

## New Data on some *Rhithrogena* Species from the Near - and Middle East (Ephemeroptera; Heptageniidae)

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New data on some *Rhithrogena* species from Lebanon, Israel and Iran are provided. The nymph and egg of *Rh. znojko* (Tshernova, 1938) are described for the first time. A new species, *Rh. paulinae* sp.n., is described from the imaginal, nymph and egg stages, and its affinities are quoted. The systematic status of *Epeiron* Demoulin, 1964 is also discussed. On the basis of our material, as well as of the literature, evidence for the synonymy with *Rhithrogena* Eaton, 1881 is presented.

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### INTRODUCTION

Information on *Rhithrogena* in the Near - and Middle East is still fragmentary in spite of some recent papers devoted to the description of new species (Braasch, 1983; Kazanci, 1985; Kluge, 1983, 1987). In this geographic area, the situation is complicated by the difficulty to generically place species described in related genera, such as *Epeiron* Demoulin, 1964, or even *Epeorus* Eaton, 1881. In that sense, the story of *Ecdyonurus* (?) *znojko* Tshernova, 1938 is significant. This species was described within this genus with the following comment: " [sie ist] sehr eigenartig und [zeigt] keine nähere Verwandtschaft mit anderen Arten dieser Gattung." (Tshernova, 1938: p. 61). In 1973, Demoulin proposed to place this species in *Epeiron* which he established in 1964. In 1981, Tshernova placed the species in *Epeorus*. Finally, Thomas and Dia (1982) proved *znojko* to belong to *Rhithrogena*. This combination was not based exclusively on the morphology of the winged stages - as done by the previous authors - but mainly on the general morphology of the nymphs. Nevertheless, the nymphal stage of *Rh. znojko* is not described in detail. Thanks to the collaboration of Dr. A. Thomas (Toulouse)

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and Dr. A. Dia (Beyrouth), we give hereafter the description of the nymph of *Rh. znojkoï*.

### ***Rhithrogena znojkoï* (Tshernova, 1938)**

For a redescription of the winged stages, see Thomas and Dia (1982).

#### *Nymph*

Size: up to 9.5 mm for female nymphs; up to 8.2 mm for male nymphs.

General colour rather uniform, ranging from middle to dark brown, depending on specimens and their relative age. Sterna somewhat lighter than terga. Femora of all legs with a distinct small violet to red spot in middle of upper face.

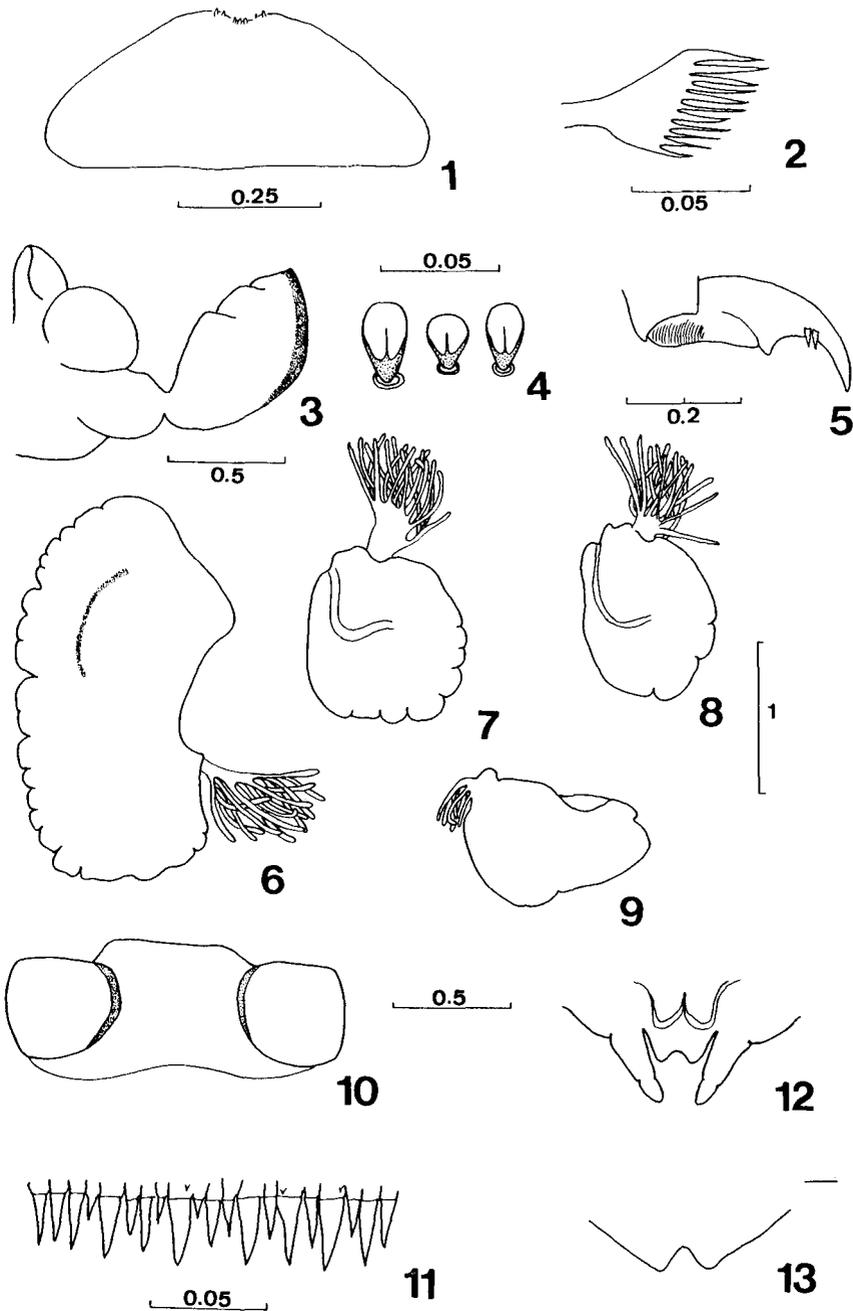
Labrum with a moderate median incision on anterior margin (Fig. 1); ratio width/length about 2.5. Middle combs of distal part of lacinia with 8-11 teeth (Fig. 2). Labial palp as in Fig. 3, with separation between each segment especially well marked on inner side. Spines on upper face of hind femora with divergent margins and rounded apex; some of them shorter and thicker, with almost truncate apex (Fig. 4). Tarsal claws generally with 2 teeth (Fig. 5). All gills with well developed tufted tracheal tubes. Gill I with medium size crenulations. Lamella without plica, but with a reinforcement (Fig. 6), as in species of the *Rh. alpestris* group (Sowa, 1984). Second gill rather quadratic, also crenulated (Fig. 7). Gills III-VI with less crenulations (Fig. 8), and gill VII almost entire (Fig. 9). First abdominal sternite with square lateral sclerites, their anterior margin perpendicular to body axis (Fig. 10). Central portion of posterior margin of abdominal tergum V with long and pointed teeth (Fig. 11). Submarginal denticles rare and barely visible even at a magnification of 600x. IXth sternite of male and female nymphs as in Figs. 12 and 13, respectively.

#### *Eggs*

Length: 145 - 160  $\mu\text{m}$ ; width: 75-90  $\mu\text{m}$ . General shape ovoid. A polar cap, with large knob-terminated coiled threads (KCT) present (Fig. 25). The whole chorion covered with same elements regularly arranged, but less numerous and smaller. Mesogranules present on exochorionic surface. These structures tooth-like and their tips directed towards opposite pole (Fig. 26).

Material: Lebanon, Nahr el Aouali: 3 nymphs (N), Jisr el Misri, 1050 m, 2.VI.1979; 2 N, Jisr Batloûn el Kharara, 980 m, 2.VI.1979. A. Dia leg. Israel, Hula Valley: numerous larvae and nymphs from the headwaters of the Jordan river (Baniyas and Dan rivers) (Sartori, in print).

Affinities: Very few *Rhithrogena* species are known in the nymphal stage from the area. By its distinctive features such as the shape of the first abdominal sternite, gills and mouthparts, *Rh. znojkoï* differs from all European species. By these criteria too, it can also be separated from *Rh. tianshanica* Brodsky and *Rh. brodskyi* Kustareva (Kustareva, 1976), as well as from *Rh. sibirica* Brodsky and *Rh. lepnevae* Brodsky (Sinitshenkova, 1973). Closer species are *Rh. eugeniae*



Figs. 1-13. *Rhithrogena znojki* (Tshernova, 1938), nymph. Scales in mm.

1, labrum; 2, middle-comb of lacinia; 3, labium; 4, spines on upper face of hind femora; 5, tarsal claw; 6, gill I; 7, gill II; 8, gill IV; 9, gill VII; 10, first abdominal sternite; 11, posterior margin of Vth abdominal tergite; 12, IXth abdominal sternite of male nymph; 13, IXth abdominal sternite of female nymph.

Kluge and *Rh. binerve* Kluge (Kluge, 1983, 1987). *Rh. znojko*i can be distinguished from the first one by the labrum, size of the dark spot on femora, as well as shape of the spines on the femora, and from the latter one by the dark spot on the femora (missing in *Rh. binerve*) and the shape of the first abdominal sternite.

In the Museum of Zoology in Lausanne, there is a small collection of Ephemeroptera collected more than thirty years ago in Iran by the caddisfly specialist F. Schmid. Among that material, some specimens related to *Rh. znojko*i were found. We give below the description of this new species.

### **Rhithrogena paulinae** sp.n.

#### *Male imago*

Body length: 8.2 mm; Fore wing: 8.5 mm; Cerci: 13.1 mm.

Face of head light brown; base of ocelli black; eyes large, beige dorsally, basal portion dark grey. Pro- and mesothoracic sclerites middle brown, metathoracic dark brown. Fore and hind wings translucent, except costal and subcostal fields of fore wing, milky. Pterostigmatic area with 9-11 transversal veins, usually not forked. Fore legs missing. Middle and hind legs uniformly light brown. A small but well marked spot in middle of upper face of femora. Tarsal claws asymmetrical. Hind tarsi with first segment less than twice as long as second one. Abdominal sterna and terga light brown, without any distinct colour pattern (maybe due to the long stay in alcohol). Cerci uniformly light brown .

Genitalia: Styliger plate with two well developed processes on posterior margin (Fig. 14). First segment of forceps with a slight internal projection on proximal area. Penes as long as broad. In ventral view, penis lobes regularly rounded at their apex (Fig. 15). No spine or titillators present. In dorsal view, genital gutter large and weakly sclerotized (Fig. 16). In caudal view, apical sclerite regularly curved, and without lateral broadening (Fig. 17).

#### *Female imago*

Body length: 7.9 - 8.1 mm; Fore wing: 9.0 - 9.2 mm; Cerci: 12.0 - 12.3 mm.

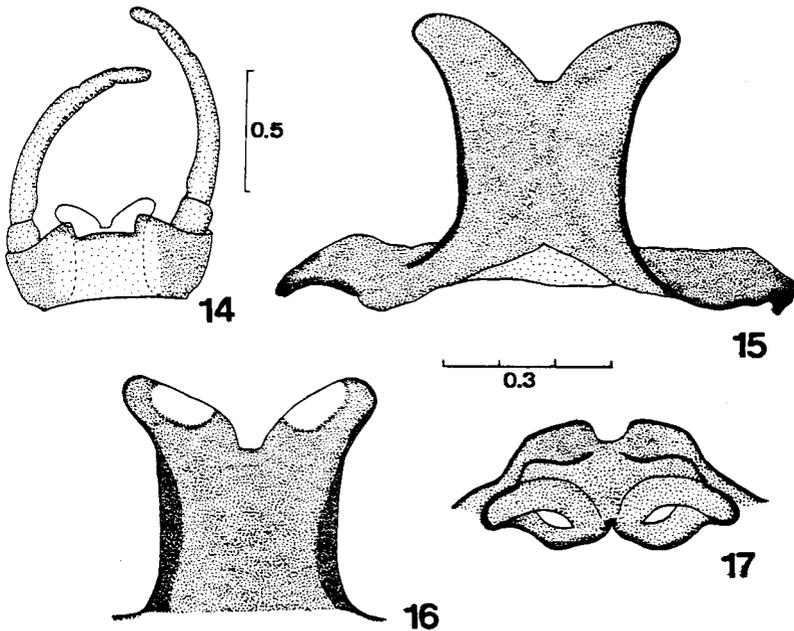
No distinct colour differences compared to male. Forewings colourless, except for pterostigmatic area milky. Femora of all legs with a small spot on middle of upper face. Tarsal claws and hind tarsi as in male. Posterior margin of the subgenital plate smooth, slightly convex. IXth sternite with a deep median incision. Cerci light brown.

*Subimagines* unknown.

#### *Nymph*

Size: up to 8.1 mm.

General colour very uniformly light brown. Sterna lighter than terga. Femora with a small sometimes barely visible dark spot in middle of area. Labrum with almost no incision on anterior margin, and very broad with a width/length ratio



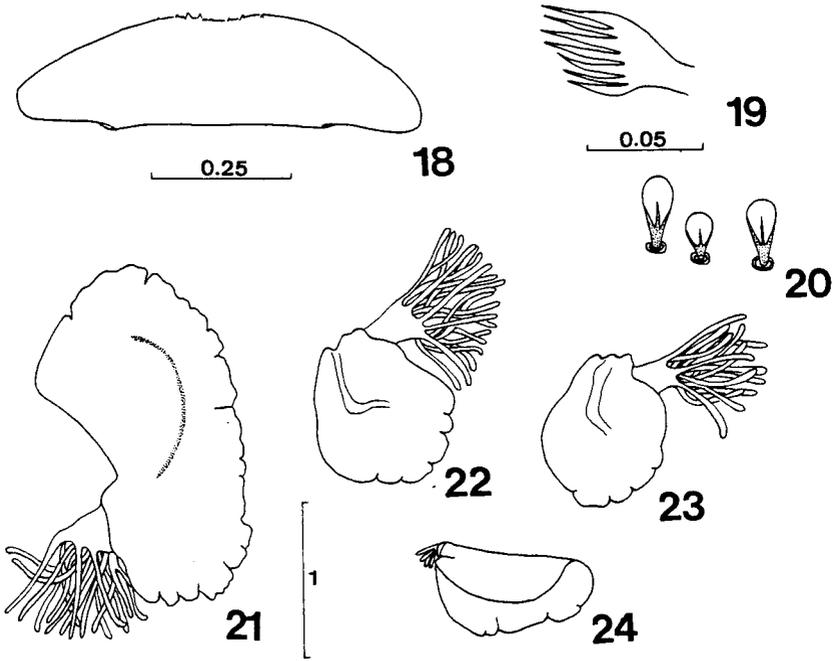
Figs. 14-17. *Rhithrogena paulinae* sp.n., male imago. Scale in mm.  
 14, genitalia in ventral view; 15, penes in ventral view; 16, penes in dorsal view; 17, penis lobes in caudal view.

of about 3.5 (Fig. 18). Mandibles somewhat narrower than in *Rh. znojkoii*. Middle combs of distal part of lacinia with 6-8 teeth (Fig. 19). Labium similar to that of *Rh. znojkoii*, separation between articles of labial palp less marked. Spines on upper face of hind femora with divergent margins and rounded apex (Fig. 20). Tarsal claw with 1 or 2 teeth. All gills crenulated and with well developed tufted tracheal tubes. Gill I with moderate crenulations; lamella without plica, but with a large and semicircular reinforcement (Fig. 21). Gills II, IV and VII as in figs 22-24. First abdominal sternite and central portion of posterior margin of abdominal tergite V as in *Rh. znojkoii*.

#### Eggs

Length: 170 - 200  $\mu\text{m}$ ; width: 115-130  $\mu\text{m}$ . General shape more ovoid than in *Rh. znojkoii* (Fig. 27). Polar cap and KCT as in *Rh. znojkoii*. Tooth-like mesogranules also present but less numerous than in previous species (Fig. 28).

Material: 1 male imago holotype: Iran, Elburz Mountain, Sefid Khok, 2200 m, 1.VI.1956, F. Schmid leg.; 4 females and 2 nymphs (penultimate larval stage) paratypes, same data as above. Material kept in 75° alcohol, except for the holotype and one nymphal paratype partly on microscopic slides. The material is housed in the Museum of Zoology, Lausanne.

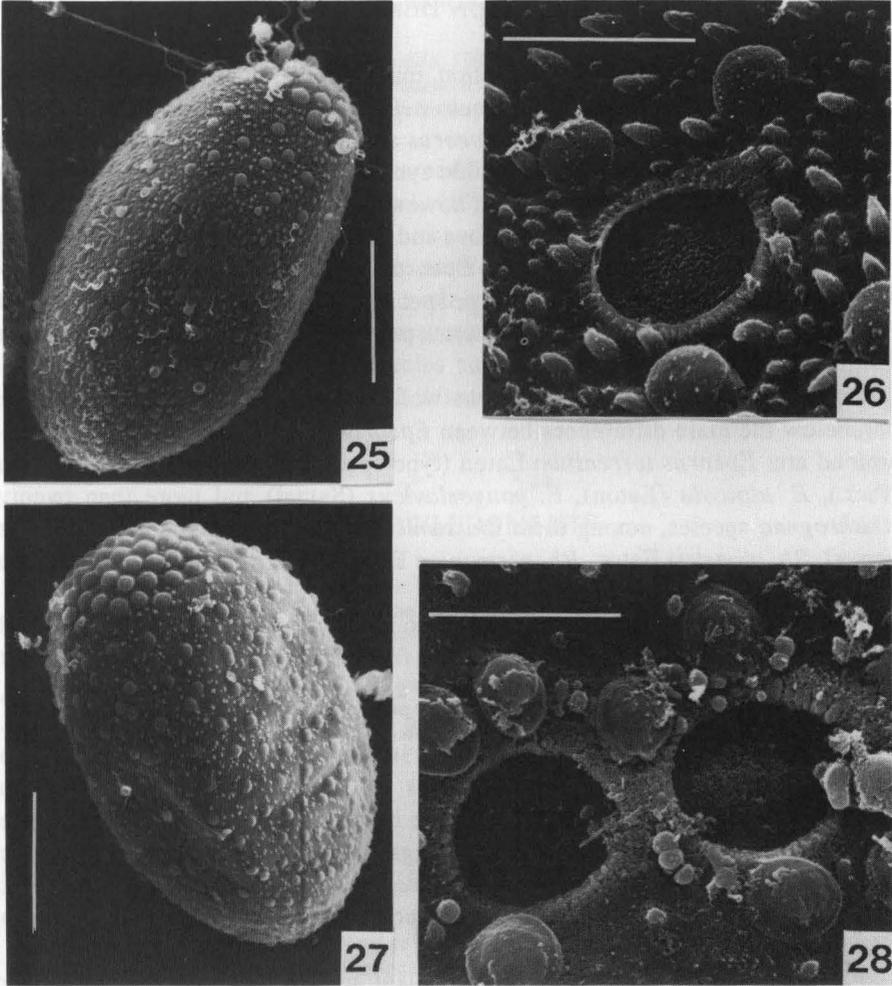


Figs. 18-24. *Rhithrogena paulinae* sp.n., nymph. Scale in mm.

18, labrum; 19, middle-comb of lacinia; 20, spines on upper face of hind femora; 21, gill I; 22, gill II; 23, gill IV; 24, gill VII.

Other material collected at the same place by Schmid includes two stonefly species: *Perlodes microcephalus* (Pict.) and *Amphinemura mirabilis* (Martynov) (Aubert, 1964).

**Affinities:** In the imaginal stage, *Rh. paulinae* n. sp. closely resembles *Rh. znojkoii*. It can be distinguished by the general shape of the penis (longer in *Rh. znojkoii*) and mainly by the shape of the apical sclerite (distinctly broader laterally in *Rh. znojkoii*; see Thomas and Dia, 1982, Fig. 6). *Rh. paulinae* also has some affinities with other species such as *Rh. eugeniae* Kluge, *Epeiron amseli* Demoulin, *E. kashmiriensis* Braasch and Soldán and *E. uzbekistanicus* Braasch and Soldán. It can be separated on the basis of the styliiger plate, penes lobes or size of the spot on the femora. In the nymphal stage, *Rh. paulinae* resembles *Rh. znojkoii*, but is easy to separate on the basis of gill crenulations, shape of the labrum and combs of the lacinia. It presents no clear affinities with the nymphs of *Rh. eugeniae*, *Rh. binerve*, *Rh. tianshanica*, *Rh. sibirica* or *Rh. lepnevae*. Some common features are found also with *Rh. minima* Sinitshenkova and *Rh. asiatica* Sinitshenkova (Sinitshenkova, 1973) concerning gills or labrum, but can be distinguished quite easily by the shape of the first abdominal sternite, the tarsal claws and the spines on the femora.



Figs. 25-28. *Rhithrogena znojki* (Tshernova, 1938) (25 and 26) and *Rhithrogena paulinae* sp.n. (27 and 28), eggs. 25, 27, general shape of egg (scale: 50  $\mu$ m); 26, 28, detail of exochorion, with micropyle (scale: 10  $\mu$ m). Critical point drying, gold coated, 25 kV, JEOL JSM-35.

WHAT IS *EPEIRON* DEMOULIN, 1964 ?

As already mentioned in the introduction, much confusion has arisen concerning the taxonomic concept of the genus *Epeiron*. In the original description, Demoulin (1964) quoted some affinities with *Epeorus* as well as with *Cinygma*. Tshernova (1974) considered *Epeiron* as a possible synonym of *Epeorus*, but carefully established no explicit synonymy. In 1981 however, she placed *Ecdyonurus* (?) *znojko*i in the genus *Epeorus*. In 1982, Tshernova and Belov removed the species *Cinygma tibiale* Ulmer from this latter genus to *Epeorus*, and claimed a possible synonymy with *Epeiron amseli* Demoulin, the type species of *Epeiron*. Finally, Kazanci and Braasch (1988), on the basis of new material, proposed the combination *Rhithrogena tibialis* (Ulmer).

Based on the existing literature, as well as on our own material, we give herebelow the main differences between *Epeorus* and *Rhithrogena*. Species examined are: *Epeorus torrentium* Eaton (type-species of the genus), *E. sylvicola* (Pict.), *E. alpicola* (Eaton), *E. yougoslavicus* (Šamal) and more than twenty *Rhithrogena* species, among them *Rh. semicolorata* (Curt.) (type species of the genus), *Rh. alpestris* Eaton, *Rh. germanica* Eaton, *Rh. loyolaea* Nav., *Rh. nivata* Eaton, *Rh. beskidensis* Alba and Sowa.

Nymphs belonging to *Epeorus* have two cerci but no terminal filament, and the apex of the galea-lacinia is covered with fine hairs and movable teeth; whereas *Rhithrogena* nymphs have two cerci with a well-developed terminal filament, and the apex of the galea-lacinia is covered with pectinate spinules and combs. The shape of the first abdominal sternite is also different between these two genera. In male imagines, fore leg claws of *Epeorus* are alike, whereas in *Rhithrogena* these claws are different, one being hooked, the other one obtuse (Eaton, 1881, 1885). Finally, *Epeorus* eggs have no well defined chorionic structure and no polar cap, whereas *Rhithrogena* eggs have generally complex exochorionic structures such as KCT and polar cap (Degrange, 1960; Smith in Needham *et al.*, 1935).

All these characters prove that *Rh. znojko*i and *Rh. paulinae* are the proper combinations for these two species. Moreover, we fully agree with Thomas' and Dia's (1982) statement about *Rh. znojko*i: "Rien ne s'oppose au classement de ces genitalia très simples dans l'ensemble morphologique du genre *Rhithrogena*." (p. 301).

Based on our study of *Epeorus* and *Rhithrogena*, we propose the following synonymy:

*Epeiron* Demoulin, 1964 = *Rhithrogena* Eaton, 1881 syn. nov.

This synonymy has already been proposed in an implicit way by Kluge (1987).

Consequently, the following new combinations are given:

*Epeiron amseli* = *Rhithrogena amseli* (Demoulin, 1964) comb. nov.

*Epeiron uzbekistanicus* = *Rhithrogena uzbekistanica* (Braasch and Soldán, 1982) comb. nov.

*Epeiron kashmiriensis* = *Rhithrogena kashmiriensis* (Braasch and Soldán, 1982) comb. nov.

Other species related to *Rh. znojkoii* are: *Rh. tibialis* (Ulmer, 1920); *Rh. eugeniae* Kluge, 1983; *Rh. anatolica* Kazanci, 1985; *Rh. binerve* Kluge, 1987 and *Rh. paulinae* nov. sp.

On a geographical point of view, *Rh. paulinae* occupies an intermediate position between caucaso-levantine species such as *Rh. tibialis* (Turkey), *Rh. anatolica* (Turkey), *Rh. znojkoii* (Turkey, Transcaucasus, Lebanon, Syria, Israel), *Rh. binerve* (Caucasus), and Middle Asian species such as *Rh. amseli* (Afghanistan), *Rh. kashmiriensis* (Kashmir), *Rh. uzbekistanica* (Uzbekistan) or *Rh. eugeniae* (Tadjikistan).

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