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# Studies on burrowing spiders of the family Lycosidae (Araneae). I. Preliminary data on structural and functional features

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Burrowing spiders of the family Lycosidae (subfamily Lycosinae) have a number of features which allow them to be distinguished from non-burrowing species (at any rate, within the Palaearctics) with a high degree of accuracy. It is assumed that these features have at least generic rank. On the basis of data obtained, the new tribe Trochosini is established within the subfamily Lycosinae. The tribe Lycosini is restricted to burrowing forms only.

## 1. Introduction

The vast group of burrowing Lycosidae, which is included in the subfamily Lycosinae, has not been analysed from the taxonomic point of view until recently. Meanwhile, the need for such an analysis is dictated by the quest for a natural classification for the family Lycosidae to replace the useless, artificial classification of Roewer (1959-1960) and his successor Guy (1966).

While carrying out our study of burrowing lycosids, we could find no specific structures in them adapted to burrowing, like, e.g. rastellum in Mygalomorphae. Marikovskii (1956) declared the same for the species *Allohogna singoriensis* (Laxmann).

We are aware that our data are only preliminary in character because we have not yet studied American, African, Australian and many of the Asian burrowing genera of the subfamily Lycosinae.

## 2. Materials and methods

The present work is based on the results of an investigation of species belonging to 13 burrowing genera<sup>1</sup>, including *Lycosa* s.str., *Arctosa* s.str., *Leaena*, *Allohogna*, ? *Geolycosa*, and the species *Avicosa krynickii* (Thorell) and *Mimohogna vultuosa* (C.L. Koch), and 6 non-burrowing genera, *Alopecosa*, *Trochosa*, *Hogna*, *Pirata*, *Tricca*, and the species *Megarctosa leopardus* (Sundevall). The spiders were examined in 70% alcohol using the binocular microscopes MBS-1 and MBS-9. The behaviour of the burrowing species was observed in laboratory glasses filled with soil. All the burrowing lycosids examined were collected

<sup>1</sup>The greater part of these genera seems to be new. According to Roewer's scheme (1959), ignoring the relief of carapace and the structure of genitalia, these genera fall within *Lycosa* and *Alopecosa*.

within the USSR, with the exception of *Lycosa tarantula* (Linnaeus) from Yugoslavia, and *L. fasciiventris* Dufour from Spain.

### 3. Results and discussion

Our investigations revealed a number of stable structural and functional features of burrowing lycosids. These features are outlined in Table 1, and are considered in detail below.

*Descent of thoracic region from the cephalic region towards the abdomen in females.* This feature allows the spider to bend its abdomen at a greater angle in relation to the cephalothorax: firstly, this facilitates movement in the hole during its digging, and, secondly, it allows the cocoon the best possible exposure to the sun; the spider

itself incidentally places its head down. Besides, we consider the structure of such a carapace to be attended by the strengthening of the muscular apparatus of the cephalic part, especially the chelicerae by which spiders loosen the soil. Some modification of the typical descending cephalothorax is shown in the species of the genus *Lycosa* s.str.: as they have a relatively low carapace, the descent of the thoracic region is only slight, and posterior pitch of the carapace is sloping and has no sharp border with the thoracic region (Fig. 3). In the wandering males, the carapace is usually straight (horizontal). Among the burrowing lycosids studied, only in the females of *Leaena* sp., the carapace was not descending but convex. In the highly specialized hole-dwellers, building superstructures in the form of turrets or opercles, even males have a descent of the thoracic region of the carapace. Another indication of the high speciali-

Table 1. Comparison of burrowing and non-burrowing Lycosidae

	Burrowing males	females	Non-burrowing males	females
Carapace	Straight (horizontal)—see Fig. 2; almost straight, as in Fig. 3, shows clear gradual descent from the cephalic region towards abdomen (as in Fig. 1)	The thoracic region usually shows clear gradual descent from the cephalic region towards abdomen (Fig. 1)	Straight, more seldom convex, the thoracic region never shows gradual descent from the cephalic region towards abdomen, the whole carapace is usually relatively high, its posterior pitch has a sharp border when passing to the thoracic region (Fig. 2)	Ditto
Edge of carapace	Supplied with dense, furlike light hairs; at the edge of the cephalic region these hairs are usually short	Ditto, but not so conspicuous as in males	Supplied with sparse hairs; if the hairs are dense (in <i>Hogna radiata</i> ), they reach only the cephalic region, and are absent at the edge of the latter	Ditto
Sides of the cephalic part of carapace	Supplied with easily visible, rather dense adpressed hairs	Ditto	Adpressed hairs are absent, or they are sparse and short	Ditto
Ocular field	Supplied with long, dense hairs	Ditto, but on the whole are less conspicuous	Short, not dense hairs	Ditto
Tip of the cymbium	Bunch (brush) of dense, rigid and straight bristles about equal in size (Fig. 4); sometimes in this brush there are two or more straight spines	—	Bunch of dense, rigid bristles is absent, hairs cover the tip of the cymbium more or less evenly	—
Ventral side of tarsus I	Two rows of short, hard spinules, or very dense scopula, or either spinules or scopula	Ditto	Spinules are rather thin, often in the form of short setae, or more or less sparse scopula	Ditto

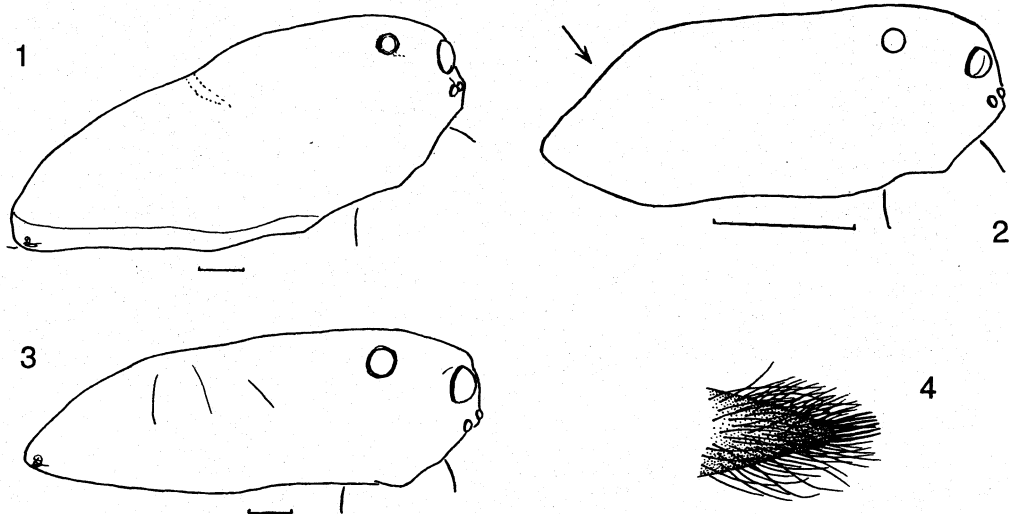


Fig. 1. Female carapace of *Mimohogna vultuosa* (C. L. Koch). — Fig. 2. Female carapace of *Alopecosa cuneata* (Clerck). Arrow indicates posterior pitch of carapace. — Fig. 3. Female carapace of *Lycosa nordmanni* (Thorell). — Fig. 4. Tip of male cymbium of *Geolycosa* (?) sp. — Scale bars 1 cm.

zation of such lycosids (St. Helena's *Dolocosa* also belongs to these) is the relatively narrow thoracic region of the carapace compared with the wide cephalic region (see Tongiorgi 1977: fig. 50, a, c). The above-mentioned differences in the relief of the carapace in the genera *Leaena* and *Dolocosa* make Guy's (1966) assertion about the two being congeneric completely groundless.

**Hairiness of the carapace.** In hole-dwellers, the edge of the thoracic region of carapace has a very clear hairiness of dense, fur-like light hairs, especially conspicuous in the males; these hairs are much more dense than those covering the carapace. The edge of the cephalic region is also pilose but the hairs are evidently shorter. On the sides of the cephalic region, both in males and females, there are adpressed hairs which are longer than those covering the carapace. In males, the ocular field is covered with rather long dense hairs; in females these hairs are practically non-existent. This hairiness of the carapace, without doubt, facilitates the spiders movements in the confined space of a hole. We connect the evidently greater hairiness of the edge of carapace of males compared with that of females, with the fact

that they must visit many holes of different diameter.

Hairiness of the edge of carapace seems to be the most stable feature of burrowing lycosids. First, it enables us to identify burrowing males, and second, it allows to include amongst hole-dwellers the species of the genus *Leaena* which have no descent of the thoracic region of carapace.

**Equipment of the tip of male palp cymbium.** In hole-dwellers, the tip of the cymbium is supplied with a bunch (or brush) of dense, rigid and straight bristles, or instead of this there are two or several long, straight apical spines; sometimes there are strong spines in a very dense brush of bristles (as in *Allohogna singoriensis*). In non-burrowing lycosids, the brush of bristles at the tip of cymbium is absent. Spines, if present, are short; if long, they are situated not only at the tip of cymbium, but also at its free part, lying above the bulb (in *Hogna radiata*).

It should be noticed that at the juvenile stages of burrowing males, the tip of the cymbium is supplied with a long, unpaired spine which, in the subimago stage, transforms into a brush of bristles. When digging its hole, the spider loosens the soil

with the chelicerae, shovels it up using the palps, encloses the soil heap in silk, takes the "sack" using the chelicerae and then carries it out to the surface (see also Marikovskii 1956).

*Equipment of the tarsus I (and II).* In hole-dwellers, the tarsus I is ventrally supplied with two longitudinal rows of short, hard spinules, or the whole ventral side of tarsus I is covered with very dense "hard" scopula. In non-burrowers, these spinules are thin and weak, setaceous, or the whole surface of tarsus I is covered with long, but relatively sparse, scopula (in *Hogna radiata*). We believe that ventral spinules or dense scopula facilitate the movement of the burrower in a vertical hole, and seem to provide support for the forelegs during digging.

Summing up all the above-mentioned data, we can assert that structural and functional features of burrowing lycosids, such as the relief of the carapace in females, the hairiness of the edge of the carapace, the bunch of rigid bristles at the tip of male palp cymbium, and also the short and hard spinules or very dense scopula on the ventral side of tarsus I, have a taxonomic rank not lower than generic. From this standpoint, it seems right to exclude the species *Arctosa leopardus* Sundevall from the genus *Arctosa* s.str., regarded by Roewer (1959) as *Megarctosa Caporiacco*. We restrict the tribe Lycosini (see Lehtinen 1978, Lehtinen & Hippa 1979), to include only typical burrowers, i.e. those genera that are characterized by the descent of the thoracic region towards the abdomen in females, and the other features of burrowing lycosids mentioned above: genera *Lycosa* s.str., *Arctosa* s.str., *Allohogna*, *Geolycosa*, the species *Mimohogna vultuosa* (C. L. Koch). We also establish the new tribe Trochosini Zyuzin & Zarko, members of which have straight (horizontal) or convex, but not a descending thoracic region of carapace in both females and males, and the other features of non-burrowers (see Table 1). We include in this tribe all the rest of the Palaearctic genera of the subfamily Lycosinae<sup>2</sup>, and also the burrowing genus *Leaena*.

<sup>2</sup>Formerly Zyuzin (1985) united the subfamilies Lycosinae and Pardosinae, but now we regard them as two distinct subfamilies (see also Dondale 1986).

## Tribe Trochosini Zyuzin, trib.n.

Type genus: *Trochosa* C. L. Koch, 1848

Diagnosis: see Table 1 in the column of non-burrowers.

Palaearctic genera included: *Trochosa*, *Alopecosa*, *Hogna* [*radiata*], *Tricca* s.lat., *Pirata*, *Piratula*, *Leaena*, *Hygrolycosa*, *Arctosa* s.lat. [*figurata*, *leopardus*].

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