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New Representatives of the *Rhithrogena diaphana*-Group from Continental Europe, with a Redescription of *R. diaphana* Navás, 1917 (Ephemeroptera: Heptageniidae)

by

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ALBA-TERCEDOR, J. and R. SOWA: New Representatives of the *Rhithrogena diaphana*-Group from Continental Europe, with a Redescription of *R. diaphana* Navás, 1917 (Ephemeroptera: Heptageniidae).

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The winged stages of *Rhithrogena diaphana* Navás, 1917 are redescribed and drawn on the basis of fresh material collected not far from the type-locality. The winged stages, the eggs and nymphs of three new species of the *diaphana*-group are also described and illustrated: *R. beskidensis* sp.n., *R. marcosi* sp.n. and *R. savoienis* sp.n. General remarks on the distribution and the biology are presented and the features distinguishing male adults and nymphs of these species from the other known species of the *diaphana*-group are keyed.

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Rhithrogena diaphana Navás was described from male specimens caught July 7th, 1915 in the N.W. of Spain (ca. 750 m, Humoso, Viana del Bollo, prov. Orense). The original description by Navás (1917) was incomplete and since then the species has never again been collected or redescribed from the type-locality.

Thomas (1968) published some drawings of the genitalia, lateral pattern of 3rd and 4th abdominal segments and the basal part of intermediate legs of a dry syntype. This specimen, a male imago, was designated lectotype by Thomas, and is now at the Museo Municipal de Zoología, Barcelona, Spain (see Alba-Tercedor & Peters, 1985). Moreover, Thomas proposed synonymy between *R. diaphana* Navás and *R. aurantiaca* sensu Eaton (1885) (nec *Baetis aurantiacus* Burmeister, 1839 = *Ecdyonurus aurantiacus* (Burm.) - see Puthz, 1973). The latter species was thought to inhabit Central Europe and was recorded by many researchers (Klapálek, 1909; Ulmer, 1929; Schoenemund, 1930; Mikulski, 1936; Landa, 1969). The synonymy proposed by Thomas was also accepted in zoogeographical and biological papers on *R. diaphana* (Puthz, 1978; Sowa 1975a, 1975b).

Recently, Belfiore (1983a) described *R. adrianae*, a new species of the *diaphana*-group, and Sowa (1984) included in this group two more species

described by Navás: *R. cincta* Navás, 1921 and *R. oscensis* Navás, 1927. Of both, only insufficiently described adults from northeastern Spain are known (Thomas, 1968; Alba-Tercedor & Peters, 1985).

We have had the opportunity to study in Kraków abundant material of the *diaphana*-group, part of it fresh, especially from France, Spain and Poland. Some still undescribed species were found, which would be identified as *R. diaphana* Nav. with presently available descriptions.

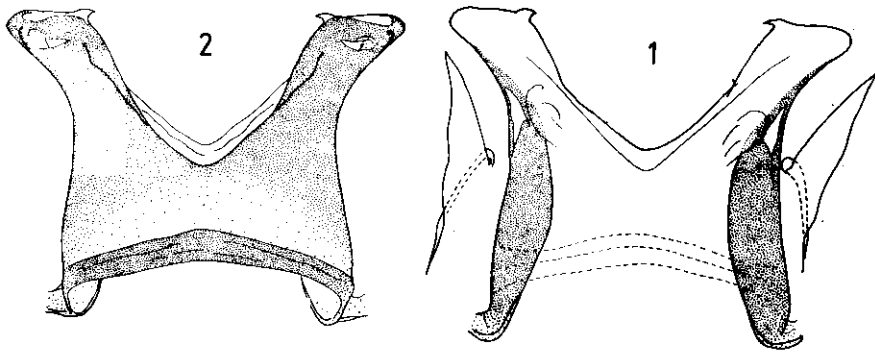
The purpose of this paper is to redescribe Navás' genuine *R. diaphana*, and to describe the related new species. The redescription offered here is based on fresh material collected not too far from the type-locality of *R. diaphana*, and in the same hydrographical basin (river Avia, Leiro, the basin of the river Mino, prov. Orense, Spain). Our specimens fit the descriptions by Navás (1917) and Thomas (1968) well, and we think that they are genuine *R. diaphana* Navás.

Finally, we considered it useful to include here for comparison some drawings of male genitalia of *R. adrianae* Belfiore, from a paratype from R. Mignone, Lazio, Oriolo, Italia, 31-V-1980, leg. and det. C. Belfiore. All material is preserved in 75% alcohol and partially also mounted as microscopic preparations.

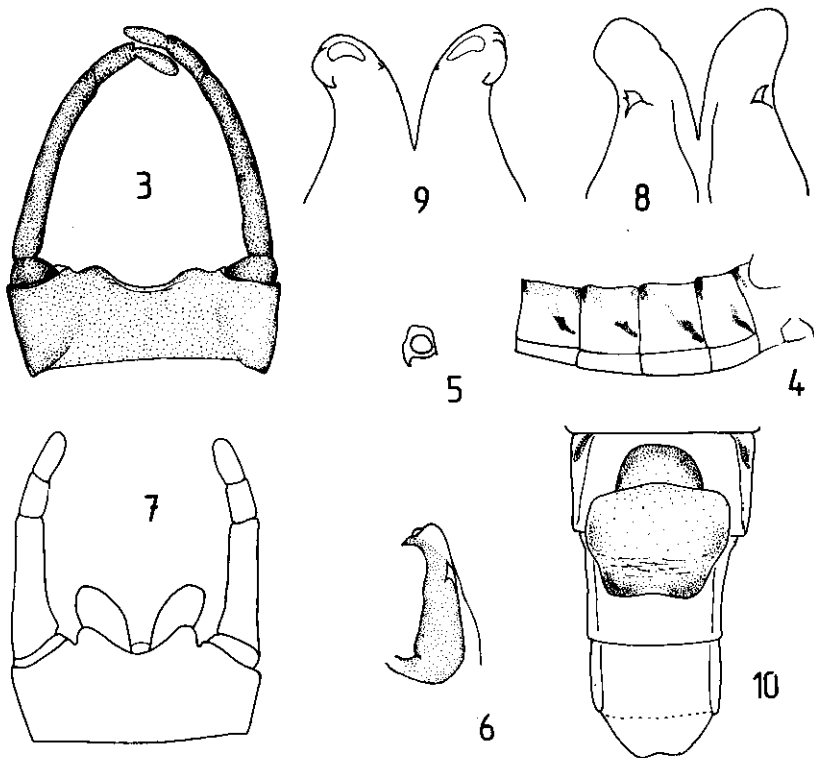
***Rhithrogena diaphana* Navás, 1917**

Male imago. Body length: 7-7.5 mm, forewings: 7-7.5 mm, cerci: 13 mm. General colour of body light, yellow-brown, with contrasting blackish markings. Head with a transverse stripe at the level of base of antennae. Compound eyes blackish, moderately high and globular. Lateral edges of pronotum obscure. Lateral parts of thorax: on the mesonotum, three violaceous stripes before the wing base, a small violaceous stripe before the basal part of intermediate and hind coxae. Ventral part of thorax: between the head and prosternum and between the prosternum and mesosternum obscured by a violaceous stripe. A blackish dot on the external face of intermediate and hind coxae. In front of the hind coxae and behind the intermediate coxae a small blackish stripe on each side of thorax. Legs pale, yellow-brown; fore legs a little darker. All femora with a distinct small blackish dot. On the ventral side of each fore femur, a similar but smaller dot. Wings hyaline; veins almost uniformly light-brown. In the forewings the subcosta and the radius a little paler. Stigmatic area whitish, with indistinct cross-veinlets. The big transversal vein between C and R at wing base pale, but dark in the vicinity of Sc and R. Lateral part of abdominal segments 2 to 8 with a dark band directed obliquely upwards, paler and wider in its dorsal part (Fig. 4). Nerve ganglia not pigmented. Cerci light brown, darker and slightly ringed in the basal part.

Genitalia: styliger uniformly light-brown, forceps darker, brown. Length of hind expansions of styliger variable, clearly bent downwards (Fig. 3). Penial lobes divergent and truncated at the ends. Internal tooth of lobe clearly visible from the ventral side. In contrast, the external one is not visible from that side (Fig. 1). Vesicular part of the penis at the level of titillators small, poorly devel-



Figs. 1-2: *Rhithrogena diaphana* Navás, male imago: 1, penis and titillators in ventral view; 2, penis in dorsal view.



Figs. 3-10: *Rhithrogena diaphana* Navás, male imago (3-6), male subimago (7-9) and female imago (10): 3, styliger and forceps; 4, anterior part of abdomen in lateral view; 5, apical part of penial lobe in caudal view; 6, penis in lateral view; 7, genitalia in ventral view; 8 and 9, part of penis in ventral and dorsal view; 10, posterior part of abdomen in ventral view.

oped. Titillators pointed, triangular (Fig. 1). Dorsal surface of penial lobes with a longitudinal fold on the sclerotised area (Fig. 2). The shape of the lobe in lateral view and its caudal view are presented in Figures 6 and 5, respectively.

Female imago. Body length: 7.5 mm; forewing: 8.5 mm, cerci missing. General colour of body and arrangement of dark dots on head, thorax and legs similar to male. Hind margin of head shaded. Wing colouration similar to that of male. Darkish bands of abdominal segments shorter than those of the male and not clearly extended dorsally. Hind margin of the first two tergites with a dark transverse band, the remaining tergites light. The ventral view of the terminal part of the abdomen is shown in Figure 10.

Male subimago. Body length and length of forewing: 7.5 mm, cerci: 8 mm. Body light grey. Arrangement of dots and dark pigmentation of head, thorax, legs and of abdomen as in the adults. Wings uniformly greyish, with the veins pronounced. The genitalia are shown in Figures 7-9.

Female subimago. Body and forewing length: 8.5 mm. Cerci missing. General colouration as in the male subimago. Abdominal bands similar to those of the male subimago.

Egg. Length ca. 230 μm , width ca. 120 μm . Egg oval, slightly narrower at the poles. Polar cap on one pole only, extending over a rather small area. On the opposite pole the adhesive elements (= a.e.) are smaller and their size is similar to that of the a.e. situated in the central part of the egg. Chorionic surface with pectinate structures (Fig. 64-66). These structures are arranged in rows along the egg and each one is composed of many obtuse and curved teeth (mace-shaped or obtuse in the apical part). The pectinate structures are flat on the surface or are raised obliquely towards the pole without polar cap. Micropyle surrounded by mace-shaped elements. Between the pectinate structures the chorionic surface is smooth. On the pole with polar cap there are roughly conical granulations, sometimes divided (Fig. 65), which are smaller on the opposite pole.

Nymph unknown.

Material: 4 ♂♂ imagines, 1 ♂ subimago, 1 ♀ imago, 1 ♀ subimago, river Avia, Leiro, prov. Orense, SPAIN, 120 m, 12-VII-1979. Leg. Marcos Gonzalez.

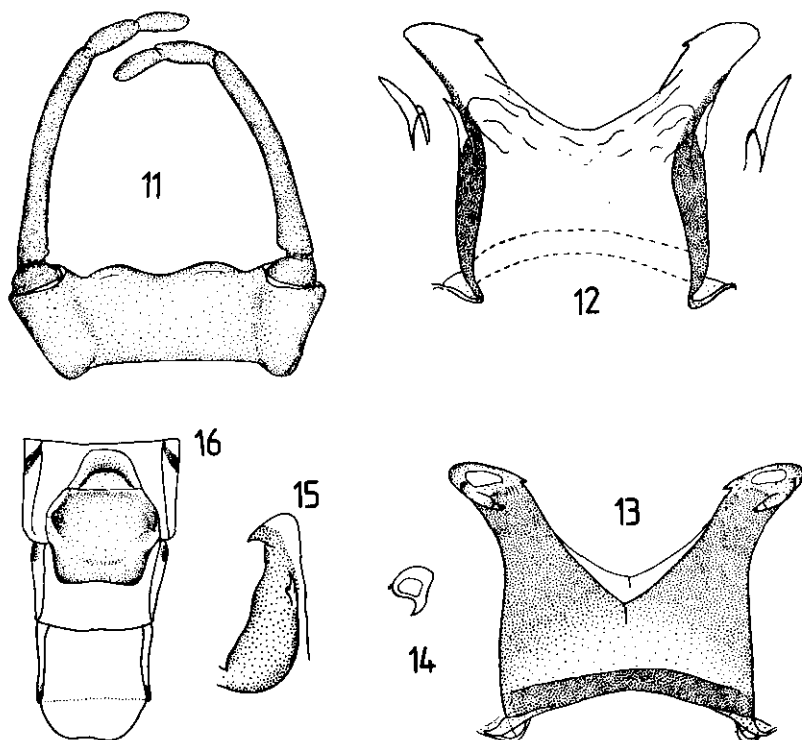
Rhithrogena beskidensis sp.n.

Male imago. Body length: 7.5-8 mm, forewings: 8-9 mm, cerci: 15-16 mm. General colour of body darker than that of *R. diaphana*: light-brown, with a wine-red or pink tint. Arrangement of dark dots on head, thorax, legs and on abdomen very similar to that of *R. diaphana*, but with the following differences: dot on coxae is larger and oblique bands of abdominal segments are more distinct on dorsal surface of segments than in *R. diaphana* and are still fairly dark where they meet. Wings hyaline; in forewings the longitudinal veins are uniformly brown with the proximal part of the costa a little darker.

Genitalia: Hind expansions of styli short and slightly bent downwards. Styli surface light-brown, forceps brown (Fig. 11). Penial lobes divergent, in comparison with lobes of *R. diaphana* their apex is sharper, and the internal tooth is smaller and situated more subapically (Fig. 12). Titillators pointed, narrower than those of *R. diaphana*. In dorsal view, the entire apical surface and gonoporus clearly visible (Fig. 13). There is no longitudinal fold on the sclerotised part of the lobes. In Figures 14 and 15, the lobe is presented in caudal and lateral views, respectively.

Female imago. Body length: 7-7.5 mm, forewings: 8-8.5 mm, cerci: 10-11 mm. General colour of body similar to that of male. Hind margin of head darkish. The subgenital plate and some abdominal segments in ventral view are shown in Figure 16.

Subimagines unknown.

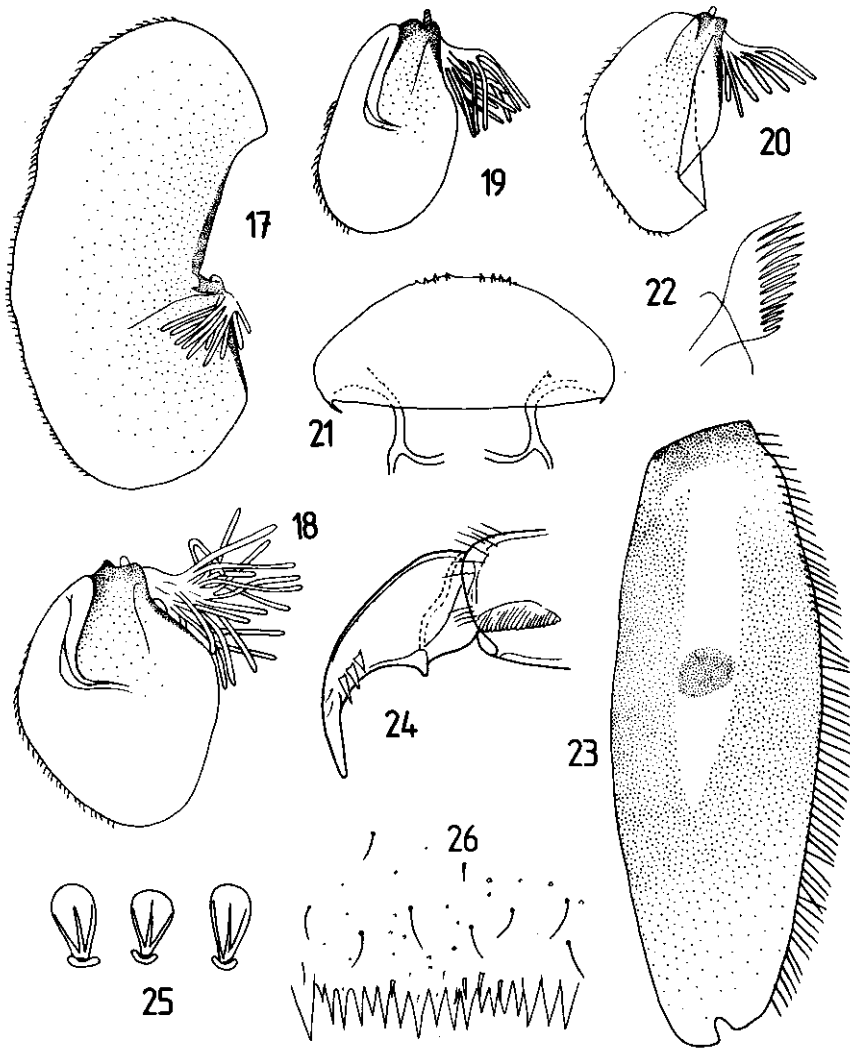


Figs. 11-16: *Rhithrogena beskidensis* sp.n., male imago (11-15) and female imago (16): 11, styli and forceps; 12, penis and titillators in ventral view; 13, penis in dorsal view; 14, apical part of lobe in caudal view; 15, penis in lateral view; 16, posterior part of abdomen in ventral view.

Egg. Length ca. 180 μm , width ca. 100 μm . Outline oval. The longest adhesive elements on one of the poles form the polar cap which extends over a large area (Fig. 67). On the opposite pole the a.e. are sparse and small, similar to those situated in the central part of egg. Chorionic surface with conical outgrowths, which tend to be grouped. Near the polar cap, the conical outgrowths form crowns, but further from the cap they appear as longitudinal rows, while near the opposite pole they are grouped in irregular clusters (Figs. 68 and 69). The conical outgrowths are erect and inclined towards the pole without a cap. On the chorionic surface fairly small and sparse granules can be seen between the groups of conical outgrowths. The margins of micropyles are somewhat notched externally.

Nymph. Body length: 7.5-9 mm, length of tails: 6-7 mm. Colouration dark-brown, olivaceous, with yellowish spots. Head dark brown, two dark spots in front of the middle ocellus. Pronotum with a yellowish spot on each anterior angle. 1st and 2nd abdominal tergite yellowish, 3rd to 8th dark brown with a yellowish transverse area on the hind part of each. 9th tergite completely or almost completely yellowish, 10th tergite uniformly dark brown. Tails uniformly pale, with filiform segments. Sternites 2 to 8 with light lateral parts and each with a rectangular spot in its central part, clearly marked by the transverse narrow sclerotisation. A small, but clearly marked darkish dot on the dorsal surface of each femur. In the forelegs, there is also a similar but smaller dot on the ventral surface of femora. This arrangement of marks is carried on from mature nymphs to the winged stages. The head is quite narrow, rounded; in dorsal view, a projecting part of maxillary palp can be observed on either side of the head. Labrum narrow, with distinct anterior teeth (Fig. 21). Comb-shaped bristles on distal part of lacinia with 10-13 teeth (Fig. 22). Few spines on the dorsal surface of femora; those on the central part of the hind femora are shown in Figure 25. A row of spines along the central surface of the hind tibiae with no more than 5 elements. Tarsal claw generally with three well developed denticles (Fig. 24). Posterior margin of middle abdominal tergites irregularly dentate in central part, with few supplementary microdenticles (Fig. 26). Lateral sclerites of first abdominal sternite short but wide, its hind part not clearly separated from the rest of sternite, its anterior margin clearly pointing backwards. Margins of all gill lamellae glabrous (Fig. 17-20). Lamella of 1st gill long, fine without any fold or enlargement on internal surface. Lamella of 2nd gill slightly rhomboid, with a central reinforcement curved at a right angle (Fig. 18). Lamella of 6th gill spatulate, with parallel margins (Fig. 19). Segments of tails practically glabrous.

In the above description a large number of features are included which are also valid for the other species considered here. In the following descriptions the distinctive characteristics of individual species will therefore be especially emphasized.



Figs. 17-26: *Rhithrogena beskidensis* sp.n., nymph: 17-20, first, second, sixth and seventh abdominal gill; 21, labrum; 22, one of the comb-shaped bristles from maxillary lacinia; 23, hind femur; 24, claw of fore leg; 25, spines from the central part of hind femur; 26, central part of fifth abdominal tergite.

Material: POLAND: Holotype ♂ imago, paratypes: 17 ♂♂, 10 ♀♀ imagines, stream Białka below Białka Tatrzańska, Podhale, 620 m, 27-VIII-1971; 23 nymphs, river Raba at Bochnia, 220 m 27-VI-1970. Leg. R. Sowa.

The holotype and most of the paratypes in R. Sowa's collection, other paratypes in J. Alba-Tercedor's collection. For other quotations from southern Poland see Sowa (1975a, sub *R. diaphana* Navás).

Etymology: the name is derived from the Beskidy mountains where this species is widely distributed.

Affinities: The new species is very close to *R. diaphana* Navás. The penis differs a little in ventral, dorsal and lateral views and especially in the position of the internal tooth of the penial lobe, which is much more subapical in the present species. The anterior part of the subgenital plate of the female imago, and the structure of the egg chorion are also different.

***Rhithrogena marcosi* sp.n.**

Male imago. Body length: 8-9 mm, forewings: 8.5-9 mm, cerci missing. General colour of body similar to *R. diaphana*, but the three oblique stripes before the base of the forewing are not clearly visible and the violaceous shading between the head and the prosternum and between prosternum and mesosternum is practically invisible. Legs, fragments of cerci and forewings similar to *R. diaphana*. Cross veinlets of pterostigma clearly visible.

Genitalia: Styliger light brown, paler in central part. Forceps dark brown. Size of hind expansions of styliger variable (Fig. 27). Penial lobes more divergent than in remaining species (Fig. 30 and 31). Vesicles situated at the base of lobes well developed, but extending for less than half the internal length of the lobes. External subapical tooth of penial lobes situated more laterally than in the previous species (Fig. 31). Titillators narrow, often with irregular outlines. Shape of penial lobe in caudal and lateral views is shown in Figures 28 and 29, respectively.

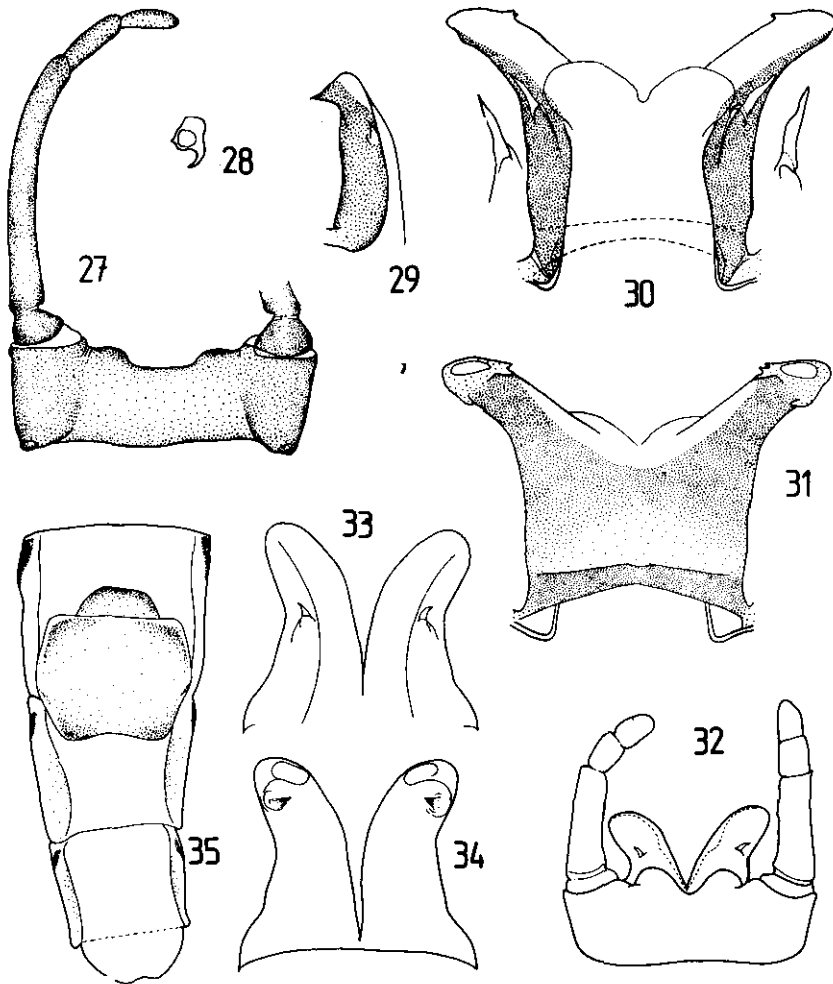
Female imago. Body length: 7-8.5 mm, forewings: 8-8.5 mm, cerci: 13 mm. General colour of body similar to male imago but paler. Arrangement of spots on head, thorax, legs and abdomen similar but the oblique bands on abdominal segments are shorter. Wing venation and colour of cerci similar. The subgenital plate with some abdominal segments in ventral view is presented in Figure 35.

Male subimago. Body length: 9 mm, forewings: 9.5 mm, cerci: 14 mm. Pattern and arrangement of dots like in the adult stage. Forewings rather dark with distinct venation. Cerci darker in basal part close to the insertion. The genitalia are presented in Figures 32-34.

Female subimago unknown.

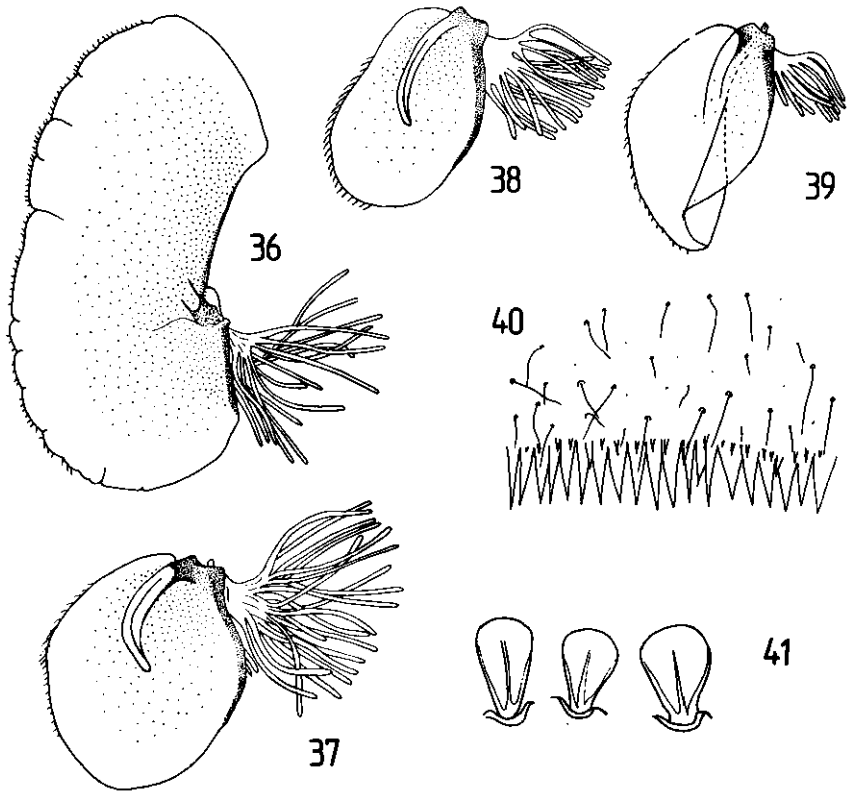
Egg. Length ca. 190 μ m, width ca. 115 μ m. Egg oval, fairly wide. Polar cap on one pole extending over a large area. Adhesive elements on the opposite pole similar, similar to a.e. situated on central part of chorionic surface. Surface of egg with numerous conical outgrowths directed towards the pole without polar cap. The conical outgrowths tend to form groups across the egg surface. Between those groups, small sparse granules can be seen on the chorionic surface (Fig. 70-72).

Nymph. Body length: 8-9 mm, length of tails: 7-8 mm. General colour and arrangement of dark spots on the body similar to *R. beskidensis* but even more contrastive. Pronotum with a yellowish spot on each anteriolateral angle and



Figs. 27-35: *Rhithrogena marcosi* sp.n., male imago (27-31), male subimago (32-34) and female imago (35): 27, styli and fragment of forceps; 28, apical part of penial lobe in caudal view; 29, penis in lateral view; 30, penis and titillators in ventral view; 31, penis in dorsal view; 32, genitalia in ventral view; 33-34, penis in ventral and dorsal view; 35, posterior part of abdomen in ventral view.

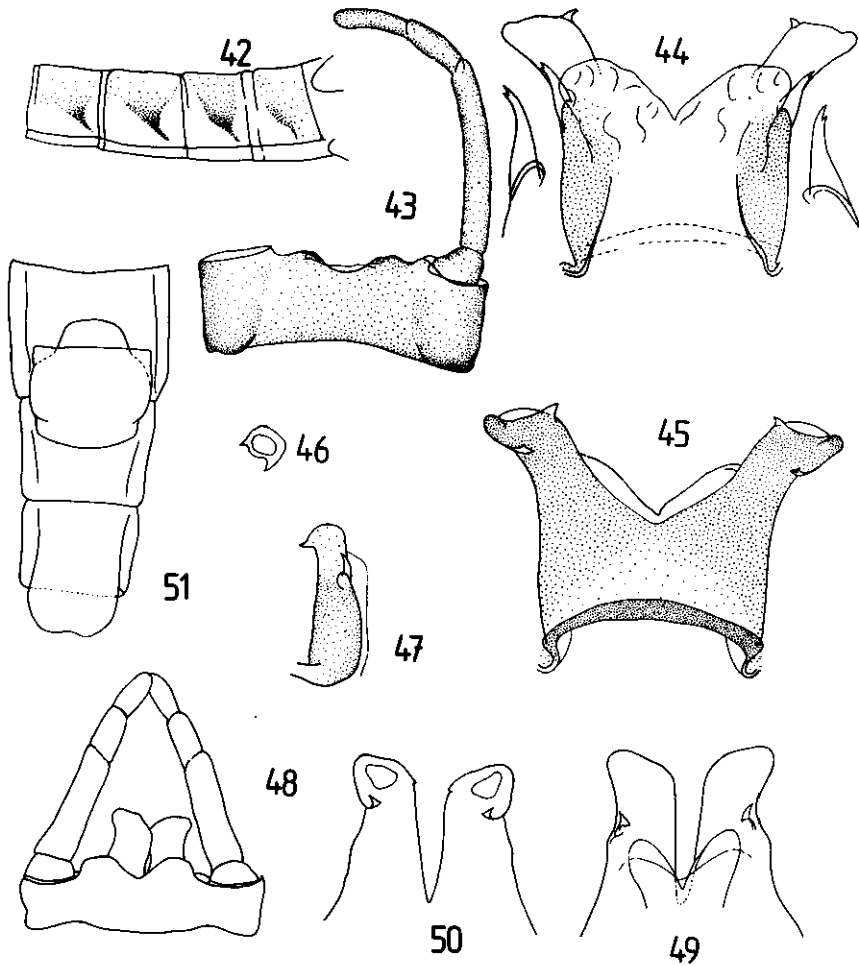
with a yellowish transverse band on the posterior margin. Mesonotum brighter in the central part. 1st to 3rd abdominal tergites bright in the middle, 4th to 8th tergites dark with a narrow yellowish band along the posterior margin, most of the posterior half of 9th tergite light, 10th tergite dark. Sternites without distinct dark spots. In the pattern of most sternites, oblique lines and dark transverse reinforcements can be observed. Tails dark, with segments of the distal half



Figs. 36-41: *Rithrogena marcosi* sp.n., nymph: 36-39, first, second, sixth and seventh abdominal gill, 40, central part of fifth abdominal tergite; 41, spines from the central part of hind femur.

bicolourous and slightly moniliform. Labrum and comb-shaped bristles situated in the middle of the distal part of lacinia similar to *R. beskidensis*. Spines from the central part of the dorsal surface of hind femora are shown in Figure 41. Tarsal claw with three denticles. Hind margin of intermediate abdominal tergites with fairly irregular teeth and with numerous submarginal micro-denticles (Fig. 40). Lamella of 1st gill with few and shallow incisions (Fig. 36). Lamella of 2nd gill rounded, with central reinforcement slightly curved (Fig. 37). 6th and 7th gills are shown in Figures 38 and 39.

Material: SPAIN, holotype ♂, paratypes: 2 ♂♂ imagines, 2 ♀♀ im., river Aguas Blancas, Sierra Nevada, prov. Granada, 800 m; 26-VI-1979. Other material: 6 nymphs, ditt., 6-X-1982; 1 ♂ im., 1 ♂ subim., 1 ♀ im., 2 ♀♀ subim. 1 nymph, 3 nymphal skins, ditt., 9-XI-1982; 1 ♂ im., ditt., 1140 m, 22-VI-1979; 1 ♂ im., 3 ♀♀ im., ditt., 21-VIII-1979; 1 ♂ im., river Genil, Sierra Nevada, Granada, 700 m, 23-X-1980; 2 ♂♂ subim. with nymphal skins, stream Bayárcal, Sierra Nevada, Granada, 560 m, 10-VII-1984; 2 nymphs, stream Laroles, 1800 m, 10-VI-1984. Leg Alba-Tercedor.



Figs. 42-51: *Rhithrogena savoiensis* sp.n., male imago (42-47), male subimago (48-50) and female (51): 42, anterior part of abdomen in lateral view; 43, styli and fragment of forceps; 44, penis and titillators in ventral view; 45, penis in dorsal view; 46, apical part of penial lobe in caudal view; 47, penis in lateral view; 48, genitalia in ventral view; 49-50, penis in ventral and dorsal view; 51, posterior part of abdomen in ventral view.

The holotype, the paratypes and most other material are kept in J. Alba-Tercedor's collection, the remaining specimens in R. Sowa's collection.

Etymology: This species is named in honour of Dr. Marcos Gonzalez from Santiago de Compostela University.

Affinities: *R. marcosi* n.sp. is very close to the two species described above but can easily be distinguished from these by the general shape of penial lobes which are more divergent and by the outline of the terminal part of the penial lobe in ventral, lateral and caudal views. The new species also differs from *R. beskid-*

sis in the nymphal stage: segments in terminal half of tails bicolourous and moniliform, lamella of 1st gill with festoons and lamellae of 2nd to 6th gill with central reinforcement slightly curved. The structure of egg chorion is also different in *R. marcosi*.

***Rhithrogena savoiensis* sp.n.**

Male imago. Body length: 7-8 mm, forewings: 7.7-8.5 mm, cerci: 13-15 mm. General colour of body pale, yellow-brown. General arrangement of dark spots similar to those in the three previously described species, but the spots are often blurred, not clearly visible or even absent, except for those on the dorsal surface of femora which are well marked. The lateral oblique bands on abdominal segments are often absent or not well visible. When visible, they are narrow in their basal part (Fig. 42). Wings hyaline, venation of forewings light brown. Transverse veins barely visible, also in pterostigmatic area. Abdominal segments slightly transparent. Cerci pale.

Genitalia: Styliger and forceps light-brown. Hind expansions of styliger rather small and bent downwards (Fig. 43). Penial lobes moderately divergent. Apical outline of lobes somewhat irregular with the external area prominent (Fig. 44 and 45). Vesicles at the basis of penial lobes well developed, exceeding half of the internal length of the lobe (Fig. 44), and overlapping part of the titillators. Titillators narrow, often bidentate (Fig. 44). The penial lobe in caudal and lateral views is shown in Figures 46 and 47, respectively.

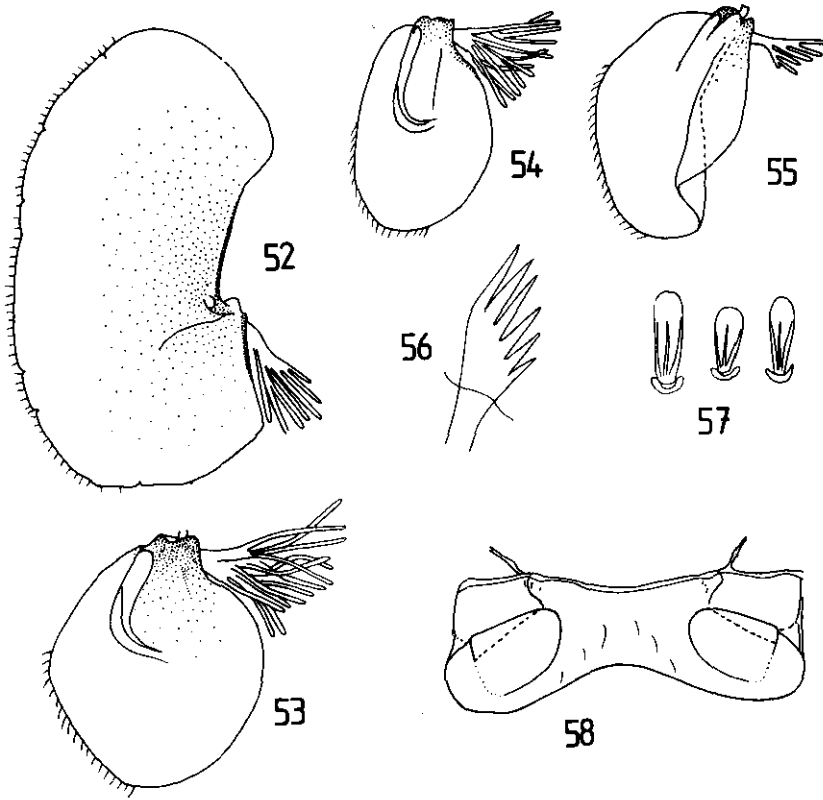
Female imago. Body length: 8-9 mm, forewings: 8.5-9.5 mm, cerci: 10-12 mm. General colour of the body lighter than in the male. Dark spots generally blurred or absent. Wings hyaline, cerci light. The terminal part of abdomen in ventral view is shown in Figure 51.

Male subimago. Body length: 7-7.5 mm, forewings: 7-8 mm, cerci: 6-8 mm. Body light, grey-yellowish. Arrangement of dark spots as in the male imago. Forewings grey-yellowish. Veins faintly marked. Genitalia as in Figures 48-50.

Female subimago. Body length: 7-8.5 mm, forewings: 8-9 mm, cerci: 5.5-7 mm. General colour of body and forewings similar to male subimago.

Egg. Length: ca. 180 μm , width: ca. 115 μm . Egg oval, with polar caps on both poles. On the wider pole the adhesive elements are longer and extend further. Except for the poles the chorionic surface is covered by tufts of outgrowths surrounding the a.e. (Fig. 73-75). Between the tufts, the chorionic surface is practically glabrous.

Nymph. Body length: 7-8.5 mm, length of tails: 6-7 mm. General colour of body brown, but paler than in the previous species. Mouthparts similar to those in *R. beskidensis* and *R. marcosi* but the comb-shaped bristles in the middle of the distal of the lacinia carry 5-7 teeth (Fig. 56). Spines on central part of the dorsal surface of hind femora slender (Fig. 57). Tarsal claw with 1-3 denticles (there are often 2). Abdominal tergites uniformly brown, the anterior ones a



Figs. 52-58: *Rhithrogena savoiensis* sp. n., nymph: 52-55, first, second, sixth and seventh abdominal gill, 56, one of the comb-shaped bristles from maxillary lacinia; 57, spines from the central part of hind femur; 58, first abdominal sternite.

little lighter. Tails pale, segments of the distal half filiform and uniformly coloured. Hind margin of intermediate abdominal tergites with teeth similar to those of *R. marcosi* (Fig. 40), but the submarginal microdenticles are even more numerous. The shape of the 1st abdominal sternite is shown in Figure 58. Lamella of 1st gill relatively short with few and very shallow incisions (festoons) (Fig. 52). Lamella of 2nd gill with internal edge more emarginate. Central reinforcement curved at right angle (Fig. 53), lamella of 3rd to 6th gills (Fig. 54) similar. 7th gill is shown in Figure 55.

Material: FRANCE. Holotype 1 ♂ imago, 2 ♀♀ im. (paratypes), plus 5 ♂♂ subim., 2 ♀♀ subim., 27 nymphs, 1 nymphal skin, le Fier River at Alex, Haute Savoie, 540 m, 26-VI-1972 (water temperature 10,6°C); 1 ♂ subim., 3 nymphs, ditt., 10.-14-VIII-1953; 4 ♂♂ im., 1 ♀ subim., le Fier by Naves bridge, 500 m, 16-VIII-1954; 1 ♂ im., ditt., 30-VII-1955; 3 ♂♂ im., 1 ♀ im., ditt., 10-VI-1957; 16 nymphs, 1 ♂ subim., ditt., 20-VII-1953; 8 nymphs, le Fier between the streams le Nant de Thuy and le Malnant, 595 m, 11-VIII-1953; 2 nymphs, le Malnant at the influence with le Fier, 610 m, 10-VIII-1953; 1 ♂

subim., 1 ♀ subim., 8 nymphs, stream le Furon at Engins, Isère, 890 m, 11-VIII-1963. Leg. Ch. Degrange. POLAND: 1 ♂ im., stream Kościeliski in the Kościeliska Valley, Tatra Mts., 900 m, 16-IX-1969. Leg. B. Szczasny; 1 ♂ im., stream Sucha Woda, Tatra Mts. 800 m, 24-VII-1965. Leg. M. Kownacka-Margreiter.

The holotype, the paratypes and most of the other specimens in R. Sowa's collection, the remaining specimens in J. Alba-Tercedor's collection.

Etyymology: The name is derived from Savoie, a French department.

Affinities: *R. savoienensis* can be easily distinguished from the other species described here, especially by the shape of penis: apico-external part of penial lobe prominent and vesicular area at the base of penial lobe well developed, exceeding half the internal length of lobe. The nymph of the new species is characterised by the colouration of its abdominal tergites and by the number of teeth on the comb-shaped bristles at the tip of the lacinia. The chorionic structure of the egg is also different.

COMPARISON

with other species of the *diaphana*-group

The four species described here are also closely related to *R. cincta* Navás, 1921, but the male imago of this species (the only stage known) can be distinguished by the different pigmentation on the coxae and on the sides of abdominal segments (Thomas, 1968: p. 211, Figs. 2 and 3).

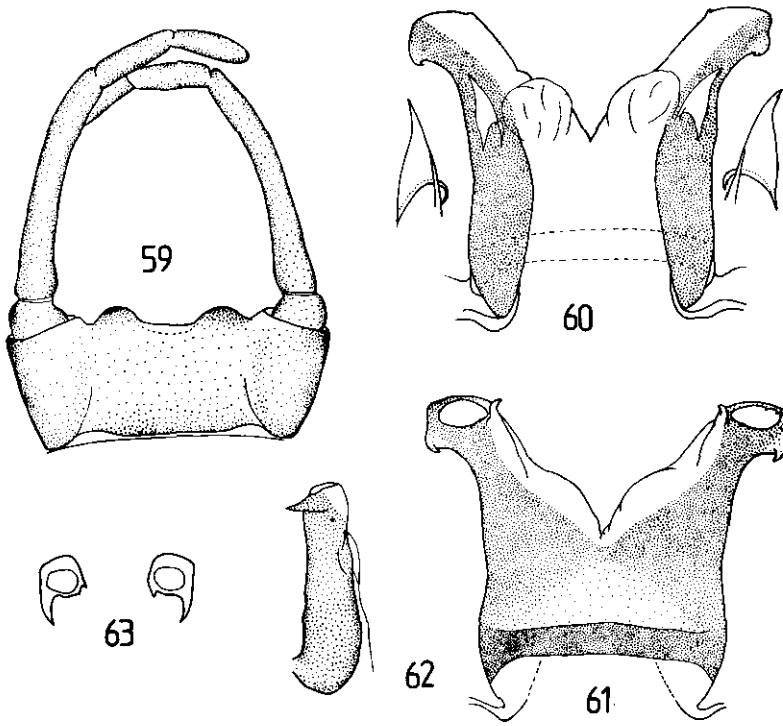
R. oscensis Navás, 1927 is only known from Navás' original description and only as male imago from Benasque, Spain. Although this species is poorly known, at least one difference from Navás' own diagnosis can be used in relation to our species: "Abdomen inferne fulvum, perisque sternitis duabus maculis elongatis obliquis fuscis, in primis subobsoletis, in ultimis grandioribus distinctioribusque..".

For *R. adrianae* Belfiore, 1983 both the male imago and the nymph are known (Belfiore, 1983a). In the male the general colour of the body is very different from our species, especially because of both the absence of spots on the coxae and the absence of oblique latero-abdominal bands. The penis of this species is also different, notably in ventral view when a great part of the external tooth of the penial lobe is visible (Fig. 60). The differences are also visible in other positions (see Figs. 61-63).

KEY TO THE SPECIES

Male adults

1. Vesicular part at the basis of penial lobe big, exceeding half the internal length of lobes (Figs. 44 and 45). Apico-external parts of penial lobe prominent and well differentiated (Fig. 45). Titillators often bidentate at the tip (Fig. 44) *R. savoienensis*
- Vesicular part at the basis of penial lobes smaller, not exceeding half the internal length of lobes (Figs. 1, 12, 30 and 60). Apico-external part of penial lobe not well differentiated (i.e. Fig. 2). Titillators generally acuminate at the tip 2

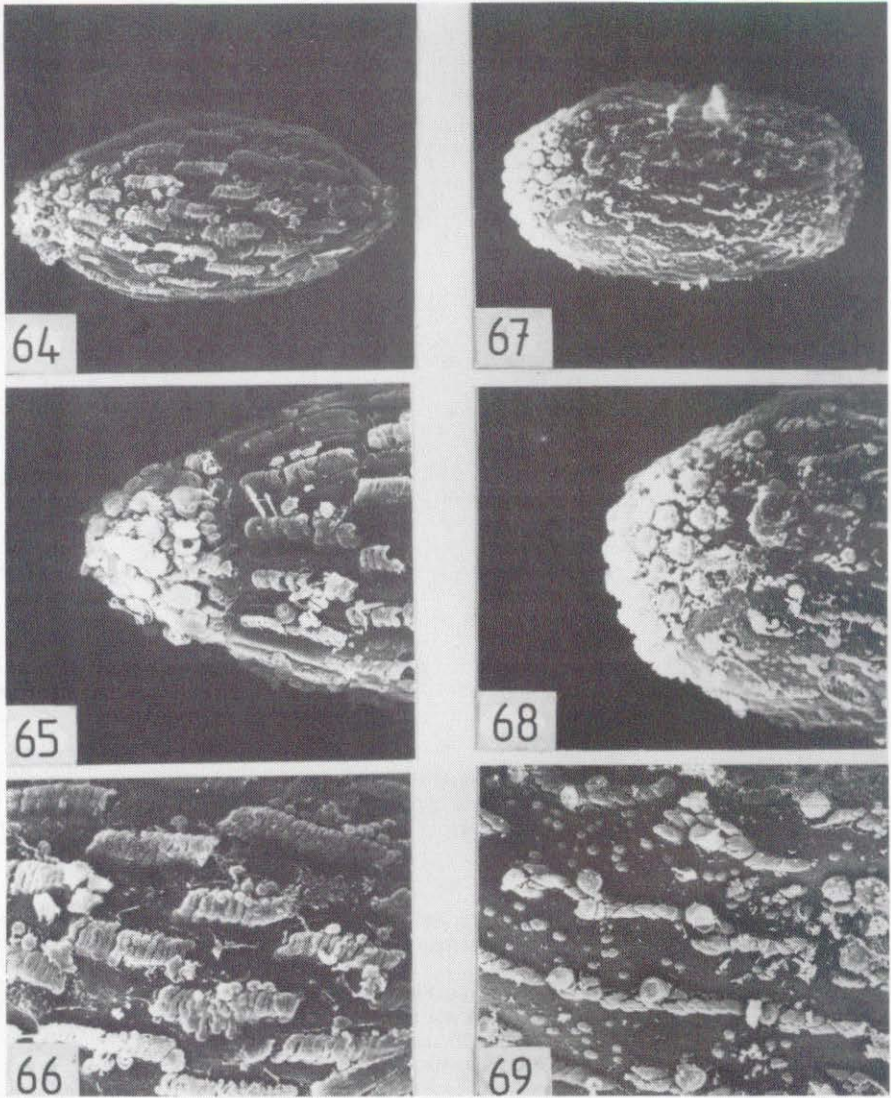


Figs. 59-63: *Rhithrogena adrianae* Belfiore, male imago: 59, styli and forceps; 60, penis and titillators in ventral view; 61, penis in dorsal view; 62, penis in lateral view; 63, apical part of penial lobes in caudal view.

2. Abdominal segments without lateral bands. Apical part of penial lobes rounded, with external subapical tooth well visible ventrally, in a certain position (Fig. 60). Titillators sharply narrowed towards the tip *R. adrianae*
- Abdominal segments with lateral bands (i.e. Fig. 4). Apical part of penial lobes more or less acuminate, with external subapical tooth not visible ventrally (Fig. 1). Titillators gradually narrowing towards the tip (Fig. 1, 12 and 30) 3
3. Penial lobes quite divergent (Fig. 30). Vesicular part at the basis of penial lobes very prominent and forming a narrow incision between lobes in central part of penis *R. marcosi* sp.n.
Penial lobes not very divergent (Figs. 1 and 12). Vesicular part at the basis of penial lobes not very prominent and not forming a narrow incision between lobes in central part of penis 4
4. Penial lobes acuminate at the end, with internal tooth clearly situated in a subapical position (Fig. 12). Titillators slender *R. beskidensis*
- Penial lobes truncate at the end, with internal tooth in apical position (Fig. 1). Titillators triangular and stout *R. diaphana*

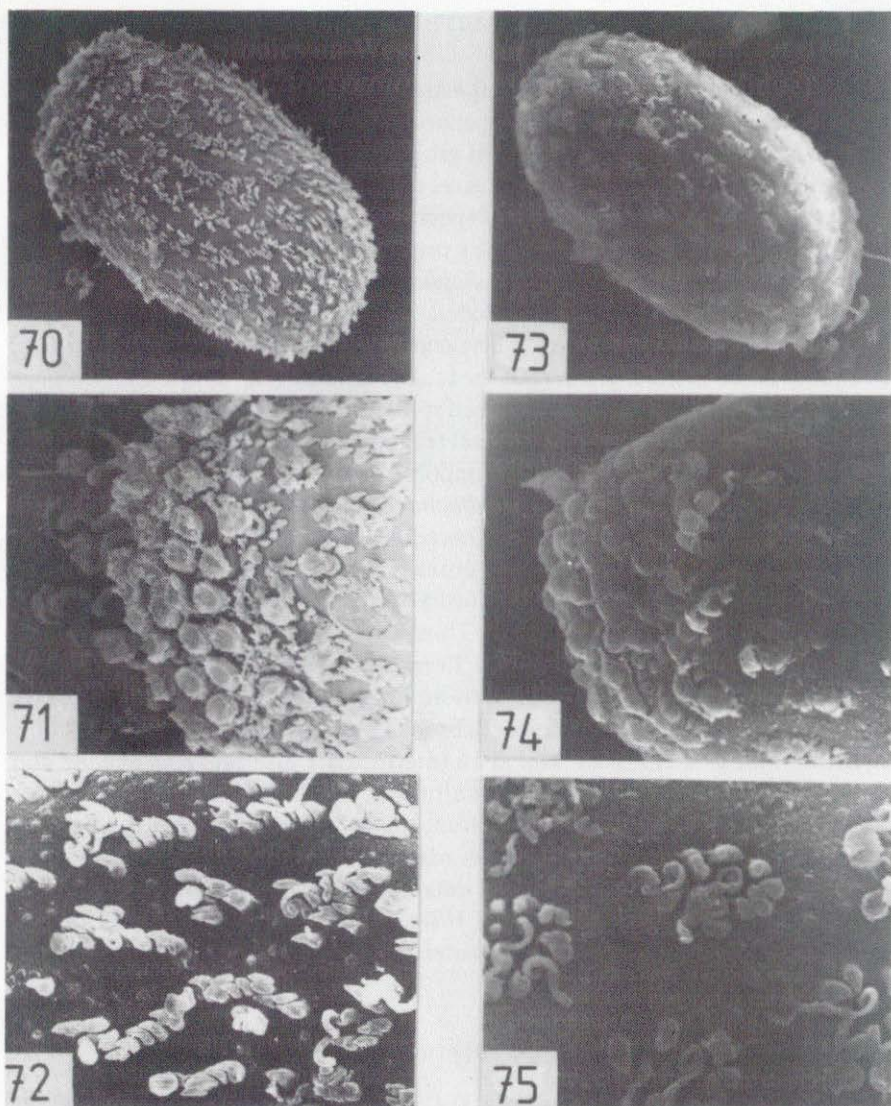
Nymphs (unknown for *diaphana*)

1. Tergites in the posterior half of abdomen uniformly brown. Comb-shaped bristles in the middle of the distal part of the lacinia with 5-7 teeth (Fig. 56) *R. savoienensis*
- Tergites in the posterior half of abdomen differentiated: either brown, yellow-brown or yellowish. Comb-shaped bristles in the middle of the dorsal part of the lacinia with 10-13 teeth (Fig. 22) 2



Figs. 64-69: *Rhithrogena diaphana* Navás (64-66) and *R. beskidensis* sp.n. (67-69), eggs: 64 and 67, general view of egg; 65 and 68, polar part, more enlarged; 66 and 69, structure of chorion from central part, more enlarged.

2. 2nd to 8th abdominal tergites dark, 9th and 19th tergites clearly lighter. Spines on the dorsal surface of femora quite slender (see Belfiore, 1983b, p. 55, Fig. 45) *R. adrianae*
- 2nd to 8th abdominal tergites bicolourous, anterior part brown, posterior part yellowish; 9th tergite yellowish at least in posterior half, 10th tergite brown. Spines on the dorsal surface of femora stout (Figs. 25 and 41) 3
3. Segments in the distal half of the caudal filaments filiform and uniformly coloured. Lamella of 1st gill with entire margin (Fig. 17). Lamella of 2nd to 6th gill with central reinforcement bent at



Figs. 70-75: *Rhithrogena marcosi* sp.n. (70-72) and *R. savoiensis* sp.n. (73-75), eggs: 70 and 73, general view of egg; 71 and 74, polar part, more enlarged; 72 and 75, structure of chorion from central part, more enlarged.

- a right angle (Figs. 18 and 19) *R. beskidensis*
 - Segments of the distal half of the caudal filaments quite clearly moniliform and bicolourous. Lamella of 1st gill with some incisions (Fig. 36). Lamella of 2nd to 6th gill with central reinforcement slightly curved (Figs. 27 and 38) *R. marcosi*

GENERAL REMARKS, DISTRIBUTION AND BIOLOGY

The number of taxa known in the *diaphana*-group has risen in comparison with that reported by Sowa (1984), 7 species are now included. It is also necessary to add to the diagnosis of nymphs of this group the following: "Lamelle de la 1ère branchie entière ou avec des festons rares et peu marqués..." (Sowa, l.c., p. 43).

We think that the definitive list of species for this group is not yet complete. Belfiore (1983a, 1983b) compared the nymphs of *R. adrianae* with some nymphs from Italy which he identified as *R. diaphana* Navás. Although the presence of *R. diaphana* in Italy cannot be excluded, those nymphs very likely belong to another and perhaps new species. The comb-shaped bristles on the lacinia are similar to those in *R. savoienis* but the tarsal claws have no denticles. There are probably some more as yet undescribed species in Southern Europe and probably also in Asia Minor. Two have in fact recently been discovered in Bulgaria by D. Braasch, T. Soldán and R. Sowa (unpublished).

It is obvious that the range of *R. diaphana* Navás as given by some authors (Sowa, 1975a, b; Puthz, 1978; Alba-Tercedor, 1981, 1982) is too large and must be verified by new research. It is not unreasonable to suppose that *R. diaphana* Navás is restricted to the Iberian Peninsula and that in other European areas it is replaced by different related species. Thus *R. savoienis* appears to be the most widespread species found from the French Alps to the Polish Carpathian Mountains. Restricting our considerations only to the species described here we can state, that they are associated with brooks, streams or little rivers in foothills or mountainous areas, generally at an intermediate altitude, *R. diaphana* and *R. beskidensis* occurred at the lowest altitudes and *R. marcosi* was the species with the highest altitudinal distribution; this is probably due to the thermal conditions of streams in the Sierra Nevada.

The life cycle has been studied in detail only for *R. beskidensis* (see Sowa, 1975b, sub nom. *R. diaphana* Navás). It is a univoltine summer species; during the winter there are only eggs in the water. We believe that this is also valid for the other species described here.

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