The Nest, Prey, and Larva of *Entomosericus kaufmani* Radoszkowski (Hymenoptera: Sphecidae)

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**Abstract.** This paper presents, for the first time, information on the nest architecture and prey of *Entomosericus kaufmani*, one of two species in a genus of sphecid wasps whose phylogenetic placement is problematic. Adult females dig nearly vertical burrows in the soil and provision them with immature and adult leafhoppers (Hemiptera: Cicadellidae). The mature larva of *E. kaufmani* is also described for the first time, and the phylogenetic implications of this new information on nesting biology and larval morphology are discussed.

*Entomosericus* is a small genus of only two species, occurring in northwest Africa, southeast Europe, Turkey, and south-central Asia (Kazakhstan to Turkmenia). Nothing was known about the life history of these wasps until the first author found a colony of *Entomosericus kaufmani* in south-eastern Kazakhstan in 1988. The wasps were nesting on a dry sandy-silt terrace of the Talas River that was covered with sparse vegetation (Artemisia spp., *Dodartia orientalis* (L.), *Halimodendron holodendron* (Pall.) Voss., *Salsolea spp.*). The nests were 20 cm to 1 m apart. Wasps visited the flowers of *Lupinus japonicus* Prokh., *Pyrethrum* sp., and other plants. Males sat on *Dodartia* and other plants near the nesting area, and rushed toward females emerging from nests or arriving with prey.

Four nests were excavated. The burrows, 3 to 4 mm in diameter and 11 to 15 cm in length, were almost vertical. An oval cell 6 to 8 mm in diameter was at the end of each burrow. There were two to four lateral galleries just above the terminal cell. Nests were left open during the provisioning period. Immature and adult leafhoppers (Hemiptera: Cicadellidae) were used as prey, and carried in flight. Eight to eighteen prey were stored per cell. I.D. Mityasov provided the following determinations of prey: *Scordopella montana* (Fieb.), *Potamytopius albus* (Lindb.), *Neoaliturus opacipennis* (Leth.), *Chandiusanus sp.*, *Pseudophlepsis sp.*, *Pseudomaneleia sp.*, *Macro leptes sp.*, and *Eremophlepsis sexnotatus* (Kuun.).

**DESCRIPTION OF LARVA**

This description is based upon two apparently full grown specimens collected by the first author at the nest site described above. These specimens were cleared and mounted on a microscope slide, and subsequently examined by the second author with an Olympus BH-2 microscope with differential interference contrast optics. All measurements presented in this description are taken from these slide-mounted specimens.

*Body.* Mean length 10.3 mm (10.2, 10.4 mm), mean maximal width 3.35 mm (3.3, 3.4 mm). Thoracic and abdominal segments with large transverse swellings dorsally and well-defined pleural lobes laterally (Fig. 1). Integument densely covered with minute spines (Fig. 2). *Spiracles.* Ten pairs of spiracles present, all of equal size; spiracular atrium with a few scattered denticles that are barely perceptible at 400x magnification (Fig. 2), opening between atrium and subatrum lined with minute denticles but not with long, narrow spines. Outer surface of wall of atrium with subparallel, Anastomosing ridges (closely resembling Fig. 5, Plate XVIII in Evans, 1939).
Figure 1–3. *Entomosericus kaufmani*. 1. General view of full grown larva. 2. Right mandible, anterior view. 3. Left mandible, anterior view.

Figure 4–7. *Entomosericus kaufmani*. 4. Integument of mesothorax, showing spinules in various orientations, 100X. 5. Anterior surface of apex of larval maxilla, showing pulpal (long, dark, cylindrical structure with apical sensilla, galea (shorter cylindrical structure, with only the apex in focus), and incisal surface, 200X. 6. Lateral view of spiracular atrium, substratum, and trachea, 400X. 7. Antenna, showing orbit and median papilla.
Head. Mean width 1.11 mm (1.12, 1.10 mm), mean height 1.05 mm (1.02, 1.08 mm). (Following Evans and Lin [1956], height is measured “from the top of the tentacles (in full front view) to the apex of the eyepiece.”) Anterior surface of head almost entirely devoid of setae, integument smooth, not spinulose as on thorax and abdomen. Antenna (Fig. 7E) with tightly arched papilla in center of circular membranous apical orbit. Papilla about 0.67 times as long as wide, apex of papilla bearing three stout, apically rounded sensilla.

Mouthparts. Apical margin of labrum broadly emarginate (Figs. 8, 9), armed with 12 stout setae along margin and about the same number of apparently pit-like submarginal sensilla (not clearly shown in the photomicrographs). Except for the most lateral sensillum on each side, these sensilla have the appearance of simple circles without an internal peg-like structure (cf. sensilla on epipharynx). Epipharynx densely spinulose laterally, spinules appressed and imbricate laterally, more erect along anterolateral margin of epipharynx (Fig. 9). Median portion of epipharynx with a narrow region devoid of sensilla or spicules, surrounded on each side by about 8 to 10 sensilla that appear to be circular pits with a central peg-like structure (Fig. 9). Hypopharynx a broad, convex lobe densely covered with sharp spinules (Figs. 8, 9). Mandibles heavily sclerotized and tanned, quadrate (Figs. 4, 6), length about twice maximum width. Maxillae (Figs. 5, 6) with lacinial area directed strongly mesad, narrowly rounded apically, outer (ventral) surface densely clothed with sharply pointed spines similar to those on hypopharynx and apical margin of epipharynx, inner (dorsal) surface with flattened papillae that appear to be associated with pitlike sensilla (Fig. 6). Inner face of stipes also papillate, but sensilla apparently not present. Maxillary palps and galea tightly tanned, remaining parts of maxilla with un sclerotized and unpigmented cuticle. Length of maxillary palp 3.18 times length of galea (accurate measurement is only possible on one maxilla of one specimen, but striking difference in length is obvious on both maxillae of both specimens). Maximum length of maxillary palp 1.8 times its maximum width; apex of palpus with four or five stout, bristle-like or subconical sensilla. Maximum length of galea 1.2 times its maximum width; apex of galea with two stout, apically rounded sensilla. Apex of labium (Fig. 7) broadly rounded, bearing lightly tanned palpi laterally and a pair of apically pointed spinnerets (openings of salivary glands) mesally. Length of labial palpus about 1.6 times its width. Apex of labial palpus with at least 2 stout, subconical sensilla. Spinnerets conical, contiguous at base, sharply pointed at apex. Anterior surface of labium smooth, with about eight setae just dorsal of bases of palpi and spinnerets. Apicoventral surface of labium densely papillate, papillae longer and more erect than those on inner face of maxilla.

SYSTEMATICS
On the basis of adult characters, Bohart and Menke [1976] placed Entomosoricus in its own subfamily because they could not confidently associate it with any other sphexid group. The genus has a combination of adult morphological characters that suggest affinities with other subfamilies, particularly Aloxysmini within the Nyssoninae and Botrysostethus within the Larriniae. They stated their preference for the hypothesis of a close relationship with Botrysostethus, and listed several characters shared by Botrysostethus and Entomosoricus, although they did not attempt to demonstrate that these are apomorphic similarities. They also listed eight characters in which Entomosoricus differs from Larriniae (and Philanthinae).

Larval characters do not support the hypothesis of a close phylogenetic relationship between Entomosoricus and Larriniae, if one accepts Evans’ [1959] polarizations of larval characters. A major synapomorphy of all known larvae is larval larvae is the subterminall, ventrally directed anus, and Entomosoricus does not appear to have this character state. Entomosoricus also possesses distinct antennal papillae, which are not present in larvae. Evans argued that the presence of antennal papillae is apomorphic within the Sphecidae (although he noted that Michener [1953] considered the presence of antennal papillae to be pleiomorphic for bees). If antennal papillae are apomorphic, they indicate that Entomosoricus could belong in a clade with Nyssoninae, Philanthinae, and Astationinae, although it should be noted that Evans [1959] hypothe-
Larval characters do not seem to solve the riddle of the phylogenetic placement of *Entomosericus*, but information about larval morphology should certainly be considered in any future phylogenetic analysis.

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