolous (nest-dwelling) invertebrates, but also their species composition has not been fully studied, especially in the hard-to-reach arid habitats of Central Asia (including Turkmenistan) – one of the most important regions for the study of epizootic foci of infections.

The study of the inhabitants of mammal burrows and nests has been carried out since the beginning of the 20th century by the staff of pest control stations and parasitologists in various regions of the post-Soviet space, but most of the studies concerned only the parasitic fauna of burrow biocenoses. With the development of biocenology and the increasing interest in the fundamental questions of nidicolity, the number of works related to the study of the general structure of burrowing biocenoses has increased. Their review for Turkmenistan and neighbouring areas of Central Asia has already been given in the article on beetle burrows of the great gerbil (*Rhombomys opimus* (Lichtenstein,

1823)) in southern Turkmenistan (Sazhnev et al., 2023). One of the last generalising works on the arthropods (Arthropoda) of the burrow fauna of Turkmenistan is devoted to the arthropods of rodent burrows of four species (*Rhombomys opimus*, *Spermophilopsis leptodactylus* (Lichtenstein, 1823), *Meriones meridianus* Pallas, 1771 and *M. libycus* Lichtenstein, 1823) of the Karakum Desert (Krivokhatsky, 1994).

Turkmenistan is located within the borders of a persistently active natural plague center; the Kopet Dag territory is characterized as a gerbil-desert type of epizootics (Karimova, 2002).

The aim of this work is to study the species composition of beetles (Insecta: Coleoptera) in burrow microbiocenoses of the red-tailed gerbil (*Meriones libycus*), one of the most widespread inhabitants of the foothills of the Western Kopet Dag (Turkmenistan) in the area of persistent plague epizootics.

Material and methods

The material for this paper was collected by the second author of this paper during the periods 25.04–10.05.1982 and 19–31.05.1982 in the natural plague focus in the foothills of the Western Kopet Dag Mountains (Turkmenistan, Balkan Province, Makhtumkuli etrap, near Makhtumkuli (before 2005 – Kara-Kala)) in colonies of red-tailed gerbil or Libyan jird (*Meriones libycus*).

In the process of collecting the material, the method of catching cylinders was used, similar to the studies of the great gerbil burrows (Sazhnev et al., 2023). The collection of insects from the burrows of the red-tailed gerbil in the Western Kopet Dag using this method was the first of its kind; such surveys have not been repeated by any other researcher, which makes the data obtained unique. The raids were carried out in both residential and non-residential colonies. After removal of the cylinders, invertebrates were picked by hand or sieved through a fine soil sieve and fixed in 70% ethyl alcohol solution. During the fieldwork period, 20 samples (depending on the number of burrows examined) and over 260 specimens of beetle imago were collected. Among the arthropods (other than beetles), other insects, arachnids (spiders, mites), crustaceans (woodlice) and centipedes were recorded in burrows.

The material is stored in alcoholic and mounted form (dry) in the invertebrate collection of the Papanin Institute for Biology of Inland Waters Russian Academy of Sciences (Borok, Russia), and some specimens of Histeridae in the private collection of V.O. Kozminykh (Perm). Nomenclature of species and general distribution data are adopted mainly according to the latest editions of the Catalogue of Palaearctic beetles (Alonso-Zarazaga et al., 2022; Catalogue..., 2007, 2010, 2015, 2016, 2017, 2020).

Illustrations were made by the first author using a Leica M165C stereomicroscope on a Leica MC170 HD digital camera (12 MP). The photos were processed and stacked in Sketchbook and Helicon Focus 7.7.4.

The identification of beetles was carried out by the first author with the help of specialists in different taxonomic groups. K.V. Makarov – some Carabidae, V.O. Kozminykh – Histeridae, A.A. Gusakov and I.V. Shokhin – some Scarabaeidae, J. Háva – Dermestidae, M.V. Nabozhenko and A.V. Kovalev – some Tenebrionidae, A.O. Bienkowski and S.V. Dedyukhin – Chrysomelidae, I.A. Zabaluev – Curculionidae.

Results and discussion

In Western Kopet Dag, the red-tailed gerbil is a common species, almost ubiquitous in the semi-desert zone (even more so than the great gerbil in Kopet Dag conditions) and ascending to the cereal steppe zone at 1100–1200 m altitude. The red-tailed gerbil avoids stony slopes, tree and shrub thickets, solonchaks and areas of continuous unfastened sands, preferring to establish colonies (towns) on hills and in interhilly depressions on loose proluvial soils with xerophytic vegetation of wormwood-ephemeroid formations (Kamnev et al., 1968). This polyestrous species is active practically all year round (activity decreases in December–January) and leads a crepuscular lifestyle. Gerbil burrows are temporary and permanent, simple and complex (but simpler than those of the great gerbil) with a depth of more than 2 meters.

Some beetle species of the families Carabidae and Tenebrionidae could not be identified to species due to poor preservation and/or lack of serial and comparative material: these are representatives of the genera *Microlestes* sp., *Cymindis* (s. str.) sp. and *Blaps* sp. The remaining species are included in the annotated list below.

Annotated list of Coleoptera species from red-tailed gerbil burrows in south-western Turkmenistan

Carabidae

Cicindela (Cicindela) clypeata octussis C.A. Dohrn, 1885

This Turanian subspecies of the Central Asian species, known mainly from Turkmenistan and entering in Tajikistan, is sporadically represented in collections (2 specimens in two samples). Not associated with mammal burrows. The beetles are active flying zoophagous beetles, occasionally found in burrows.

Acinopus (Acinopus) laevigatus Ménétriés, 1832

The species is distributed in the Western Palearctic from southern Europe and the Caucasus to the Near East, Middle and Central Asia (as far as China and Pakistan), and is associated with dry steppes and semi-deserts. Geochortobiont, phytophagous, the finding of which (1 specimen) in burrows of gerbil is accidental.

Calathus (Neocalathus) ambiguus ambiguus Paykull, 1790

The species is widely distributed in the Western Palearctic (from Europe to Siberia and Central Asia), one of the most common eurytopic species of steppe and semi-desert zones. It is not associated with burrowing biocenoses, and the finding of this litter zoophagous beetle is accidental and isolated (1 specimen).

Taphoxenus (Taphoxenus) goliath (Faldermann, 1836)

The species is widespread in semi-deserts and deserts of Afghanistan, Iran and Central Asia (Kazakhstan, Tajikistan, Turkmenistan, Uzbekistan). Although the species, like many members of the tribe Sphodrini (stratobionts-botrobionts), is a facultative nidicolous, it is rarely found in samples (1 specimen). Zoophagous.

Zabrus (Zabrus) morio klapperichi Jedlička, 1956

The species is widespread in the Near East, Afghanistan, Central Asia, and enters in Transcaucasia. In samples it is represented by subspecies known from Turkmenistan, Afghanistan and Southern Kazakhstan. Geochortobiont, phytophagous, very common in samples from red-tailed gerbil burrows (72 specimens in 10 samples); probably uses burrows as a daytime shelter or enters them while searching for seeds, which gerbil may store in burrows.

Staphylinidae

Aleochara (Xenochara) jacobsoni Kirshenblat, 1935

In the material from the burrows of the red-tailed gerbil it is represented sporadically (2 specimens in two samples). The species is recorded for Kazakhstan and Turkmenistan. Obligate nidicolous, zoophagous. Common (sometimes mass) in nests of the great gerbil (Krivokhatsky and Kashcheev, 1986; Sazhnev et al., 2023), recorded in burrows of the little ground squirrel (*Spermophilus pygmaeus* (Pallas, 1778)) and long-clawed ground squirrel (*Spermophilopsis leptodactylus* (Lichtenstein, 1823) (Kirshenblat, 1935, 1937). If numbers are high, it can reduce rodent flea populations by feeding on their larvae in the nest litter.

Coprophilus (Zonyptilus) dimidiatipennis Fauvel, 1900

Common in material (47 specimens in 9 samples). Nidicolous species (recorded in burrows and nests of little ground squirrel and gerbils), associated with decomposing plant remains in nests. Described from Ashgabat (Fauvel, 1900), distributed rather widely: Kazakhstan (European and Asian parts), Russia (Astrakhan Oblast and Kalmykia), Turkmenistan and Uzbekistan (Gildenkov, 2020).

Leiodidae

Cholevinus pallidus pallidus (Ménétriés, 1832)

It occurs relatively frequently in the material (8 specimens in 6 samples). A widespread species, the nominate subspecies of which is known from Afghanistan, Georgia, Iran, Iraq, southern Russia (Dagestan), Turkmenistan and Uzbekistan, where it inhabits mainly desert areas. Sapronecrophagous, nidicolous and troglobiontic species (Jeannel, 1936).

Histeridae

Pholioxenus phoenix (Reichardt, 1929)

It is common in our collections of red-tailed gerbil nests (17 specimens in 9 samples), not uncommon in the burrows of the great gerbil (Krivokhatsky and Kashcheev, 1986), where we also recorded it (Sazhnev et al., 2023). Turanian species, known for Central Asia: Kazakhstan, Turkmenistan and

Uzbekistan. Nidicolous species, associated with gerbil burrows on loess and clay soils, less commonly on consolidated sands (Kryzhanovsky and Reichardt, 1976).

Saprinus (Saprinus) aeratus Erichson, 1834

One specimen has been recorded from the nests of red-tailed gerbils. The species is distributed in southern European Russia, Iran, Kazakhstan, Tajikistan, Turkmenistan and Uzbekistan. The species is endemic to deserts, mainly sandy, and feeds on carrion (Kryzhanovsky and Reichardt, 1976). It may be a facultative nidicolous species.

Scarabaeidae

Scarabaeus pius (Illiger, 1803)

A single specimen was recorded in the samples. The species is widespread in southern Europe, the plains of the Caucasus, the Near East and Central Asia, including Turkmenistan. Coprophagous, mainly associated with the faeces of large mammals (camel, etc.); probably occasionally in burrows.

Onthophagus (Palaeonthophagus) psychopompus Ziani et Gharakhloo, 2010

Obligate nidicolous species, but in our material, it is represented by two individuals from one sample. The species has been described from Iran, where it is quite widespread (Ziani and Moradi Gharakhloo, 2010) and is associated with burrows of rodents of at least three genera: *Meriones* Illiger, 1811, *Microtus* Schrank, 1798 and *Allactaga* Cuvier, 1837 (Ziani and Moradi Gharakhloo, 2010). First recorded for Turkmenistan.

Onthophagus (Palaeonthophagus) vlasovi S.I. Medvedev, 1962

Species is not frequent in our material, but rather constant (8 specimens in 4 samples). The species was described from Ashgabat and is distributed in Afghanistan, Iran, Kazakhstan, Tajikistan, Turkmenistan and Uzbekistan, where it is more common in sandy deserts, although it also occurs on clay substrates (Kabakov, 2006); in development it is associated with burrows of rodents (sandflies, gophers, porcupines, etc.).

Hemictenius (Asiactenius) tokgajevi (S.I. Medvedev, 1962)

Very constant in material, but sporadically represented (mainly females, 6 specimens in 5 samples). Known from Iran and Turkmenistan. At the subgenus level, the group of similar species is characteristic for ephemeral foothill and low mountain areas of the Kopet Dag (Nikolaev, 2000), females are wingless, therefore, the ranges can be very localised: *Hemictenius tokgajevi* is most common for the Western Kopet Dag, especially for the “Kara-Kala” area (Nikolaev, 2000). Probably a facultative nidicolous species.

Micropertha variabilis (Ballion, 1871)

Presented by a single specimen in samples. Central Asian species of monotypic genus, known from Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. Habitat in burrows, beetles associated with open steppe and semi-desert landscapes, phytophagous on herbaceous plants, larvae in soil (Medvedev, 1949).

Aethiessa szekessyi Brasavola de Massa, 1939

In our materials, the species is represented by a single specimen. Turanian xerophilous species known from Kazakhstan, Turkmenistan and Uzbekistan. The beetles are found on the ground, sand and loess soils in ephemeral foothills (Medvedev, 1964); probably associated with rhubarb, not restricted to burrows, the finding is accidental, i.e. the species is an “accidental nidicolous”.

Oxythyrea cinctella (Schaum, 1841)

Beetles were sporadic in the samples (3 specimens in 2 samples). The species is widespread in southern Europe, the Caucasus, the Near East and Central Asia, where it is a eurytopic xerophilous species. It is not associated with rodent burrows; beetles are found on flowers of herbaceous, shrubby and woody plants; larvae develop in the soil (Medvedev, 1964).

Dermestidae

Attagenus (Attagenus) duplex (Reitter, 1890)

Three specimens of this species were collected from two burrows of red-tailed gerbils (recorded in two samples). Known from Iraq, Tajikistan, Turkmenistan, Uzbekistan and Mongolia. Adults are anthophiles, occurring in foothills on flowering vegetation, larval development is associated with gerbil burrows (Zhantiev, 1976).

Cryptophagidae

Cryptophagus cf. *quadrimaculatus* Reitter, 1877

A single specimen is represented in the samples. Holarctic species, widespread in the Palaearctic, including all of Central Asia. A mycetophagous, nidicolous species, found both in burrows of rodents (pikas, voles, ground squirrels, gerbils) and in bird nests (Lyubarsky, 2002). In our materials, in addition to red-tailed gerbil burrows, species was also found in the burrows of great gerbils (Sazhnev et al., 2023).

Tenebrionidae

Omophlus (*Euomophlus*) *pilicollis pilicollis* (Faldermann, 1832)

Polymorphic species distributed in southern Europe, the Near East and Central Asia (as far as China), with a nominative subspecies reported from Turkmenistan. In the Caspian lowlands it is restricted to semi-deserts and deserts. Phytophagous, adults feed on flowering vegetation, larvae are soil dwellers (Ogloblin and Znoiko, 1950). Found in burrows (1 specimen) by chance.

Cheirodes (*Cheirodes*) *dentipes* (Ballion, 1878)

There is a single specimen in our material from the burrows of the red-tailed gerbil. Widespread species, recorded in Southern Europe, North Africa and Afrotropical region, the Middle East and Central Asia (up to China), in Turkmenistan it is known in its southern part (Medvedev and Nepesova, 1985). Habitat in clay and sandy semi-deserts and deserts, probably a stratobiont.

Zophosis (*Oculosis*) *punctata punctata* Brullé, 1832

Two specimens from one sample were collected in burrows. Nominative subspecies is widely distributed in the Western Palearctic from southern Europe and North Africa to Central Asia and Western China. Like most free-living tenebrionids, it feeds primarily on plant material, not excluding saprophagy, and may use burrows for daytime shelter and also for feeding (with gerbil reserves or nesting material). From here on we consider the species in the family Tenebrionidae list as facultatively nidicolous.

Blaps (*Blaps*) *titanus* Ménétriés, 1849

Rare in materials (4 specimens in 4 samples). The species is recorded from Azerbaijan, Iran and Turkmenistan, mainly restricted to sands (Medvedev and Nepesova, 1985).

Cyphogenia (*Cyphogenia*) *gibba gibba* (Fischer von Waldheim, 1820)

In the burrows of the red-tailed gerbil, it is rather constant (11 specimens in 8 samples). Widespread from Afghanistan and Iran to Pakistan (Medvedev and Nepesova, 1985). Probably a facultative nidicolous species.

Netuschilia *hauseri* (Reitter, 1897) (Fig. 1)

In the material 5 specimens were found in 4 samples. The species is widespread in semi-deserts and deserts from southern European Russia and Transcaucasia to China. It is nidicolous and troglophilic species – it has been recorded in burrows and in the Bakharden Cave (Turbanov et al., 2016).

Ocnera *pilicollis* (Faldermann, 1836)

14 specimens were recorded in five samples. The species is widely distributed in Syria, Afghanistan and Central Asia (including Turkmenistan).

Pimelia (*Chaetotoma*) *abnormis* Reitter, 1915

Five specimens were collected in burrows in 3 samples. Local species recorded from Afghanistan and Turkmenistan.

Pimelia (*Chaetotoma*) *cephalotes cephalotes* (Pallas, 1781)

In our material there are 3 specimens from 2 samples. The nominative subspecies is recorded from southern European Russia, Iran, Kazakhstan, Tajikistan and Turkmenistan.

Pseudopachyscelis *galinae* (G.S. Medvedev, 1964)

Rare in material (3 specimens in 2 samples). The species is distributed in Afghanistan and Turkmenistan.

Stalagmoptera *ruginota* Reitter, 1896

One specimen was collected from burrows. The species is known from Afghanistan and Turkmenistan (Kopet Dag).

Dissonomus (*Dissonomus*) *tibialis* (Reitter, 1904)

Occurs sporadically in our materials (1 specimen). Known from Kazakhstan and Turkmenistan.

Reitterohelops *steinbergi* (G.S. Medvedev, 1964) (Fig. 2)

Two specimens were collected in the burrows of the red-tailed gerbil. The species is locally distributed in Turkmenistan (described and known from Kopet Dag).

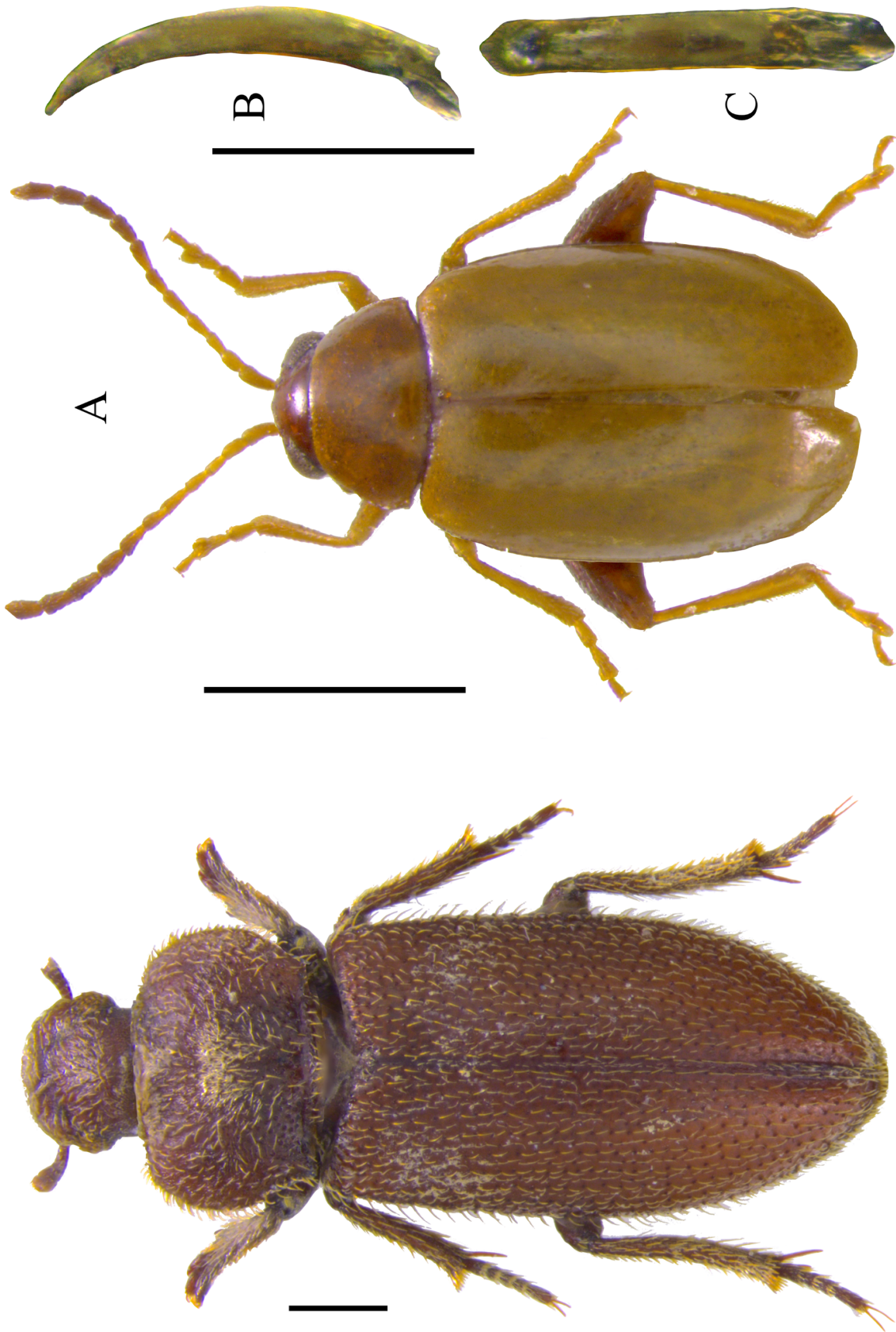


Fig. 1. *Netuschilia hauseri* (Reitter, 1897); scale bar – 1 mm.

Fig. 3. *Aphthona mohri* Warchalowski, 1973. A – habitus, scale bar – 1 mm; B – aedeagus, lateral view; C – aedeagus, dorsal view, scale bar – 0.5 mm.

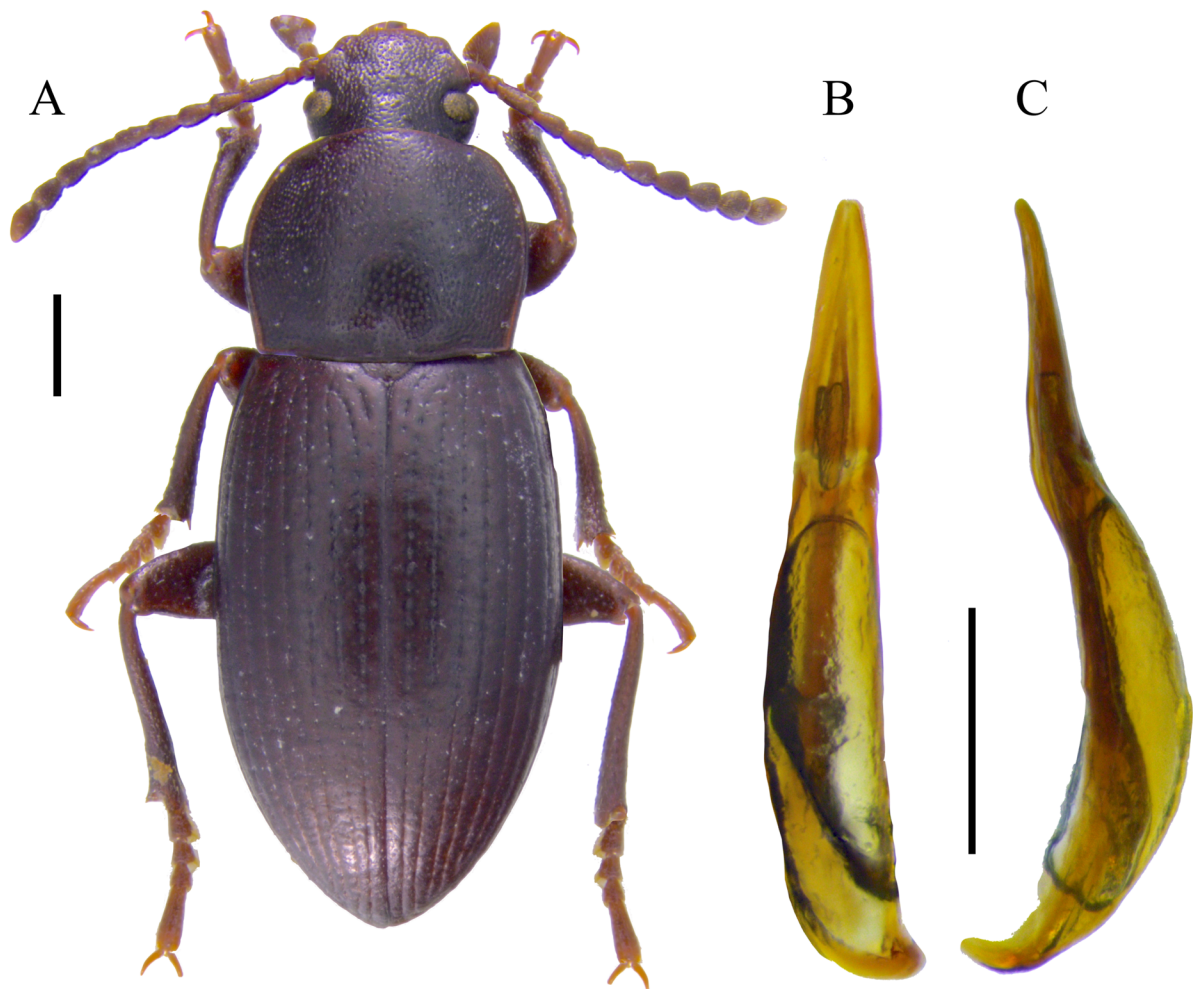


Fig. 3. *Reitterohelops steinbergi* (G.S. Medvedev, 1964). **A** – habitus, scale bar – 1 mm; **B** – aedeagus, dorsal view; **C** – aedeagus, lateral view, scale bar – 1 mm.

Chrysomelidae

Aphthona mohri Warchałowski, 1973 (Fig. 3)

We found 4 specimens from 3 samples. The species is known from Turkmenistan and Northern Iran, probably develops on the spurge *Euphorbia* (Lopatin, 2010) and is not associated with burrows.

Chaetocnema (Tlanoma) tibialis (Illiger, 1807)

In our material from gerbil burrows, 7 specimens were recorded in 3 samples, which is probably related to the mass development of the species. The species is distributed in the Western Palaearctic (Southern Europe, Mediterranean, Kazakhstan, except south; Turkmenistan, south of Uzbekistan, Tajikistan, Kyrgyzstan). The beetles develop on plants of the family Amaranthaceae (Lopatin, 2010). Not associated with burrows.

Galeruca interrupta armeniaca Weise, 1886

One specimen was collected from the gerbil burrows. Distributed in the Palaearctic, in Turkmenistan it is represented by a subspecies from the semi-deserts and deserts of southern Europe, Transcaucasia, the Near East and the western part of Central Asia (Lopatin, 2010). The beetles develop on *Artemisia* (Lopatin, 2010) and are not associated with burrows.

Curculionidae

Aulacobaris caerulescens (Scopoli, 1763)

Two specimens collected from gerbil burrows. The species is distributed in the Western Palaearctic (almost all of Europe, Central and South European Russia (up to the Urals), the Caucasus, Central Asia, Iran, North Africa). It develops on various cruciferous plants, not associated with burrows.

Sitona callosus Gyllenhal, 1834

Represented by a single specimen in our material. Distribution: Eastern and south-eastern Europe, central and southern Europe, Russia, the Caucasus, southern Siberia, Central Asia, Mongolia, North Africa. It develops on the sainfoins and other Fabaceae (Smreczyński, 1966), not associated with burrows.

Conclusion

As an example of the phenomenon of natural environment conditioning by cenotic groups of organisms, rodent burrows provide conditions for the development of life in extra-arid and arid regions (Udovikov et al., 2009). Characteristic features of the microclimate (no direct influence of sunlight, moderate thermal regime, high relative humidity) make gerbil burrows attractive not only for the host (consortium organizer), but also for many invertebrates and microorganisms (consorts), including beetles, which can account for up to 40% of the invertebrate species composition in gerbil burrows with an abundance share of about 20% (data for the great gerbil) (Sazhnev et al., 2023). According to other generalized information from burrows of various rodent species in the Repetek area, beetles represent less than 10% of all invertebrates in terms of abundance, but make a significant contribution to the nidicolous arthropod fauna (Krivokhatsky, 1994). For example, more than 300 species of beetles are known from the Karakum Desert in southern Turkmenistan, of which 70 are botrobionts (obligate nidicoles) and botrophiles (facultative nidicoles) (Krivokhatsky, 1994). In our studies of great and red-tailed gerbils, the proportion of ecological groups is also shifted towards facultative and occasional species (26%, 32 obligate nidicolous species out of 121), many of which use burrows for temporary shelter and are not among consorts.

The family Staphylinidae is the most abundant of the true nidicolous species in gerbil burrows: *Atheta flagellicornis* G. Benick, 1967, *Sepedophilus rufulus* (Hochhuth, 1849) and *Aleochara jacobsoni* in gerbil burrows in the Central Karakum (Sazhnev et al., 2023) and *Coprophilus dimidiatipennis* in

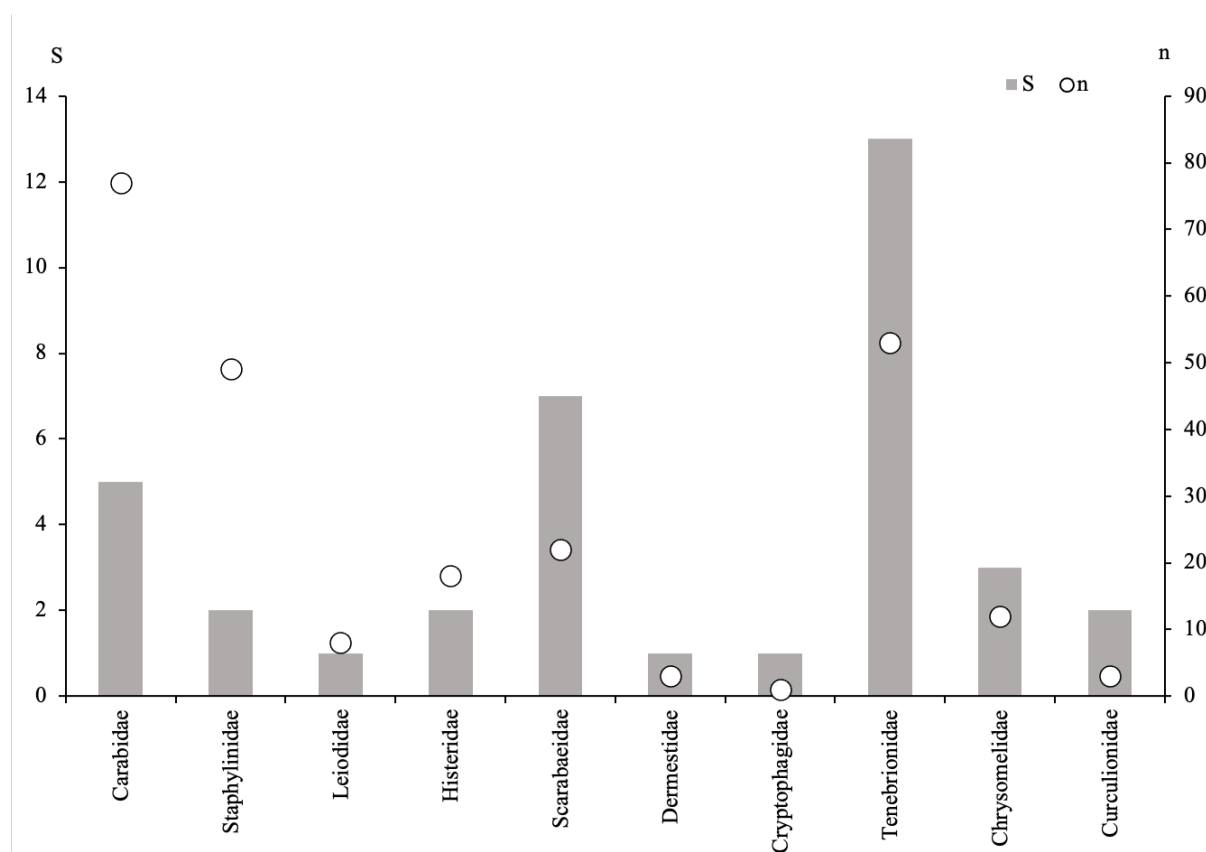


Fig. 4. Representation of the main families of beetles by number of species (S) and number of individuals (n) in the burrows of the red-tailed gerbil.

gerbil burrows in the foothills of the Western Kopet Dag Mountains. Among the botrobionts, *Cholevinus pallidus*, *Pholioxenus phoenix*, *Onthophagus psychopompus* (for the first time in Turkmenistan), *O. vlasovi*, *Attagenus duplex*, *Cryptophagus* cf. *quadrimaculatus* and *Netuschilia hauseri* were also recorded in the burrows of *Meriones libycus*, but their numbers were insignificant. Carabidae dominate in abundance (Fig. 4) in red-tailed gerbil burrows at the expense of the geochortobiont phytophage *Zabrus morio klapperichi*, which probably uses burrows for daytime shelter or foraging (e.g. seeds from rodent stocks) and whose abundance reflects a seasonal peak. In terms of species number, the Tenebrionidae (13 species) predominate, active herpetobionts characteristic of the open spaces of semi-deserts and deserts, which may also use burrows to protect themselves from daytime temperatures or appear as facultative nidicoles at different stages of development. A total of 37 beetle species (identified to species) from 9 families were recorded in the burrows of the red-tailed gerbil.

Undoubtedly, burrow ecotopes are a time-varying system. Invertebrate species composition also changes seasonally, depending on both the time of year and the individual and social development of the consortium organiser. Unfortunately, our studies allow us to reflect only part of this cycle, but even such a modest contribution to the study of the nidicolous fauna of the beetles of Turkmenistan adds to our knowledge of these amazing communities.

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