New data and new species of Microcoryphia and Zygentoma (Insecta) from Israel

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Abstract. The presented contribution concerns the study of several samples of Microcoryphia and of Zygentoma obtained in Israel; an up to date of the species of these insect Orders reported from Palestine is also presented. Genus *Hyperlepisma* (Lepismatidae: Ctenolepismatinae) is reported for the first time from the country and one new species *H. palaestinensis* **n. sp.**, is described from the northern Negev. Another new species this one of the genus *Lepidospora* s. s. (Nicoletiidae: Coletiniinae), *L. (L.) ayyalonica* **n. sp.**, is described from the Ayyalon Cave in Western Central Israel, from where several other terrestrial and aquatic endemic arthropods were already known.

Résumé. **Nouvelles données et nouvelles espèces de Microcoryphia et de Zygentoma (Insecta) d'Israël.** L'étude présentée porte sur quelques échantillons de Microcoryphia et de Zygentoma provenant d'Israël ; il comporte aussi une actualisation des données concernant ces ordres d'insectes en Palestine. Le genre *Hyperlepisma* (Lepismatidae : Ctenolepismatinae) est signalé pour la première fois du pays et l'espèce nouvelle *H. palaestinensis* **n. sp.** est décrite du nord du Negev. On décrit aussi une espèce nouvelle de *Lepidospora* s. s. (Nicoletiidae : Coletiniinae) provenant de la grotte de Ayyalon dans le centre ouest de Israël (*L. (L.) ayyalonica* **n. sp.**), d'où plusieurs autres arthropodes terrestres et aquatiques endémiques sont déjà connus.

Keywords: Lepismatidae, Nicoletiidae, Negev, Palestine, cave endemism.

The present paper deals with the study of representatives of 3 species of Microcoryphia (bristletails) and of 8 of Zygentoma (silverfishes), from Israel. Genus *Hyperlepisma* Silvestri 1932 (Lepismatidae: Ctenolepismatinae) is reported by the first time in the country and one new species from the Mashabim area is described. One new species of *Lepidospora* s. s. Escherich 1905 (Nicoletiidae: Coletiniinae) is described from the Ayyalon Cave.

The study of the fauna of thysanurans s. l. (Insecta) of the area includes to date 11 papers, and previous references concern 7 species of Microcoryphia and 19 (or 18?) species of Zygentoma (Bodenheimer 1935, 1937, Mendes 1993, 1995, Paclt 1961, Silvestri 1923, and Wygodzinsky 1939, 1942, 1952, 1974), as follows:

Order Microcoryphia: Family Meinertellidae: *Machilinus kleinenbergi* (Giardina 1900) from Dagania, Lake Tiberias; probably, it represents one other non-described species, as previously discussed by Mendes (1995); *Machilinus* sp. was, further, assigned from Jerusalem and from the Judean Hills, Nabi Samwil Spring, in what almost certainly concerns the same species.

Family Machilidae: *Allopsontus (Machilanus) hebraeus* Wygodzinsky 1974, described under *Machilanus* from Sataf; the female sex remains unknown in Israel as noted below. *Charimachilis palaestiniensis* Wygodzinsky 1939 from Beth Lechem; Jerusalem; Ramoth Haschawin; and Scopus; it remains known by the female sex only. *Haslundiella steinitzi* Wygodzinsky 1942 from Dagania, Lake Tiberias; and Ejn Fescheha. *Lepismachilis* sp. from Aqua Bella; Under Galilee, Allonin, SE Haifa; Haifa; Upper Galilee near the Elon kibbutz, and Nahal Bezet; males were never collected, preventing a more precise (specific) identification. *Praetrigoniophthalmus gigas* (Burmeister 1838) from Aqua Bella; Jerusalem; and Sataf. And *Silvestrichilis trispina* Wygodzinsky 1939 described under *Praemachilis*, from Ammi'ad and reported also from Dagania, Lake Tiberias; Under Galilee, Allonin, SE Haifa; SE Karmel-Berg, SW of Elyaqim, 300 m; and Ramoth Haschawin. Bodenheimer (1935) registers the occurrence in Palestine of "... *Several broad, triangular species of* Machilis ..." and later (1937) he points that

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Machilis sp. was registered in the country; these data certainly concern one or several species of any other genus, though almost certainly not of *Machilis*, due to this genus known range. A note in the same paragraph ("*... during the night and at summer-noons they hide in crevices ...*") points to the fact that those specimens will be actives by day, and so, that they will belong to genus *Machilinus*. Further, non-identified "Machilinae" were reported by Wygodzinsky (1942) from Dagania and from the Carmel upon females with a primary-type ovipositor, eventually concerning specimens of *Lepismachilis* sp. due to the shape of the paired ocelli and to the reported number of abdominal vesicles.

Order Zygentoma: Family Lepismatidae: *Allacrotelsa kraepelini* (Escherich 1905) from Chirbeth Zemach; Dagania, Lake Tiberias; Under Galilee, Allonin, SE Haifa; Jerusalem; Haifa, 100 m; Under Galilee, W Yodefat, 300 m; Upper Galilee, near the Elon kibbutz, Nahal Bezet; and Judean Hills, 'En Se'adim, 10 Km S Jerusalem. *Lepisma saccharina* Linnaeus 1758 from the Judean Hills, Nes-Harim, 20 Km W of Jerusalem; and Rehobot, near Jaffa (Tel Aviv). *Neoasterolepisma palmonii* (Wygodzinsky 1942) from Dagania, Lake Tiberias – redescribed by Mendes (1988) upon the type-material. Bodenheimer (1935) reports *Neoasterolepisma "wasmannii"* (Moniez 1897) without precise location as inhabiting *Messor* sp. nests; also from Dagania, Lake Tiberias; after Mendes (1988) this name shall correspond to several peri-Mediterranean species in need of revision. *Acrotelsa collaris* (Fabricius 1793) from Allonin, Dagania, Lake Tiberias; Jerusalem; Under Galilee; 12 Km NW Elat, Negev, 600 m); SE Haifa, 200 m; Jericho; Ptechah, W of Lake Tiberias; and Wadi Nafkh, opposite to J. Tiwal en-Nafkh, Negev. *Lepismina persica* Escherich 1905 from Jerusalem; Naqb Gharib, Negev; it corresponds to a misidentification of the following species, or both will be one only and the very same taxon – note on Mendes (1995). *Lepismina pluriseta* Wygodzinsky 1942 from Dagania, Lake Tiberias; and Haleiqim Plain, Negev. *Ctenolepisma (C.) ciliata* (Dufour 1831) from Natanya. *Ctenolepisma (C.) insulicola* Mendes 1984 from Galilee, N Nahariyya. *Ctenolepisma (C.) lineata pilifera* (Lucas 1840) from Jerusalem. *Ctenolepisma (C.) longicaudata* (Escherich 1905) from Chissah; Haifa; and Rehobot, near Jaffa (Tel-Aviv). *Ctenolepisma (Sceletolepisma) michaelseni* Escherich 1905 from Rvivim. *Ctenolepisma (Sceletolepisma) roszkowskii* Stach 1935 from Dagania, Lake Tiberias; Jerusalem; and Judean Hills, Nabi Samwil spring, N of Jerusalem. *Ctenolepisma (Sceletolepisma) targionii* (Grassi & Rovelli 1889) from the 'En Gedi oasis, 220 m; Under Galilee, Allonin, SE Haifa, 200 m; Jericho; and Sahl el-Hawa, Negev; *Ctenolepisma (Sceletolepisma) wahrmani* Wygodzinsky 1952 from Wadi Menaiye, Negev. *Thermobia aegyptiaca* (Lucas 1840) from Aqua Bella; Dagania, Lake Tiberias; Under Galilee, Allonin, SE Haifa, 200 m; 2 Km N of Mizpe Ramon, Negev, 700 m; Upper Galilee, Huleh reserve; Jebel 'Ureif, Negev; Jericho; Jerusalem, Scopus; Mosad Rupin; Naqb Gharib, Negev; Ptechah, W of Lake Tiberias; Rehobot, near Jaffa (Tel-Aviv); Rosch Pinah; and Wadi Lussan, Negev. Bodenheimer (1935) assigns *Thermobia domestica* (Packard 1873) but none locality is given; he reports *T. aegyptiaca* and *T. domestica* as "*... common in houses, behind pictures...*" (these names may correspond, both, to *T. aegyptiaca* only); besides, he notes that "... Ctenolepisma lineata *and others are common in the mountains among rocks ...*" what, though far from precise, conveys an idea about the abundance of silverfish specimens in the rocky areas of Israel. Wygodzinsky (1939) assigns, further, a non-determinable *Ctenolepisma* from Ramoth Haschawin upon immature female(s).

Family Nicoletiidae: *Lepidospora (L.) silvestrii* Wygodzinsky 1942 from Dagania, Lake Tiberias. And *Arabiatelura palaestinensis* Mendes 1995 from the Kinneret kibbutz, Jordan Valley – southern connection of the river with Lake Tiberias.

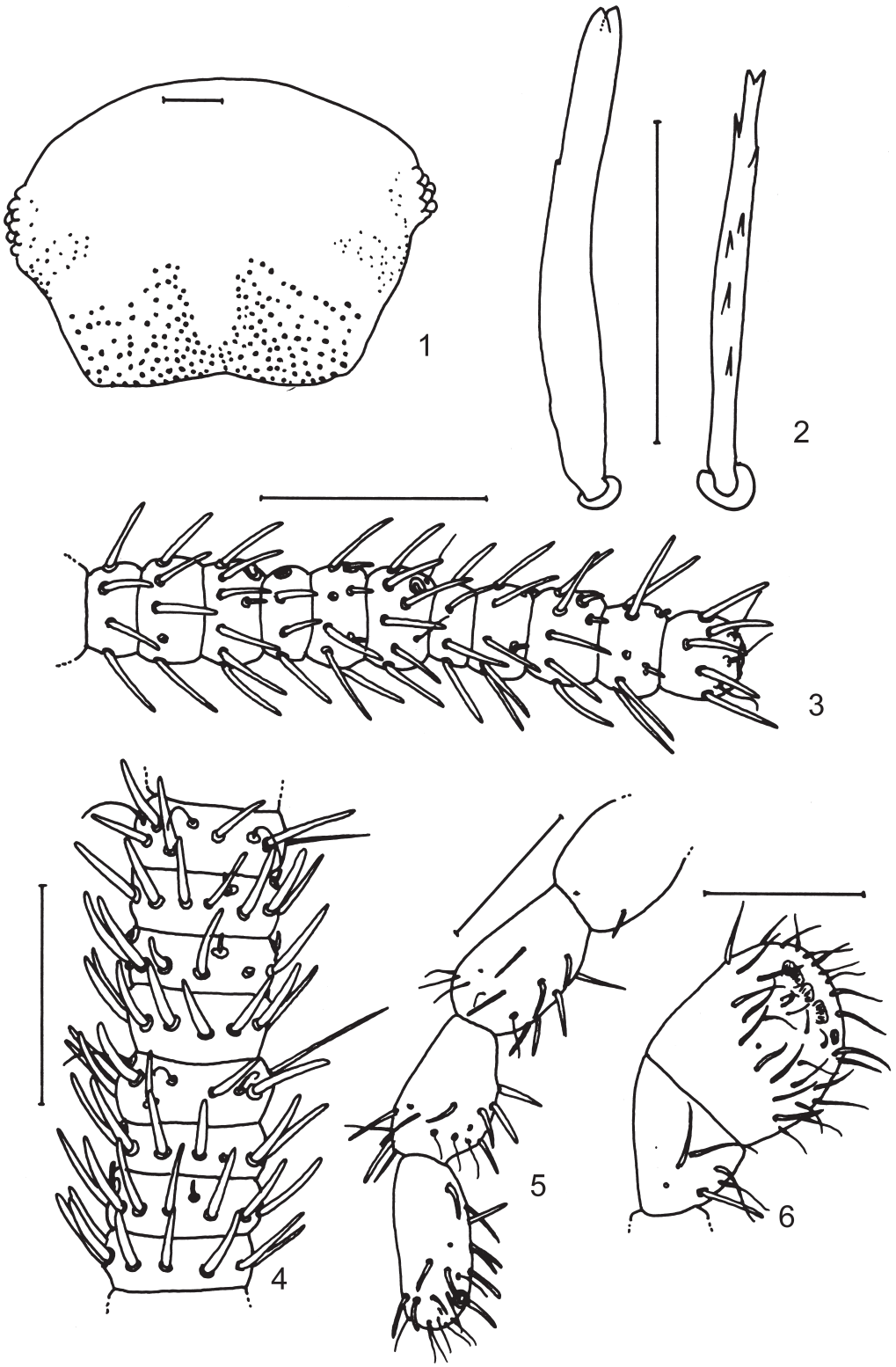
Identification keys to the previously known species were provided by Mendes (1995).

Material and Methods

All the studied specimens were alcohol preserved when received. For more detailed study, some were dissected under the stereoscopic microscope, mounted in Tendeiro Liquid (modified Hoyer) and maintained in a stove at ca 40 °C by ca one week to clarify and dry before they can be observed in detail (longer, before storage). Subsequent studies were performed at an optical microscope and a camera lucida was used to draw the figures. Non-dissected material is maintained in 70–75 % ethanol, in hermetic vials.

One studied sample was loaned by Prof. Emer. Chanan Dimentman (CD in the text) of the Hebrew University of Jerusalem, Israel and is deposited in the entomological collections of this University (HU in the text); the remaining specimens were offered by Dr. Sérgio Silva Henriques (SH in the text), of the Évora University, Portugal, and are deposited in the entomological collection of the Instituto de Investigação Científica Tropical / Jardim Botânico Tropical - Zoology, in Lisbon (the former Centro de Zoologia, CZ in the text).

Studied material was obtained in the following localities, which approximate coordinates are reported: Adullan: Region south-west from Jerusalem, not far from the Palestine border, centred at ca 31° 40' N, 34° 37' E; Ayyalon Cave, near Ramla: ca 31° 54' N, 34° 55' E; Hatzefa: unable to be located; Mashabin: near Beer-Sheva, 31° 15' N, 34° 47' E; Sde-Boker: ca 30° 52' N, 34° 48' E; and Tel Arad: ca 31° 17' N, 35° 08' E.



Figures 1–6
***Hyperlepisma palaestinensis* n. sp.** (holotype) male. **1,** Chaetotaxy of head; **2,** Macrochaetae of frons (left) and of anterior border of the pronotum (right); **3,** Antenna, distal chain; **4,** Idem, median chain; **5,** Maxillary palp (articles II-V); **6,** Labial palp (median and distal articles). Scales: 0.1 mm.

Results and discussion

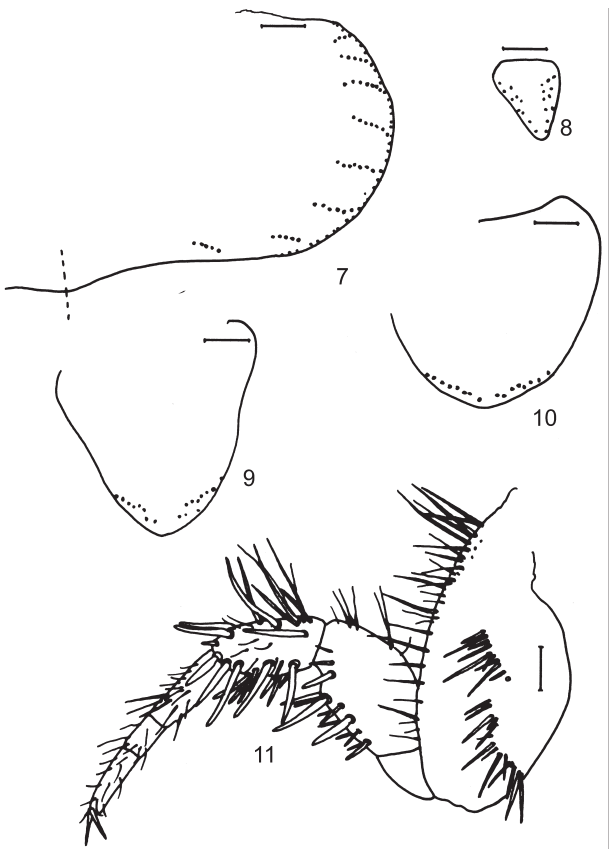
Order Microcoryphia

Fam. Meinertellidae

Machilinus sp.

Material examined. Tel Arad, 17.III.2007, SH, 1♀ (CZ-5517)

Discussion. The only studied specimen shows quite conspicuous and well delimited pigment spots on the maxillary palp. Though somewhat variable inside each one of the species/subspecies known in the genus, this characteristic seems distinct in the Tel Arad female relatively to what is known in the remaining Palaearctic taxa of the genus, reinforcing the idea of the presence in Israel of (at least) one non-described *Machilinus* species (Mendes 1995). Only the capture of males in the area will allow solving this problem.



Figures 7–11
***Hyperlepisma palaestinensis* n. sp.** (holotype) male. **7,** Metanotum; **8,** Prosternum; **9,** Mesosternum; **10,** Metasternum; **11,** P I. Scales: 0.1 mm.

Fam. Machilidae

Allopsontus (Machilanus) hebraeus (Wygodzinsky 1974)

Material examined. Tel Arad, 17.III.2007, SH, 2 ♂♂ (CZ-5517)

Discussion. The studied specimens agree fairly with the Wygodzinsky' (1974, sub *Machilanus*) description of the only other Palestinian studied sample of this species, which includes its holotype male only; the ventral spines of the P I femur are more robust and more abundant in the Tel Arad material, concerning eventually elder males, but the more important morphological features (the palps shape and chaetotaxy and the sensorial field of the femur of P I) completely agree with the original data; the tibias of P II and of P III are also more spinose than originally described with, respectively, 8–10 and 14–15 ventral spines. *A. hebraeus* remains known in Israel by the male sex only. Females said to belong to this same species were described from Turkmenistan (Kaplin 1993). However, due to the absence of Palestinian known females and of Turkmen known males, as well as because of the more than 2000 Km that separate those two samples and taking into account that none sample is known from between the reported ones, the problem of their objective con-specificity remains unsolved. We believe that their remoteness suggests the presence of two independent species and so, the existence of one species (*A. (M.) hebraeus*) in Israel which females remain unknown and of another, unnamed for the moment, in Turkmenistan, of which males were never found.

Silvestrichilis trispina Wygodzinsky 1939

Material examined. Adullam, 13.III.2007, SH, 1♀ (not preserved, used for DNA analysis)

Discussion. *S. trispina* is endemic from Palestine (Wygodzinsky 1939, sub *Praemachilis*); the only collected female agrees fairly with the characteristics of the species.

Order Zygentoma

Fam. Lepismatidae

Sub.-fam. Acrotelsatinae
Acrotelsa collaris (Fabricius 1793)

Material examined. Adullam, 13.III.2007, SH, 1♀ (CZ-5515). Tel Arad, 17.III.2007, SH, 1 ♂ (CZ-5517). Hatzefa, 16.III.2007, SH, 2♀♀ 2 juveniles (CZ- 5516)

Discussion. The species is known along the tropics

almost exclusively by domestic or peridomestic populations; the only "free" known samples, collected almost always from under stones, seem to be those from the Eastern Mediterranean basin countries (Israel included) to Iran and Afghanistan, which is probably its original range.

Lepismina pluriseta Wygodzinsky 1942

Material examined. Mashabim, 12.III.2007, SH, 1 ♂ 1 young ♂ 3♀♀ (CZ-5514)

Discussion. *L. pluriseta* was previously reported to occur in Israel, Syria, Kuwait and Saudi Arabia. Taking into account the problematic identification of the species of *Lepismina* Gervais 1844 already enhanced by Irish (1991), we believe wiser to consider the Mashabim material as part of the present species (to which it agrees in most of the characteristics) though the body is longer than twice its width. *L. persica* Escherich 1905, one very similar but more delicate taxon (shall they be both, one only and the same species? – then *L. persica* will take priority over *L. pluriseta*), was previously reported to occur in Iran and in Israel.

Sub.-fam. Ctenolepismatinae

Hyperlepisma palaestinensis n. sp.

Type-specimen. **Holotype** ♂. Mashabim, 31° 15' N, 34° 47' E, 12.III.2007, SH, (dissected and slide-mounted, with the registration number CZ-5514) (fig. 1–15)

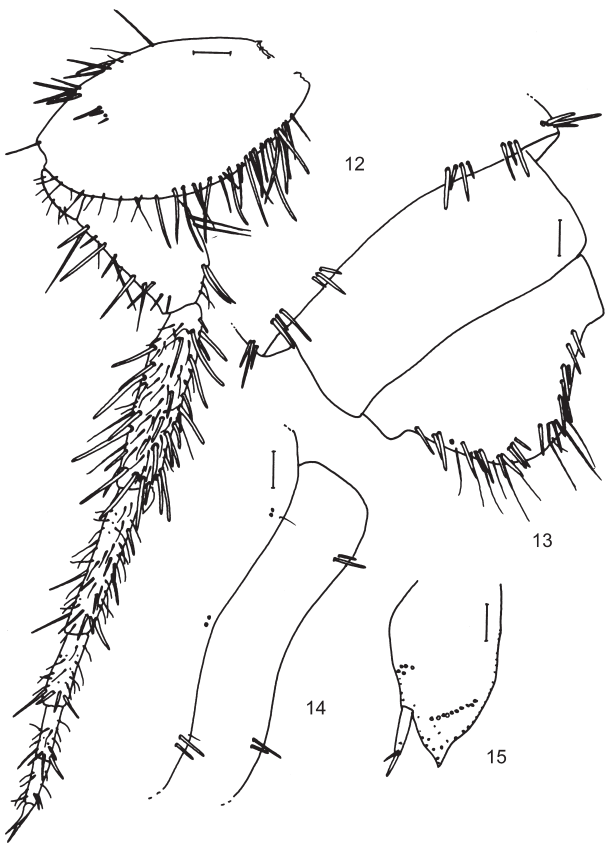
Diagnosis. Labial palp with 3 papillae; coxa of P III with one short transverse comb of macrochaetae; urosternites I-VI with one median, the IV-VII with 1+1 lateral bristle combs; urotergite X semi-circular and with 1+1 transverse bristle-combs; coxites IX with a single transverse bristle-comb.

Description. Male: Body length: 4.9 mm; thorax length: 1.6 mm; thorax width: 1.3 mm; antennae surpassing 2.8 mm (broken).

Body spindle-shaped; abdomen not clearly enlarged in its anterior area and not conspicuously detached from the thorax base. Scale pattern unknown, the scales light, round, with thin and very numerous rays, all identical, present on the head, body and legs (coxa and femur). Pigment absent. Macrochaetae hyaline, only exceptionally pectinated (some rare, very large and spiniform macrochaetae from the thorax and legs are indistinctly barbed; very few, from the coxite X base, are delicate and clearly feathered).

Cephalic capsule setation as in fig. 1, the frontal macrochaetae very robust (fig. 2), arranged as 1+1 large tufts; clypeus with 1+1 lateral tufts, the labrum with numerous short, strong, similar setae (somewhat more dense in the lateral areas), arranged in a dispersed fashion instead of in groups. Antennae robust, each one of the most distally preserved divisions with a whorl of short and very robust setulae plus some thin cylindrical basiconic sensilla, the poculiform sensilla rare, isolated, in the divisions 6–7 and 9 of each chain (fig. 3); median chain with wider divisions (fig. 4) but with a similar chaetotaxy. Maxilla without special features. Maxillary palp short, with very robust setae plus one typical poculiform sensilla at the apex of the distal article (fig. 5). Labial palp also reduced, its apical article not enlarged and with 3 papillae only (fig. 6).

Pronotum anterior marginal area (nape) with a continuous collar of very strong, almost smooth macrochaetae, the posterior border slightly convex; lateral margins with 5 combs, each one with 6-8 strong, almost non-pectinated macrochaetae, plus 1+1 posterior combs with 4–5 smaller similar setae. Metanotum (fig. 7) with 7 similar lateral combs, the median ones with 7–8 macrochaetae (most anterior one with 4 only), the 1+1 posterior combs with 3-4 identical macrochaetae. Prosternum quite reduced (fig. 8), much smaller than the remaining thoracic sternites and with scattered setae. Mesosternum (fig. 9) semi-ovoid and about as long as wide at base, with 2+2 apical combs (or 1+1 irregular combs) as a whole each side with 8–9 setae. Metasternum (fig. 10) ca 1/4 wider at base than long and more rounded, with 1+1 distal marginal combs with 8 setae, their distance ca 1/4 of each comb width. Legs spinose, the tibia of P I (fig. 11) ca 1/3 shorter than that of P III (fig. 12). Coxa of P I with 3 oblique setal combs with 6-9, that of P II with 2 co-linear small combs of 5–6, the tibia of P III with 2 similar combs with 3–4 macrochaetae. Spines robust and long,



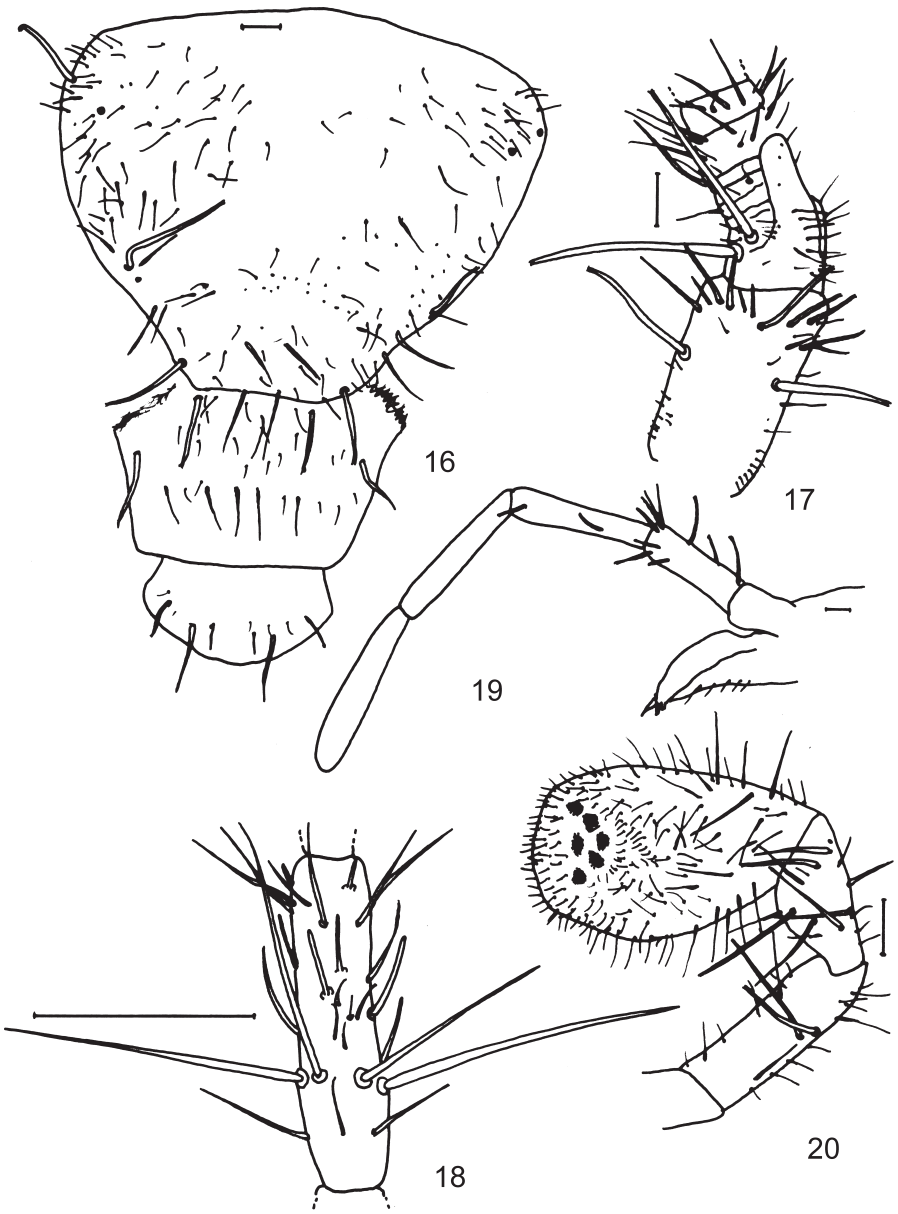
Figures 12–15
***Hyperlepisma palaestinensis* n. sp.** (holotype) male. **12,** P III; **13,** Urotergites VIII-X; **14,** Urosternites VI-VII; **15,** Coxite IX. Scales: 0.1 mm.

attaining ca 1.5 times of the tibial diameter. Praetarsus with long and almost straight paired claws, without empodium. Coxa and femur with typical hyaline round scales, the tibia and tarsus unscaled.

Urotergites I-VIII with 3+3 bristle-combs (infralateral, lateral and submedian), each one with 5–6 macrochaetae (3–4 in the VIII), the IX without setae. Urotergite X sub-semicircular, with 1+1 ante-apical combs with 4–5 macrochaetae plus 5 lateral isolated or paired macrochaetae (fig. 13). Urosternites I-VI with a median comb of 2–3 short and very robust macrochaetae (5 in the I), the IV-VII with 1+1 lateral combs with 2 similar setae (fig. 14). Coxite VIII lacking setae. Coxite IX with a transverse comb with ca 9 macrochaetae plus a small lateral outer group of ca 5 macrochaetae, the delicate stylets laterally displaced and reduced, as in fig.15**.** Paramera absent, the penis as usual.

Terminal filaments short, with very numerous short and strong setae.

Etymology. The new species is named after its origin, the Palestine – a classical Greek denomination for the geographical area today occupied by Israel, Palestine and surrounding areas of Jordan, Syria and Lebanon.



Figures 16–20
***Lepidospora (L.) ayyalonica* n. sp.** (holotype) male. **16,** Head, dorsal; **17,** Base of antenna (scapus, pedicellus and base of flagellum; **18,** Antenna, detail of distal chain of flagellum; **19,** Maxillary palp; **20,** Labial palp. Scales: 0.1 mm.

Discussion. Genus *Hyperlepisma* Silvestri 1932, was known to occur in eastern Libya (Silvestri 1932 – *H. patrizii*, the genus nominal species, from the Al Khufrah oasis), in Algeria (Mendes 1984 – *H. occidentalis*, from Beni-Abbès – west from the Grand Erg Occidental) and in the Arabian Peninsula (Irish 1991 – three species, two from Saudi Arabia, one from Oman and Saudi Arabia: *H. arabiensis*, *H. acinacis* and *H. obliqipectinis*); it is now reported by the first time from Israel. The new species, from the northern Negev, is quite distinct from the remaining *Hyperlepisma* due to the presented combination of characteristics. It is the only species in the genus to show the abdominal sternites I-VI with one median and the IV-VII with 1+1 lateral combs. It has 3 labial palp papillae only, small number of notal combs and a reduced number of macrochaetae on the urosternal combs like *H. obliqipectinis* (eventually the most similar species); the cephalic setation and the X urotergite chaetotaxy are however, quite distinct.

If we adapt the proposed identification keys (Irish 1991) to integrate *H. palaestinensis* n. sp., it will enter point 1A with *H. occidentalis* from which it can be immediately separated, among many other differences, by the number of labial palp papillae (5 *versus* 3) and by the urosternal combs distribution (median in I-III and lateral in the IV-VIII in *H. occidentalis*, median in the I-VI and lateral in the IV-VII in the new species).

Ctenolepisma (C.) lineata pilifera (Lucas 1840)

Material examined. Sde-Boker, 12.III.2007, SH, 1♀ (CZ-5520)

Discussion. *C. lineata pilifera* (status and nomenclature at present under revision) is known to occur all along the Western Palaearctic (Israel included), either as free living, then mainly under bark or stones, or as synanthropic taxon.

Ctenolepisma (Sceletolepisma) michaelseni Escherich 1905

Material examined. Hatzefa, 16.III.2007, SH, 4 juveniles (CZ- 5516)

Discussion. The species was already known from Israel and is distributed from Central and Eastern Mediterranean basin to the Arabian Peninsula.

Ctenolepisma (Sceletolepisma) targionii (Grassi & Rovelli 1889)

Material examined. Sde-Boker, 12.III.2007, SH, 1♀ (CZ-5520). Tel Arad, 17.III.2007, SH, 1♀ (CZ-5517)

Discussion. *C. targionii* is known from Portugal and Spain where it occurs as a synanthropic species, to the Eastern Mediterranean countries (Greece, Turkey, Israel and Egypt) where the populations are free-living and live mainly under stones.

Thermobia cf. *aegyptiaca* (Lucas 1840)

Material examined. Sde-Boker, 12.III.2007, SH, 2 ♂♂ 1♀ (CZ-5520). Tel Arad, 17.III.2007, SH, 4 ♂♂ 1♀ 1 juvenile (CZ-5517)

Discussion. This identification is considered as in need of confirmation due to the simultaneous presence of a classical 5-divided maxillary palp, typical for *T. aegyptiaca* (in most of the specimens it is apically damaged), and of a submedian bristle-comb on urotergite VII with 6–7 macrochaetae similar to the infralateral one, considered (Irish 1988) as typical for *T. domestica*; furthermore, the apical prosternum is distinct from those of both species figured in the same paper. *T. aegyptiaca* seems common in Israel and it ranges from all along South-western Asia and most of Africa, especially with free-living populations; in the Eastern USA of Ohio and Pennsylvania domestic populations were determined under *Ctenolepisma campbelli* (Irish 1988, who justifies this synonymy).

Fam. Nicoletiidae

Sub.-fam. Coletiniinae

Lepidospora (L.) ayyalonica n. sp.

Type-specimen. **Holotype** ♂. Ayyalon Cave, ca 31° 54' N, 34° 55' E, ?.V.2006, leg. A. Frumkin, CD (dissected and mounted in one slide with the registration number HU-JINVTHYS-500) – Figs. 16–33

Diagnosis. Very long, symmetrical antennae with sub-cylindrical thin and elongate pedicellar apophysis; very long and delicate maxillary palp articles (mainly the two apical ones); short and stomp praetarsal claws (all the claws, but mainly, the empodium); paramera cylindrical, ca 5.5 times longer than wide and attaining level of half the stylet IX; absence of typical sclerotized pegs on the three terminal filaments (instead, a few very stout setae occur on the basal divisions of cerci and paracercus).

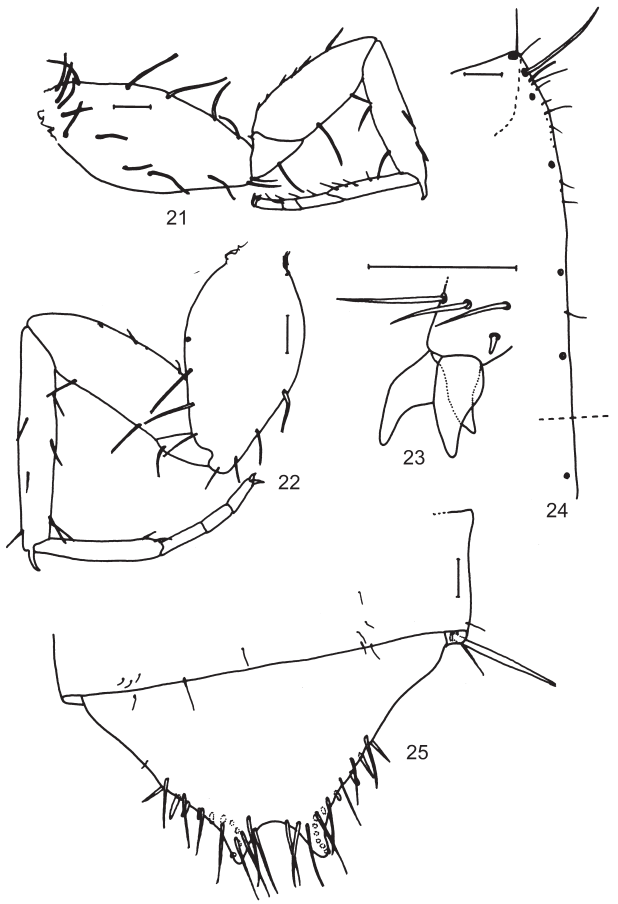
Description. Male: Body length: 9.6 mm; thorax length: 3.2 mm; thorax width: 1.6 mm; antenna length: maximum preserved of 12.9 mm; cerci length: 8.7 mm; total body length: 17.0 mm (terminal filament apically damaged). Body long, thin, and without pigment, whitish. Head and body with abundant, typical, very light or hyaline scales and setae, the macrochaetae markedly spiraled, brownish.

Head not much wider than long, with some marginal macrochaetae and, in the disc, with not very numerous thin, minute setae as in fig. 16. Antennae symmetrical, thin and quite elongate, exceeding the posterior area of abdomen, the pedicellar apophysis (fig. 17) sub-cylindrical, about 3 times longer than wide, attaining level of the 3rd-4th article of flagellum. Chains

of flagellum with 4 unities, the most distal ones 3–4 times longer than wide (fig. 18), the median ones clearly shorter, ca 1.5 times longer than wide; distal division of each tetrad in the distal antenna, with numerous thin, cylindrical sensilla (these ones are clearly less numerous on the n-2 division and rare on the two remaining unities). Mandibles robust, well sclerotized, asymmetrical as usual for the genus, with well developed incisive and molar areas. Maxillae typical; galea and lacinia similarly elongated the former with 2 big distal conules, the last one with two acute apical teeth; prostheca almost attaining the lacinia apex**.** Maxillary palp (fig. 19) thin and long, the distal article cylindrical, ca 6.5 times longer than wide and slightly longer than the preceding one; two basal articles with numerous very strong macrochaetae, remaining chaetotaxy as usual. Labium without special characteristics, postero-laterally rounded; distal article of labial palp ca twice longer than wide (fig. 20), the papillae as usual.

Thorax attaining ca 1/3 of the body length. Pronotum with almost straight posterior border, the metanotum somewhat more concave, all the nota with some marginal (lateral and posterior) big macrochaetae and with numerous discal small setae. Legs robust and (mainly the tibias) elongate (figs. 21, 22), the tibia III ca 3/4 longer than tibia I; P I with 5–6 dorsal and 3 ventral femoral macrochaetae, 3 dorsal and 8 ventral tibial macrochaetae and numerous tarsal spines, the P III with, respectively, 4–5 dorsal and 3 ventral, 3 dorsal and 5 ventral (plus some robust setae) and also with numerous tarsal spines. Praetarsus simples and complete, the lateral claws and (mainly) the empodium very short and stomp, all smooth (fig. 23).

Urotergites I-VIII as usual, with scales, macrochaetae and setae along the posterior border (fig. 24); the IX (fig. 25) without posterior macrochaetae (only thin small setae are present)**.** Urotergite X as in figs. 25–26; dorsal surface with 4–5 lateral strong setae plus 3–4 similar setae on the posterior notch; ventral surface with 11–12 sclerotized pegs each side, the more anterior ones lanceolate, less sclerotized and lighter, longer and much thinner than the remaining, the median and distal conules rounder and shorter, brownish, at least some of them more or less clear grooved apically. Urosternites typical, the I composed by one independent median sternite plus 1+1 lateral coxites (fig. 27). The remaining are entire (fig. 28) with 1+1 median, 1+1 posterior submedian and 1+1 postero-lateral (on the stylet insertion inner area) macrochaetae. Median area of the VIII poorly extruded, the most anterior pair of macrochaetae of the coxite lacking (fig. 29). Terminal spine of the stylets, mainly that of the IX, large and with very conspicuous inner denticulations (fig. 30). Paramera (figs. 29, 31) sub-cylindrical, ca 5.5 times longer than wide and attaining half the length of the stylets IX, the apical glandular setae thin and long, not numerous. Penis big, ovoid, without special characteristics.



Figures 21–25
***Lepidospora (L.) ayyalonica* n. sp.** (holotype) male. **21,** P I; **22,** P III; **23,** Idem, detail of praetarsus; **24,** Urotergite V, right half; **25,** Urotergites IX and X, dorsal. Scales: 0.1 mm.

Figures 26–29
***Lepidospora (L.) ayyalonica* n. sp.** (holotype) male. **26,** Idem, ventral, detail of urotergite X pegs; **27,** Urosternite I; **28,** Urosternite VI; **29,** Coxites VIII-IX and profile of paramera. Scales: 0.1 mm.

Cerci and paracercus long, with some very strong macrochaetae but devoid of typical sclerotized pegs. In the most proximal three divisions of the cerci, some acute-pointed, very strong, dark and obliquely striated spines (fig. 32), being in the following annuli substituted by very strong macrochaetae and after that, by typical macrochaetae; the dorsal basal paracercus (fig. 33), shows some long, very strong and acute similar spines, modified in spiniform elongate macrochaetae after the 4-5th division, and after that changing gradually to typical macrochaetae.

Etymology. The new species is nominated according to its type-locality, the Ayyalon Cave.

Discussion. The new species of *Lepidospora* Escherich, (generic characteristics fairly agree with Escherich 1905, Paclt 1963 and Wygodzinsky 1980) is the only one known in the genus in which male lacks typical sclerotized pegs on all the three terminal filaments; indeed, the remaining known species either of the nominal subgenus or in *L. (Brinkina)* Wygodzinsky 1955 have typical sclerotized conules at the inner basal area of cerci or/and at the dorsal basal portion of paracercus (identification keys in Mendes 2002). *L. ayyalonica* n. sp. is, furthermore, characterized by the quite short and stomp praetarsal claws (especially, the empodium) and by the combination of the remaining features, particularly the very long antennae, the shape and development of the pedicellar apophysis, the elongation of the two apical maxillary palp articles and the development of paramera.

The new species will enter the Palaearctic group of *Lepidospora* s. s., known to occur from the Eastern Mediterranean basin to Iraq, all with typical pegs in the paracercus only; this group includes:

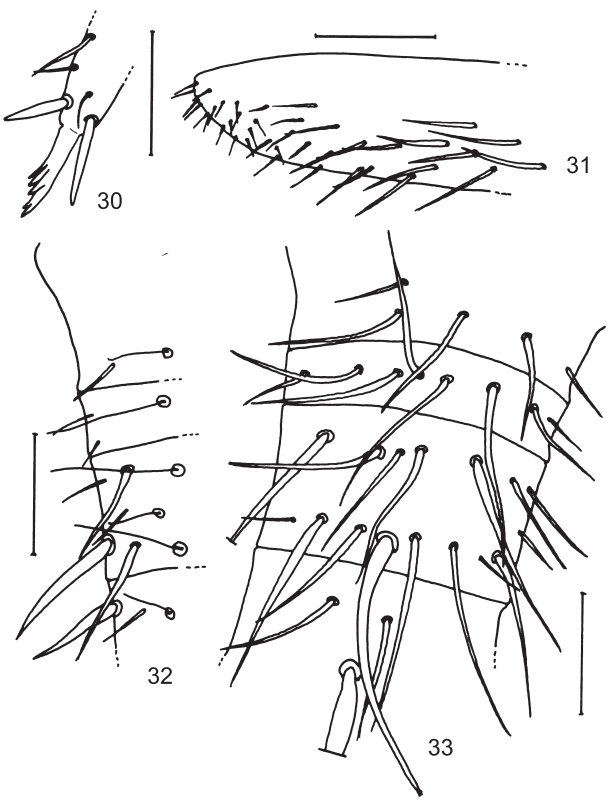
Lepidospora silvestrii, the only other species of the genus described from Israel (Wygodzinsky 1942), collected only once in Dagania (= Deganya, close to the Tiberias Lake): yonder the lack of typical pegs in the new species already emphasized, and among other differences, its body is clearly bigger (almost twice longer than in *L. silvestrii*), the antennae are visibly more thin and elongate and with a quite different pedicellar apophysis, the tarsal claws are much shorter and (mainly the empodium) blunt, the maxillary palp is much longer and more delicate (especially in what the distal articles are concerned) and the urotergite X is completely different, either in its morphology, or in the number and arrangement of the ventral sclerotized pegs.

Lepidospora kurda from Iraq (Mendes 1985), much smaller and with clearly less elongate appendages, presents a quite different pedicellar apophysis, distinct tergal chaetotaxy and very different urotergite X.

The Turkish *Lepidospora aquilonaris* (described as a subspecies of *L. silvestrii* – Wygodzinsky 1959) has, apart from other dissimilarities, a distinct urotergite X and a very different pedicellar apophysis.

At last the two Greek species, *Lepidospora (L.) escherichi* Silvestri 1908 (redescribed by Mendes 1992) and *Lepidospora (L.) wygodzinsky* Mendes 1992 (Wygodzinsky 1980, as the redescription of *L. escherichi*), are much smaller and with clearly less elongated appendages. Both present more "lepismatoid" body shape, quite different praetarsus (long claws and thin, spinulated empodium) and typical pegs on the dorsal basal paracercus.

Biotope. The Ayyalon Cave is an inner coastal plain deep cave supported by chemosynthesis in a karstic area ca 4 Km south-east of the town of Ramla, south from Tel Aviv and close to the road to Jerusalem (Frumkin & Gvirtzman 2006, Por 2007), from where some aquatic and terrestrial unique endemic arthropods were previously described (Levy 2007, Curcic 2008, Tsurnamal 2008). The cave entrance was accidentally exposed by bulldozers in the Nesher limestone quarry. Despite the appendages elongation, the capture of a single male raises the question point of which is the real biotope of *L. ayyalonica* n. sp. Is it a true troglobite, restricted to the cave environment or is it instead a



Figures 30–33
Lepidospora (L.) ayyalonica n. sp. (holotype) male. **30**, Detail of apical spine of stylet IX; **31**, Detail of paramerum; **32**, Base of left cercus, inner ventral; **33**, Base of paracercus, dorsal. Scales: 0.1 mm.

casual deep soil species that arrived to the cave when it was opened?

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References

Bodenheimer F. S. 1935. *Animal Life in Palestine*, Jerusalem, 335 p.

Bodenheimer F. S. 1937. Prodromus Faunae Palestinae. *Mémoires de l'Institut d'Égypte*, Le Caire **33**: 232.

Curcic B. P. M. 2008. *Ayyalonia dimentmani* n. g., n. sp. (Ayyaloniini n. trib., Chthoniidae, Pseudoscorpiones) from a cave in Israel. *Archives of Biological Sciences*, Belgrade **60** (3): 331-339.

Escherich K. 1905. Das System der Lepismatiden. *Zoologica*, Stuttgart **18** (43): 1-164.

Frumkin A., Gvirtzman H. 2006. Cross-formational rising groundwater at an artesian karstic basin: the Ayyalon Saline Anomaly, Israel. *Journal of Hydrology* **318**: 316-333.

Irish J. 1988. Revision of *Thermobia* Bergroth (Thysanura:Lepismatidae). *Cimbebasia* **10**: 15-30.

Irish J. 1991. Lepismatidae (Thysanura: Insecta) of the Arabian Peninsula. *Fauna of Saudi Arabia* **12**: 225-241.

Kaplin V. G. 1993. Shyetynokhvostky roda Allopsontus (Thysanura, Machilidae) myrovoy fauni [Bristletails of the genus *Allopsontus* (Thysanura, Machilidae) of the World fauna]. *Zoologiceskij Zurnal* **72** (3): 53-67 [In Russian].

Levy G. 2007. The first troglobite scorpion from Israel and a new Chactoid family (Arachnida: Scorpiones). *Zoology in the Middle East* **40**: 91-96.

Mendes L. F. 1984. Sur quelques Lepismatides (Zygentoma, Insecta) du Sahara algérien. Notes et description d'une nouvelle espèce du genre *Hyperlepisma* Silv., 1932. *Bulletin du Musée national d'Histoire naturelle*, Paris (4) **6** (A) (4): 1135-1151.

Mendes L. F. 1985. Sur quelques thysanoures (Microcoryphia et Zygentoma) de l'Asie sud-occidentale. Notes et descriptions. *Nouvelle Revue d'Entomologie* (n.s.) **2** (3): 303-317.

Mendes L. F. 1988. Revisão do género *Lepisma* Lin., 1758 s. lat. (Zygentoma, Lepismatidae). *Boletim da Sociedade portuguesa de Entomologia* **supl. 2** : 1-236.

Mendes L. F. 1992. Some new data on the Nicoletiidae (Insecta: Zygentoma) from Europe and Asia Minor. *Revue suisse de Zoologie* **99** (4): 821-834.

Mendes L. F. 1993. New data on the thysanurans (Microcoryphia and Zygentoma: Insecta) from Northern Africa and from the Near East. *Garcia de Orta* (Zool.) **18** (1/2) [1991]: 79-93.

Mendes L. F. 1995. A review of the Thysanura of Israel with new data on the Microcoryphia and Zygentoma. Ed. Romanian Academy & Israel Academy of Sciences and Humanities. *Soil Fauna of Israel* **1**: 87-110.

Mendes L. F. 2002. Some new data and descriptions of thysanurans (Zygentoma, Nicoletiidae) from Central and Eastern Africa. *Annales du Muséum royal de l'Afrique Centrale* (Zool.) **290**: 87-127.

Paclt J. 1961. Borstenschwänze (Ins., Thysanura) des Senckenberg-Museums. *Senckenbergiana biologica* **42** (1/2): 75-84.

Paclt J. 1963. Thysanura. Fam. Nicoletiidae. *Genera Insectorum*, Creinham **216**: 1-58.

Por F. D. 2007. Ophel: a groundwater biome based on chemoautotrophic resources. The global significance of the Ayyalon Cave finds, Israel. *Hydrobiologia* **592**: 1-10.

Silvestri F. 1923. XI. Thysanura, Termitidae and Embiidae collected in Mesopotamia and N.W. Persia by W. Edgar Evans, B.Sc., late Capt. R.A.M.C., and Dr. P. A. Buxton. *Transactions of the Entomological Society of London* **105** (1/2): 258-262.

Silvestri F. 1932. Spedizione scientifica all'oasis di Cufra (Marzo-Luglio, 1931). Tisanura. *Annali del Museo civico di Storia naturale da Genova* **55**: 293-301.

Tsurnamal M. 2008. A new species of the stygobiotic blind prawn *Typhlocaris* Calman, 1909 (Decapoda, Palaemonidae, Thyphlocaridinae) from Israel. *Crustaceana* **81** (4): 487-501.

Wygodzinsky P. 1939. Beiträge zur Kenntnis der Thysanuren Palaestinas. *Bulletin de la Société Fouad Ier d'Entomologie* Le Caire: 73-85.

Wygodzinky P. 1942. Second contribution towards the knowledge of Diplura and Thysanura from Palestine. *Revista brasileira de Biologia*, Rio de Janeiro **2** (1): 29-46.

Wygodzinsky P. 1952. On some Machilidae and Lepismatidae from Israel, Cyprus and Arabia (Thysanura, Insecta). *Bulletin of the Research Council of Israel* **2** (3): 260-265.

Wygodzinsky P. 1959. Beitrag zur Kenntnis der Machilida und Thysanura der Türkei. *Opuscula Entomologica* **24** (1/2): 36-54.

Wygodzinsky P. 1974. Notes and descriptions of Machilidae from the Old World (Microcoryphia, Insecta). *American Museum Novitates* **2555**: 1-21.

Wygodzinsky P. 1980. A survey of the Nicoletiinae of Europe (Nicoletiidae, Thysanura, Insecta). *American Museum Novitates* **2695**: 1-24.