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ECOLOGY OF THE SCORPIONS (ARACHNIDA, SCORPIONES) OF THE SOUTHEASTERN KARA-KUM

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The scorpions are a small group of arthropods, comprising no more than 14 species in the USSR. Although scorpions have been quite well investigated as regards their systematics, information on their ecology is fairly fragmentary.

We examined material collected by staff members of the Institute of Physiology, Siberian Department, USSR Academy of Sciences and of the Repetek Sandy Desert Station in the Repetek Reservation (southeastern Kara-Kum, Turkmenia) in 1967 and 1972-1974. The material consisted of 998 scorpions belonging to 6 species of the family Buthidae. We also processed 1967 data on 636 specimens not taken in the collections. The present article contains data on 5 species; the 6th is probably new to science.

Conclusions on the distribution of scorpions by habitat, and on their seasonal and diurnal activity may be drawn from the material examined.

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THE OPERATIONAL AREA

The terrain of the Repetek Reservation consists of large sand ridges with areas of sand dunes and valley-like depressions occupied by saksaul thickets (Haloxylon ammodendron and H. persicum) (Gunin et al., 1972). The tops of the ridges, in the vegetation of which Calligonum arborescens and Aristida karelini predominate, consist of dune and semi-consolidated sands. A large part of the area of the depressions is occupied by a Haloxylon persicum — Carex physodes association. Haloxylon ammodendron — Carex physodes associations flourish beneath the steep slope of the ridges.

The observations were carried out in areas where the main habitat (H. persicum and H. ammodendron thickets, semi-consolidated and dune sands) were clearly delineated.

PROCEDURE

Scorpions were caught by means of a guide fence, along which cylindrical traps (40 in number) were sunk into the ground at intervals of 10 m. The guide fence crossed the whole locality in an unbroken line; in addition, a part of the guide fence (5 cylinders) simultaneously functioned in an area of dune sands. Additional catches were also made using trapping ditches (4 cylinders in a ditch 50 m long). The fence was used in the spring (March 28 - May 31) and in the summer (July 24 - Aug. 4) 1967 and from April 25 to Sept. 19, 1972; ditches were used from March 28 to May 16, 1967.

THE SCORPION SPECIES OF REPETEK RESERVATION

Five scorpion species are known for Repetek Reservation (Birulya, 1904, 1911; Morits, 1922; Sabirova, 1977; Shestoperov, 1934): Mesobuthus eupeus (C. Koch, 1813); M. caucasicus (Nordmann, 1840); Liobuthus kessleri Birula, 1898; Anomalobuthus rickmersi Kraepelin, 1900; Orthochirus scrobiculosus (Grube, 1873).

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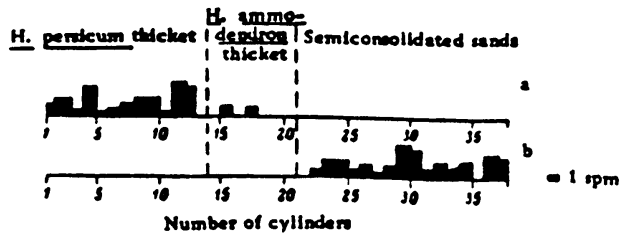

Fig. 1. Landscape profile distribution of stenobiontic scorpion species.

a) Orthochirus scrobiculosus (Gr.); b) Anomalobuthus rickmersi Kraep.

Habitat distribution and frequency of scorpions

Species	Habitats							
	H. persicum thicket		H. ammodendron thicket		semi-consolidated sands		dune sands	
	I	II	I	II	I	II	I	II
M. eupeus	17	0.1	6	0.1	4	0.03		—
M. caucasicus	68	0.6	17	0.3	48	0.3		—
L. kessleri	241	2	21	0.3	150	1	1	0.1
A. rickmersi	4	0.04	1	0.01	83	0.6	10	1
O. scrobiculosus	38	0.3	6	0.1	—	—		—

Note. I - total number, II - trapping frequency (specimens per day per 10 cylinders).

All these species, which were present in the collections examined by us, are common in Turkmenia, but there is little information on their ecology.

Mesobuthus eupeus (C. Koch, 1813).

The species, widely distributed in the southern USSR, in the Levant and Central Asia, has 15 subspecies (Vachon, 1958a, 1966). Repetek is inhabited by the subspecies M. eupeus thersites (C. Koch, 1839), which is common in Soviet Central Asia and Kazakhstan. There were 47 specimens of this species in the collection. It is found mainly in consolidated sands.

Mesobuthus caucasicus (Nordmann, 1840).

This species, also widely distributed in southern regions of the USSR (Odessa Province, Caucasus, Soviet Central Asia), in the Levant, Mongolia, and China, has 7 subspecies (Vachon, 1958a, 1966), 2 of which have been recorded for Repetek (Birulya, 1911): M. caucasicus intermedius (Bir., 1897) and M. caucasicus parthorum (Pocock, 1900). It is represented in our material by 210 specimens evidently belonging to subspecies M. caucasicus parthorum. Birulya, (1911) notes that "ecologically" this subspecies "is mainly connected with sandy deserts", and has psammophilous features. M. caucasicus occurs in all habitats at Repetek, but is noticeably associated with semiconsolidated sands, and with Haloxylon persicum thickets. In contrast to the spring period (1967), data obtained in the summer (1972) show a greater association with semiconsolidated sands than with H. persicum thickets.

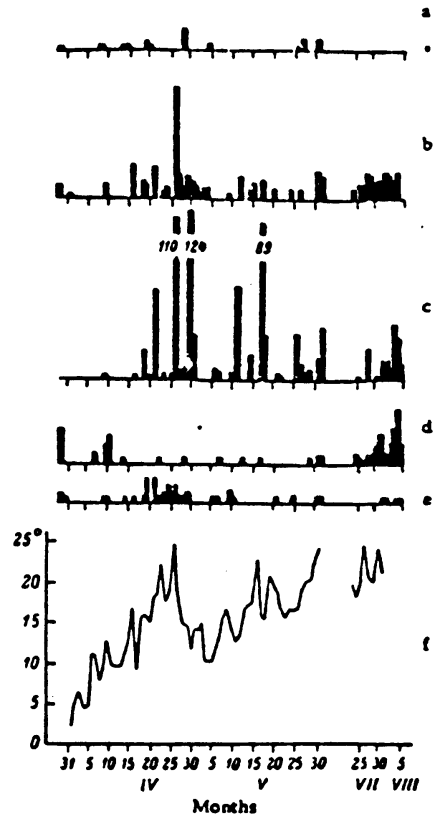

Fig. 2. Dependence of seasonal activity of scorpions on temperature.

a-e) Cylinder trapping frequency for 5 scorpion species:
a) Mesobuthus eupeus (C. Koch.); b) M. caucasicus (Nordm.);
c) Liobuthus kessleri Bir.; d) Anomalobuthus rickmersi Kraep;
e) Orthochirus scrobiculosus (Gr.); f) curve of mean nocturnal temperature at soil surface.

Liobuthus kessleri Birula, 1898.

An endemic species of Soviet Central Asia (Birulya, 1911; Vachon, 1958b). L. kessleri, a most numerous scorpion species, was represented in the collections by 560 specimens. It is a clearly expressed psammophilous species having a number of morphological adaptations to life in loose sand. The habitat pattern of L. kessleri is partly similar to the distribution of M. caucasicus, but preference for consolidated sands in H. persicum thickets is discernible in L. kessleri.

Anomalobuthus rickmersi Kraepelin, 1900.

An endemic of the sandy deserts of Soviet Central Asia (Birulya, 1911). The collections contained 119 specimens. Like the previous species, A. rickmersi is a psammophile, but in contrast to L. kessleri it is almost exclusively confined to semiconsolidated and dune sands. The frequency of the species is markedly reduced in consolidated sands.

The monotypic genera Anomalobuthus and Liobuthus are endemic psammophilous elements in the Soviet Central Asian scorpion fauna. Such forms are typical of the scorpion

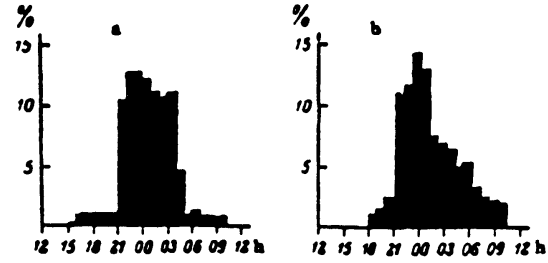

Fig. 3. Diurnal activity:

a) Anomalobuthus rickmersi Kraep.; b) composite diagram for Mesobuthus eupeus (C. Koch); M. caucasicus (Nordm.), and Liobuthus kessleri Bir.

fauna of many sandy deserts in the Old World: these include Psammobuthus zarudnyi Bir. (Fergana Valley sands), Blesiobuthus paradoxus Poc (Baluchistan), and Buthiscus bicalcaratus Bir. (Tunis) (Birulya, 1917). Also under this heading is the new species found in the Repetek dune sands.

Orthochirus scrobiculosus (Grube, 1873).

This species, found in Soviet Central Asia, the Levant, and northwestern China, was represented in the collection by only 38 specimens, although it is fairly common and not a rarity. O. scrobiculosus is exclusively confined to consolidated sands, mainly in H. persicum thickets. The infrequency with which it was taken in the cylinders was probably due to the relative immobility of the species, which leads a cryptozoic mode of life (Vlasov, 1937).

HABITAT DISTRIBUTION AND TRAPPING FREQUENCY

Information on the frequency with which scorpions were taken in the cylindrical traps (1967 data) is set out in the Table. The frequency reflects the degree of mobility of the species, and their abundance in the given habitat. A higher trapping frequency was noted for Liobuthus kessleri, Mesobuthus caucasicus, and Anomalobuthus rickmersi, a lower frequency for M. eupeus and Orthochirus scrobiculosus.

All the scorpion species are represented in consolidated sands, but mainly psammophilous species in semi-consolidated and dune sands. All 5 species were found in the H. persicum thicket, with Liobuthus kessleri and Mesobuthus caucasicus predominating. The frequency of all species was far lower in the H. ammodendron thicket than in the H. persicum thicket. Liobuthus kessleri and Anomalobuthus rickmersi predominated in the semi-consolidated sands, whereas Orthochirus scrobiculosus was absent. Finally, in practice, only A. rickmersi (and the new species of the Buthidae) was found in the dune sands.

The additional 1972 data confirm the general scorpion distribution pattern.

Figure 1 shows the distribution over the profile of the stenobiontic species O. scrobiculosus and A. rickmersi (1967 data, material respectively 50 and 114 spec; the other 3 species were not differentiated in the records). Clear spatial isolation is to be noted for these 2 species. Spatial demarcation within a small area is also known for other scorpion species. For example, Williams (1970) has observed a similar pattern for 3 Vejovidae species in Arizona. Such demarcation is regarded as one mechanism conducive to the coexistence of ecologically similar species.

SEASONAL ACTIVITY AND ITS CONNECTION WITH TEMPERATURE

The number of scorpions taken in the cylindrical traps was recorded daily (1967) or weekly (1972). This enabled us to examine seasonal variations in the activity of all 5 species. There is evidently a correlation between locomotor activity and cylinder trapping frequency (at least for the mobile psammophilous species).

Diagrams of the trapping frequency of the 5 scorpion species in spring-summer 1967 are given in Fig. 2 (a-f) along with a curve of mean nocturnal temperature at the soil surface during the period. Mean temperature at 3 times (23.00, 02.00 and 05.00) was taken from the records of the Repetek weather station.

An undoubted correlation is to be noted between the activity of almost all species (apart from Anomalobuthus rickmersi) and periods of raised soil temperature, especially in the spring, between April 15 and May 5. A local increase in trapping frequency noted for A. rickmersi in early April may be connected with an increase in activity during the reproductive period. This psammophilous species was taken most frequently in the summer. The only appreciable increase in trapping frequency for O. scrobiculosus was noted during a period of increased temperature between April 15 and 30, and may also have been connected with the reproductive period, during which the locomotor activity of this generally somewhat immobile species is increased.

The seasonal distribution pattern is in general similar for Mesobuthus eupeus, M. caucasicus, and Liobuthus kessleri. Individual abrupt increases in abundance noted for L. kessleri (April 26, April 29, May 17), which cannot be ascribed to the influence of temperature, may possibly have been due to biological characteristics of this species (the specimens taken on these days were mainly sexually immature).

On the whole, the data obtained in summer 1972 confirm the seasonal distribution pattern of scorpions (mainly with reference to M. caucasicus).

Locomotor activity over the course of the season correlates with temperature variations over a fairly wide range: scorpions were taken in the cylinders at nighttime soil surface temperatures ranging from 1°C (April 1, 1967) to 27°C (July 30, 1967); scorpions may possibly be more mobile at higher temperatures.

DIURNAL ACTIVITY

We know that twilight and nocturnal activity is found in scorpions. A record was made in 1967 of the cylinder trapping frequency of scorpions; for some time (in the spring, and in the summer) the traps were not examined daily, as was normal, but at 3-hourly intervals. We recorded 7 O. scrobiculosus, 53 A. rickmersi and 166 specimens of the other 3 species. This information was used to construct a diagram of locomotor activity over 24 hours (Fig. 3a, b) separately for A. rickmersi, and as a composite diagram for M. eupeus, M. caucasicus, and L. kessleri. It is evident that the scorpions become active at twilight (19.00–20.00). This main activity peak is between 21.00 and 01.00 (lasting until 04.00 for A. rickmersi). Thereafter there is a gradual reduction in activity. The existence of a clearly restricted period of nocturnal activity in A. rickmersi, relative to the more protracted period in the other species, may be related to the feeding characteristics of this mobile psammophilous species.

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