Contribution to the study of European Ephemerellidae (Ephemeroptera) : I. completion of description of three endemic Iberian species

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Contribution to the study of European Ephemerellidae (Ephemeroptera). I. Completion of description of three endemic Iberian species.

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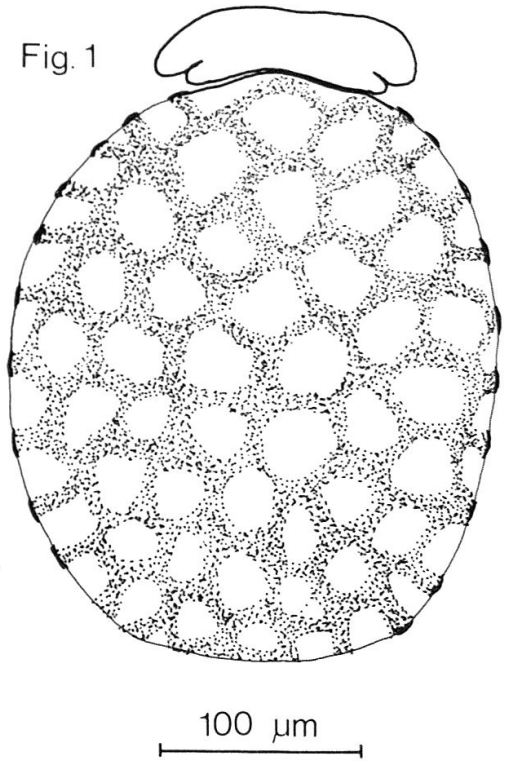
The description of three Iberian species of Ephemerellidae is completed for every stage of development: *Drunella paradinasi* GONZALES DEL TANAGO & GARCIA DE JALON, 1983, *Serratella hispanica* (EATON, 1887) and *Eurylophella iberica* KEFFERMUELLER & DATERRA, 1978. Their belonging to the genera *Drunella* NEEDHAM 1909, *Serratella* EDMUNDS 1959 and *Eurylophella* TIENSUU 1935 is discussed for the nymph, the imago, and the egg of each species.

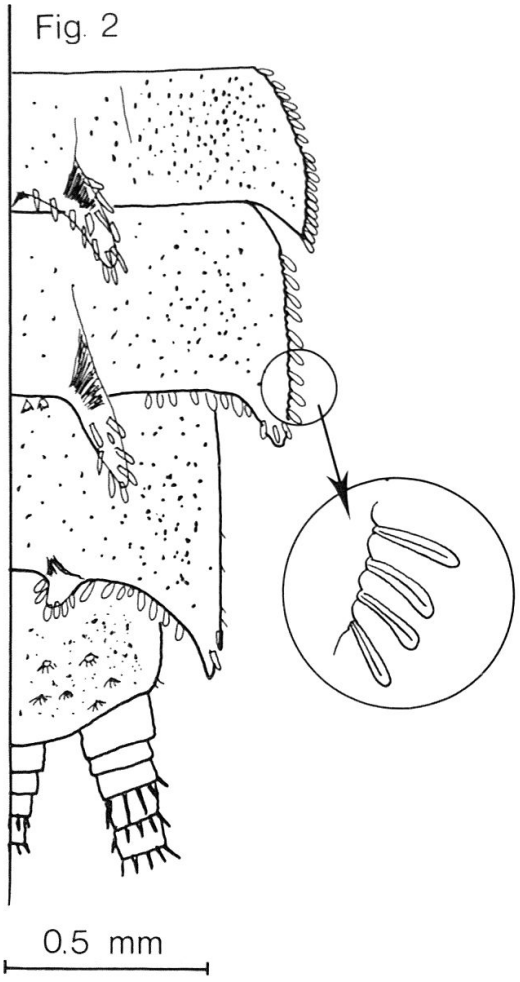
INTRODUCTION

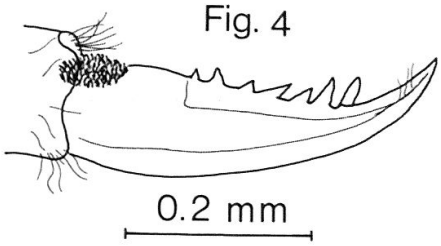
During our expedition through Spain, we collected some species of Ephemerellidae which until now have been incompletely described. GONZALES DEL TANAGO and GARCIA DE JALON (1983) give nymphal descriptions of *Serratella hispanica* (EATON, 1887), *Eurylophella iberica* KEFFERMUELLER & DATERRA, 1978 and *Drunella paradinasi* GONZALES DEL TANAGO & GARCIA DE JALON, 1983. A description of the adult male of *S. hispanica,* based on two dried examples, is given by EATON (1887), but the genitalia are not mentioned. *D. paradinasi* was only known at nymphal stage. From *E. iberica* has been described (by KEFFERMUELLER & DATERRA, 1978) the female nymphal stage and the male and female imaginal stage.

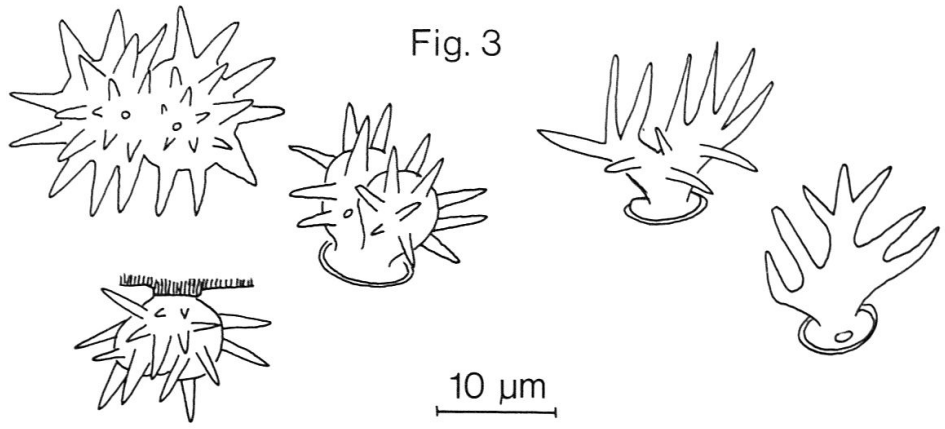
Thanks to a special construction in our car, with cooled running water, we were able during the excursion to raise the larvae of these species to the imaginal stage. That allowed us to complete the description of these species for all the stages, including egg and subimago.

We used the characteristics of every stage to study the taxonomy of these species. In our opinion, the systematics of the Ephemerellidae is not yet solved. For the belonging of the investigated species to the genera *Serratella* EDMUNDS 1959, *Drunella* NEEDHAM 1909 and *Eurylophella* TIENSUU 1935, we consulted the key of EDMUNDS, JENSEN & BERNER (1976). Following the more recent publications about systematics of Ephemerellidae (LANDA, SOLDAN & EDMUNDS, 1982 and ALLEN, 1980), these three taxa are treated here as genera. To clarify the systematics and phylogeny in the family of Ephemerellidae, we are now studying world-wide material with biochemical and morphological methods.









Figs. 1–4. *Drunella paradinasi.* 1: Egg. 2–4: Nymph. 2: Last abdominal tergites. 3: Starlike hairs on the body. 4: Tarsal claw of the first right leg.

Egg

The eggs were extracted from the imaginal abdomen. As for the other species, the eggs were prepared as follows: they were first dipped in a drop of chloralphenol and then preserved in a medium after HEINZE (1952). The observations were made with light microscopy at a magnification range of X 600.

The eggs of *D. paradinasi* are oval, yellowish, with a flat polar cap. The chorion presents a small-mesh reticulation with round areas, limited by a very fine granulation (fig. 1). The dimensions are about 300 μm in length (with cap) and 240 μm in width.

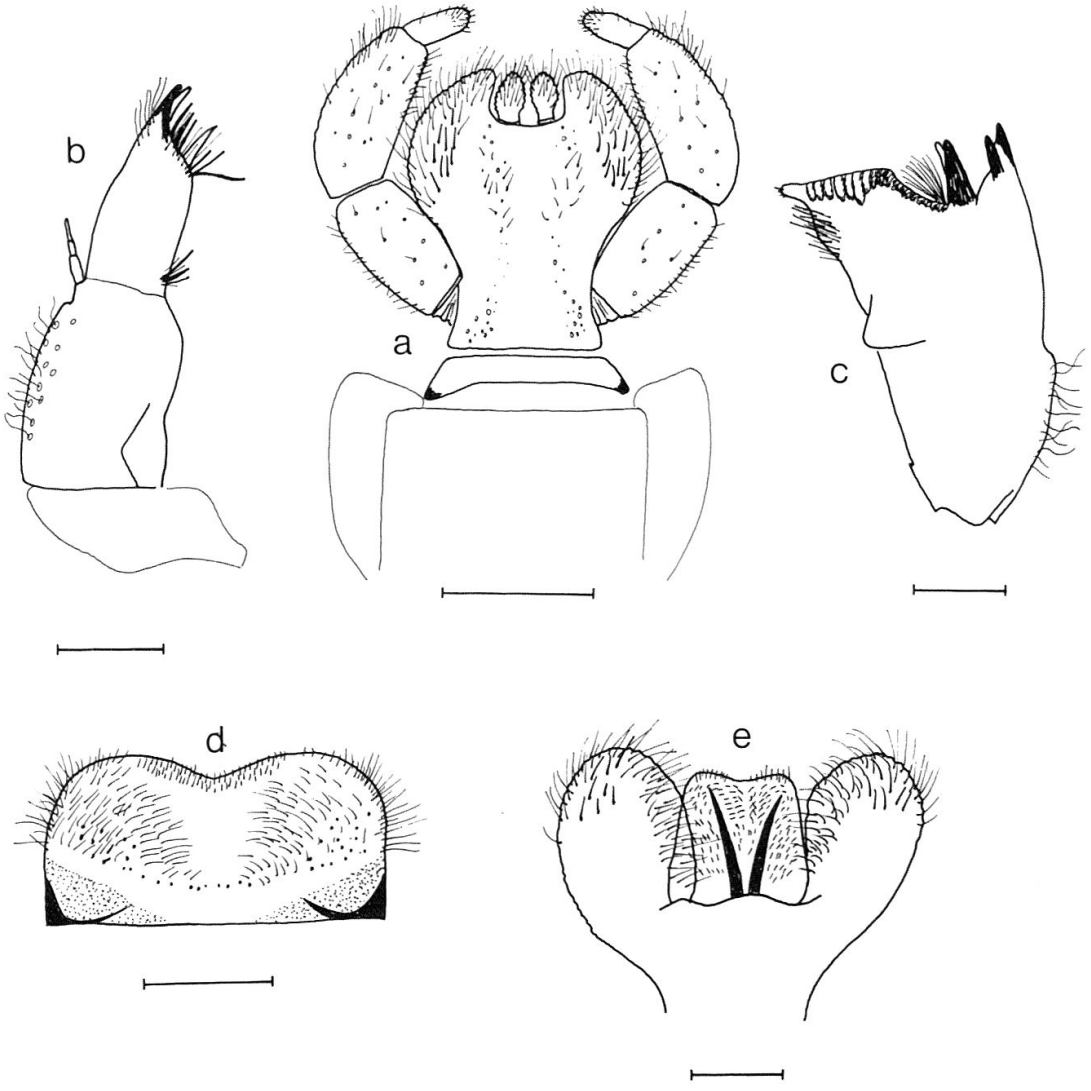
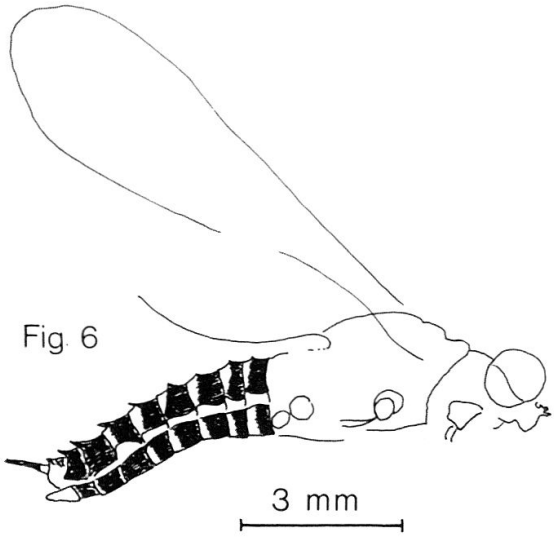
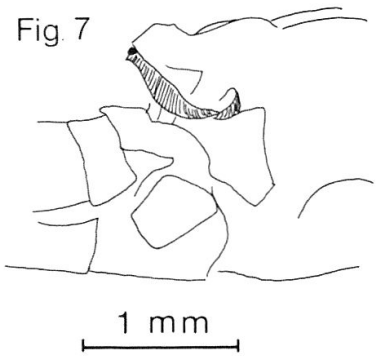
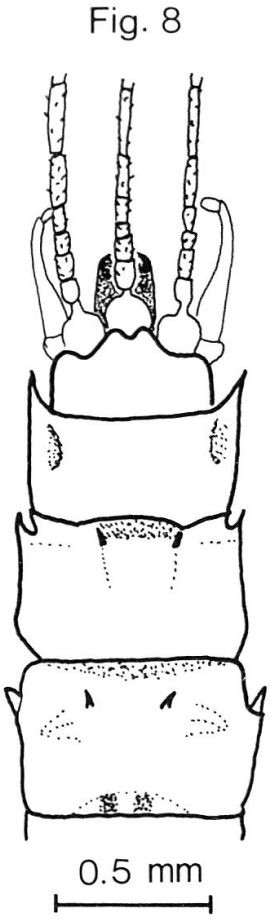
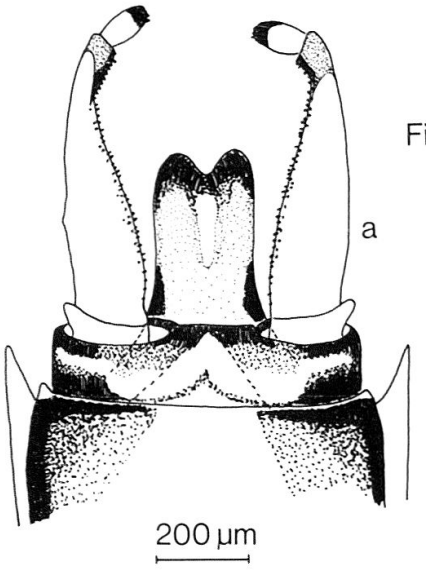


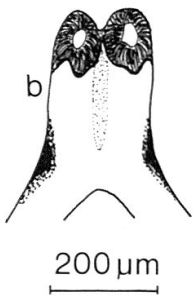
Fig. 5. *Drunella paradinasi,* mouth parts of the nymph. a: Labium. b: Left maxilla. c: Right mandible. d: Labrum. e: Hypopharynx. (Scale line: 200 μm.)

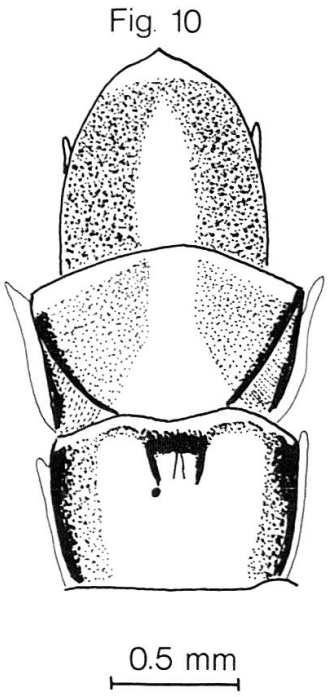












Figs. 6–10. *Drunella paradinasi*. 6: Male subimago, abdominal segments, lateral view. 7–9: Male imago. 7: Metanotum, lateral view. 8: Last abdominal segments, dorsal view. 9a: Genitalia, ventral view. 9b: Penis, dorsal view. 10: Female imago, last abdominal segments, ventral view.

Nymph

The nymph is described by GONZALES DEL TANAGO & GARCIA DE JALON (1983). As for both other species, we tested all the morphological characteristics required for the systematics of EDMUNDS *et al.* (1976). Lamellate gills are present on abdominal segments 3 to 7 (cf. GONZALES DEL TANAGO & GARCIA DE JALON, 1983, fig. 3f). Cerci and terminal filament are subequal in length. The head, the thorax and the abdomen present well-developed tubercles (cf. op. cit. fig. 3a, 3b, 3f). The tubercles are absent on the ventral edge of the fore femora (cf. op. cit. fig. 3d). The abdominal sternites are glabrous. The claws possess about 6 to 8 denticles (fig. 4). On the abdomen, the tubercles and the posterolateral margin of the sternites are covered with scales (fig. 2). The maxilla possesses a three-segmented palpus (fig. 5b). We can add the following characteristic: the whole body of the nymph is covered with starlike hairs (fig. 3) which were not found on the other species.

Imago, male

Length of the body (without cerci): 7–8 mm.
Length of the cerci: 7–8 mm.
Length of the anterior wing: 8 mm.
Length of the fore leg-parts: femur 1540 μm, tibia 2380 μm, tarsus I 730 μm, tarsus II 660 μm, tarsus III 440 μm, tarsus IV 220 μm, total tarsi 2050 μm.

General aspect: bright dark body with white legs.

Head: dark brown, upper part of eye dark red, lower part black.

Thorax: dark black-brown, some sutures of the pleura white. The metanotum, which can be used in phylogenetic studies, is drawn on fig. 7.

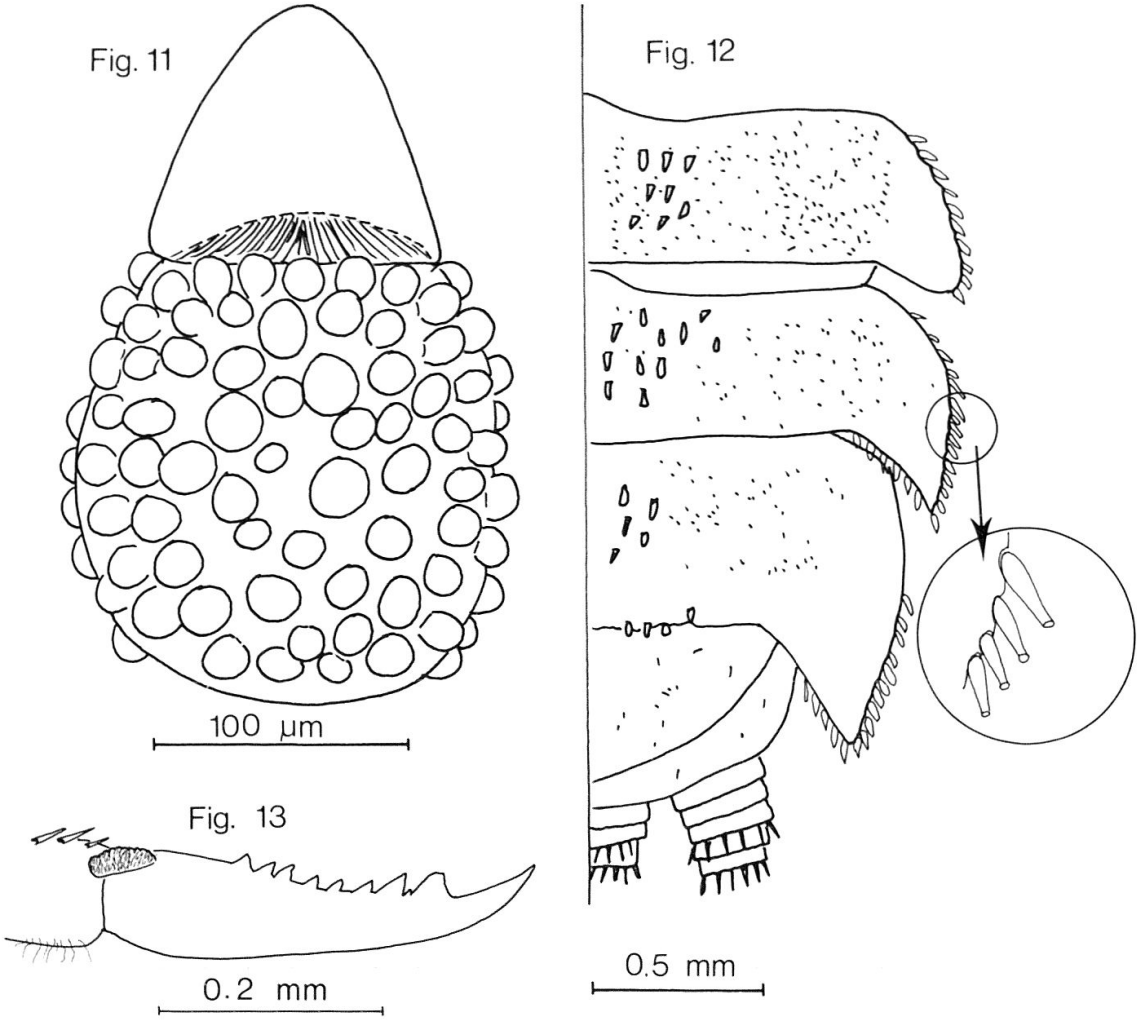
Legs: all coxae brown, with whitish shade on the lower part, all claws and last tarsal articles brown. Apart from that, the fore leg is yellowish with dark brown tibia. The other legs are whitish, the fore face of the femur presents a little brown spot on the apical region, and the first tarsal articles are grey-brown on their upper part.

Wings: The fore wing presents a hyaline surface with exception of the costal and subcostal area which is opaque, even whitish apically. The neuration is brown. The hind wing is transparent too, but the neuration is pale.

Abdomen: dark red-brown. From the third segment, posterior margin of each sternite white, pleura pale. The abdominal tergites 5 to 9 present each two tubercles reminding of the typical great tubercles of the nymph. The spines are situated in the middle of the tergites 5, 6 and 7. They are more important and placed more apically on the segments 8 and 9 (fig. 8).

Cerci: Cerci and terminal filament are subequal in length. Except the basic segment which is white, all the caudal filaments are brown, covered with fine transparent hairs.

Genitalia: forceps white, lightly brown apically, penis brown, swollen at base and narrow at apex, seminal holes turned to each other or dorsally (fig. 9 and 26).



Figs. 11–13. *Serratella hispanica.* 11: Egg. 12–13: Nymph. 12: Last abdominal tergites. 13: Tarsal claw of the first right leg.

Imago, female

Length of the body (without cerci): 6–7 mm.
Length of the cerci: 8 mm.
Length of the anterior wing: 8–9 mm.

General aspect: bright dark body with white legs. In comparison with the male, the general colour of the body and legs is paler. The head, the thorax and the abdomen are squat, much thicker than those of the male.

Abdomen: red-brown, with white pleural sutures, same tubercles as by the male. The last but one sternite possesses sharp-pointed postero-lateral projections (fig. 10).

Legs: middle and hind legs a little lighter than in the male. In the fore leg, the femur is white, and the articulations of the tibia and the tarsi are brown.

Wings: The neuration is darker than in the male.

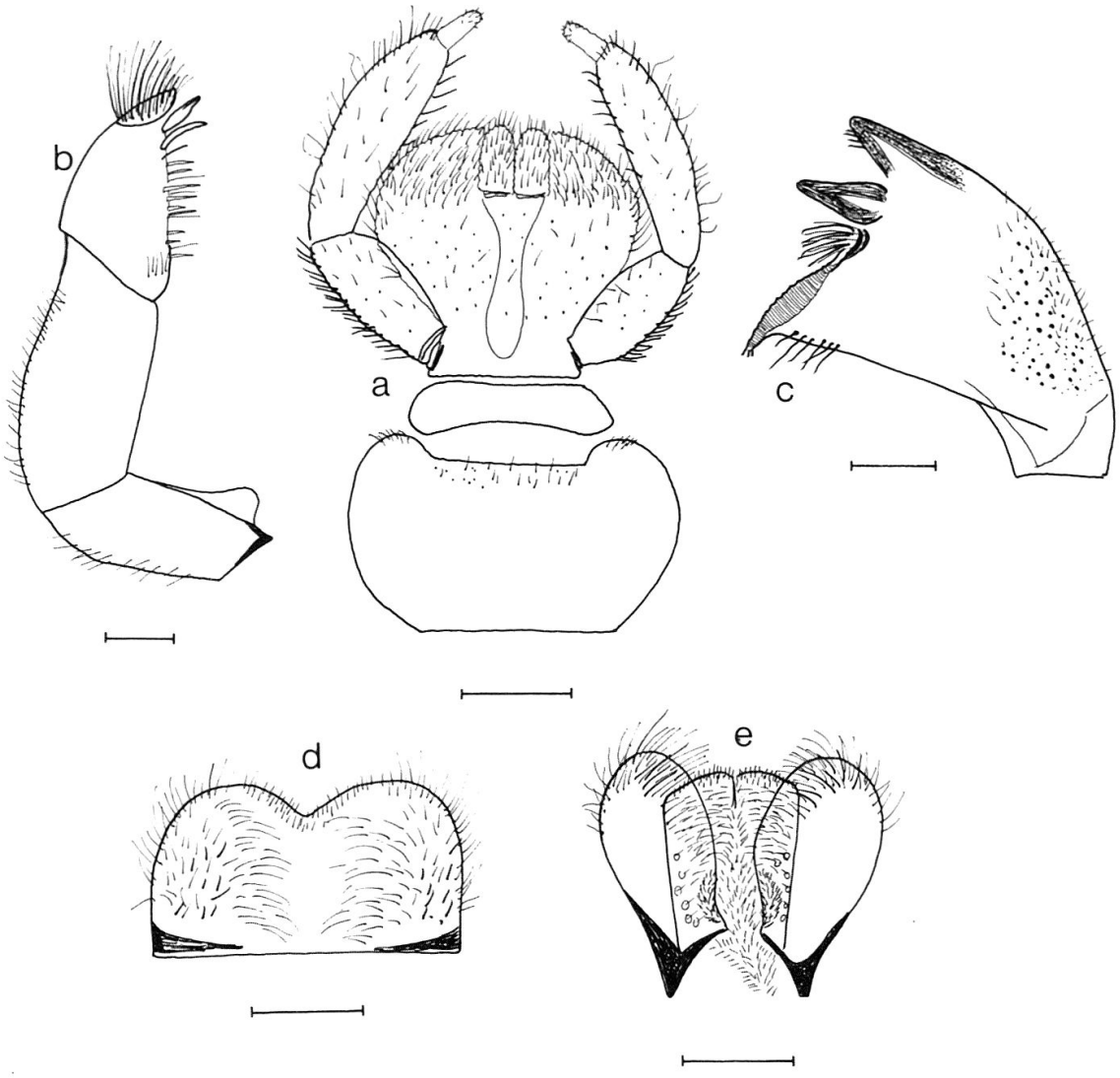


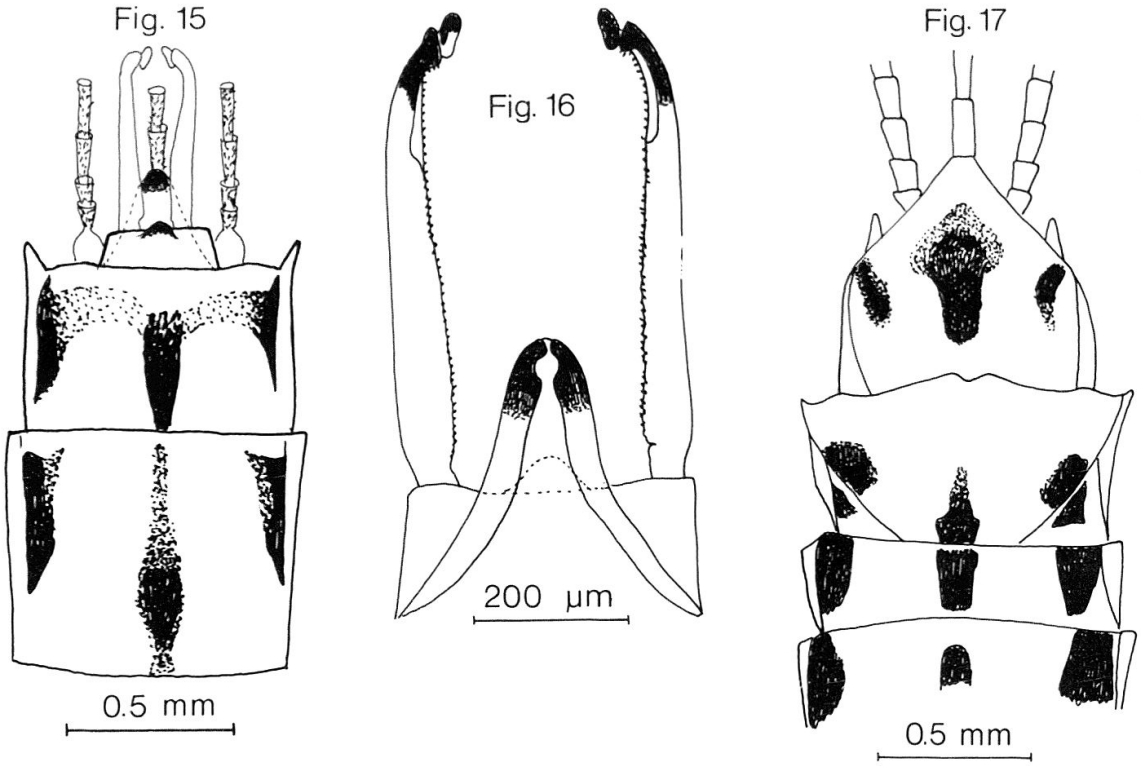
Fig. 14. *Serratella hispanica,* mouth parts of the nymph. a: Labium. b: Left maxilla. c: Right mandible. d: Labrum. e: Hypopharynx. (Scale line: 200 μm.)

Subimago, male and female

In both sexes the subimago presents similar colours to those of the adult, a little less dark. Especially the thorax is very pale in the subimagines: white with light brown pattern. Both tubercles on each last tergite are well developed in both sexes. They are greater and situated always more apically from segment 4 to 8. On the 9th segment, the tubercles are small and situated on the hind margin of the tergite (fig. 6).

Ecology and development

We caught larvae in the middle of July (11–20.7.1986) always on the same water plant, *Oenanthe crocata* L. One locality, the Tera river in Trefacio, was visited twice: we found many larvae on 11th July and none on 22th July. We raised the larvae during our excursion and in our laboratory. The casting to subimagines



Figs. 15–17. *Serratella hispanica*. 15–16: Male imago. 15: Last abdominal segments, ventral view. 16: Genitalia, dorsal view. 17: Female imago, last abdominal segments, ventral view.

and imagines began on the end of July, but most adults hatched in the first days of August.

While rearing the larvae and nymphs, we noticed that they were predators. We had to feed them with larvae of *Ephemerella ignita* (PODA) in order to prevent them from eating each other. This carnivorous behaviour is confirmed by HAWKINS (1985) who tested the diet of 20 species of Ephemerellidae: the most predatory-species are from the genus *Drunella,* and only one of the 5 tested *Drunella*-species is not a predator.

Taxonomy and systematics

The presence of a membrane on the base of the wing in the imago and the configuration of the metanotum (fig. 6) are characteristic for the family-group Panota.

The following characteristics allow us to place the nymph of *D. paradinasi* in the family of the Ephemerellidae:
- maxillar palpus much shorter than galea and lacinia,
- paraglossa of labium not separated from mentum,
- gills on abdominal segment II absent,
- mandibles without tusks,
- head and prothorax without pad of spines,
- gill tufts absent from bases of maxillae and fore coxae.

The nymph of this species presents the typical characteristics of the genus *Drunella* after EDMUNDS *et al.* (1976):

- lamellate gills present on abdominal segments 3 to 7 (so it cannot be *Timpanoga, Danella, Eurylophella* or *Attenella*),
- cerci and terminal filament subequal in length (so it cannot be *Caudatella*),
- head, thorax and abdomen with well-developed tubercles (so it cannot be *Ephemerella* nor *Serratella*).

We can add a typical characteristic, found only on *Drunella:* the presence of star-like hairs on the whole body (fig. 3).

In the same way, we looked for the typical characteristics for the imago (after EDMUNDS *et al.* 1976):
- cerci and caudal filament subequal in length (*Caudatella* is excluded),
- terminal segment of genital forceps less than four times as long as broad (so *Attenella* is excluded),
- fore tibia longer than tarsi (so *Eurylophella* and *Danella* are excluded),
- penis without long apical lobes (so *Timpanoga* is excluded).

At this point, three genera remain possible: *Drunella, Ephemerella* and *Serratella.* EDMUNDS *et al.* (1976) make the distinction on point 70 page 114, with the terminal segment of genital forceps: more than twice as long as broad *(Drunella)* or less than twice as long as broad *(Ephemerella, Serratella).* By *D. paradinasi,* this segment is exactly twice as long as broad. However, this length-width proportion cannot be taken from the SEM-photography, because the orientation of the forceps is not adequate. To cover *D. paradinasi* as well, we propose to change the point 70 of the key as follows:

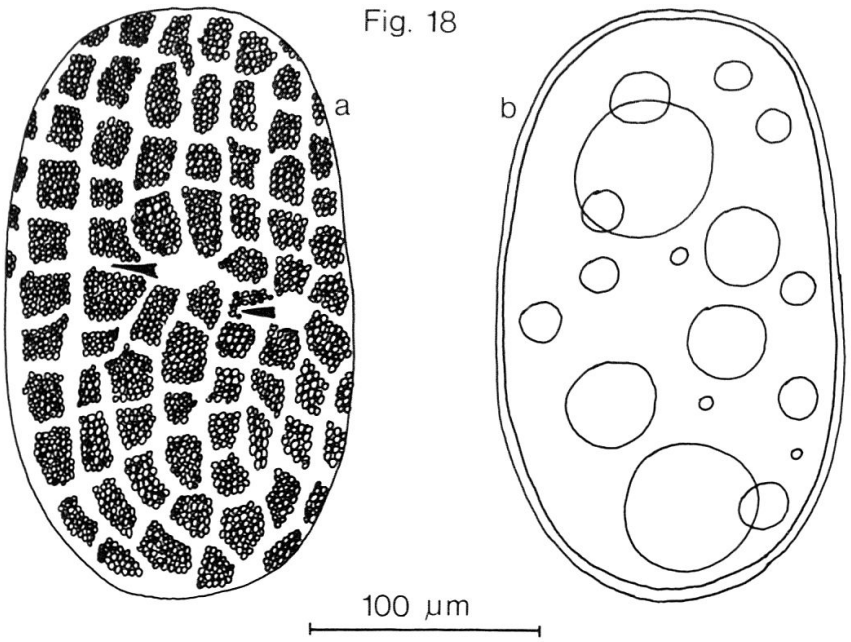
"Terminal segment of genital forceps **at least** twice as long as broad.
. . . . . *Drunella.*"

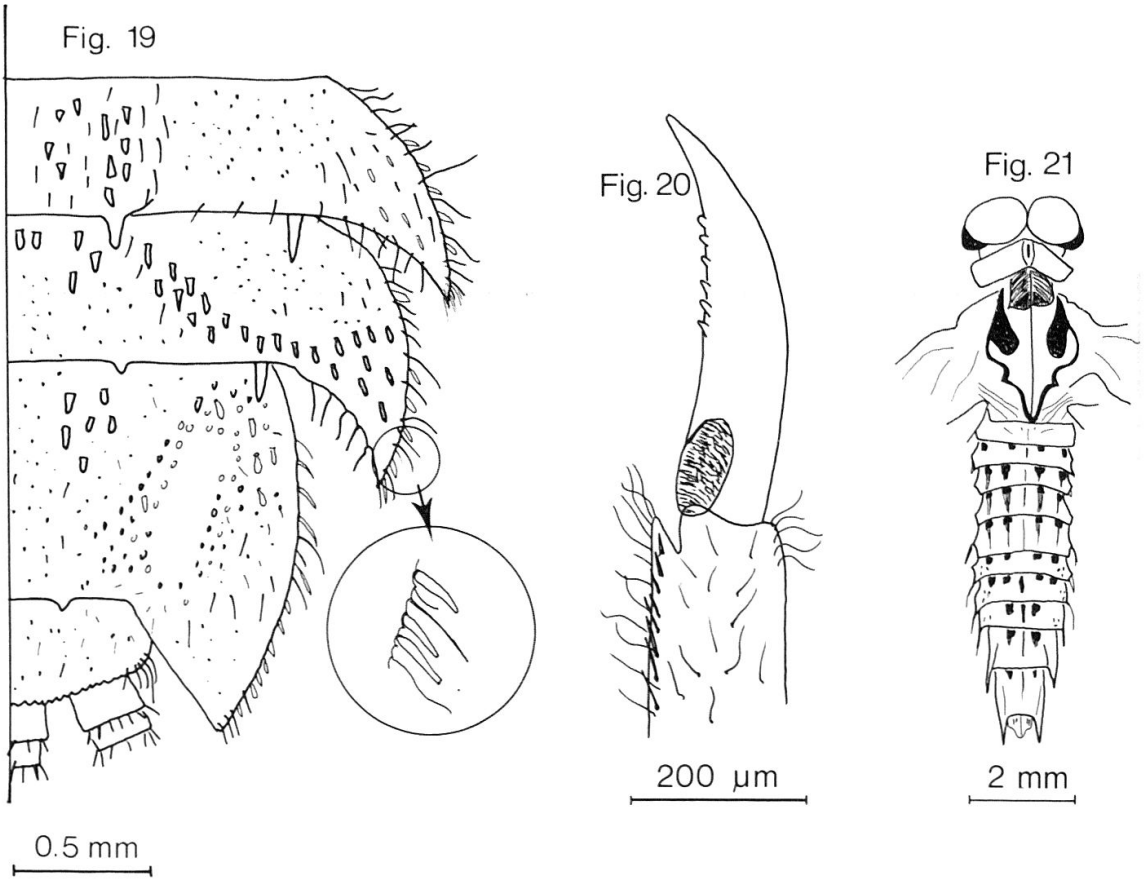
KOSS (1968) presents a key to separate *Drunella, Eurylophella, Ephemerella* and *Serratella* on the base of the eggs. The chorions observed on the eggs of *D. paradinasi* possess many more oval areas (more than 40 on one given surface) than proposed by KOSS (6 or less).

Material

Our material comes from the following localities:
- Rio Tera in Trefacio, alt. 960 m (Zamora, Spain),
- Rio Requejo in Requejo, alt. 960 m (Zamora, Spain),
- Rio Lozoya in Los Cotos-Valdesqui, alt. 1800 m (Madrid, Spain),
- Rio Manzanares in La Pedriza, alt. 1280 m (Madrid, Spain),
- Rio Eresma in La Solana, alt. 1280 m (Segovia, Spain),
- Rio Valcarce in Vega, alt. 630 m (Lugo, Spain),
- Rio Asma in Chantada, alt. 480 m (Lugo, Spain),
- Rio Navia in As Nogias, alt. 550 m (Lugo, Spain).

The nymphs were caught from 11th to 20th July 1986. The casting to subimagines and imagines followed on the first days of August.
Kept in alcohol: 30 nymphs, 30 nymphal skins, 10 subimagines, 3 male imagines, 2 female imagines.
Kept frozen: 14 subimagines, 16 imagines.
All the material is deposited at the address of the authors.





Figs. 18–21. *Eurylophella iberica*. 18: Egg. a: Chorion. b: Internal vesicles. 19–20: Nymph. 19: Last abdominal tergites. 20: Tarsal claw of the first right leg. 21: Male subimago, dorsal view.

Egg

As in *Ephemerella ignita,* the eggs are released in a single mass. The egg mass of *S. hispanica* forms a spherical yellowish ball that is carried at the genital aperture with the posterior abdominal segments curved downwards and round the ball to hold it in position. Each egg is oval, yellowish, with a big cone-shaped polar cap. The chorion is covered with round tubercles (fig. 11).

Length with (without) polar cap: 300 μm (210 μm).
Width: 170 μm.

Nymph

The nymph is described by GONZALES DEL TANAGO & GARCIA DE JALON (1983). Lamellate gills are present on abdominal segments 3 to 7. The cerci and the caudal filament, subequal in length, possess whorls of short spines at the apex of each segment, without intersegmental setae (cf. op. cit. fig. 2g). Head, thorax, abdomen and legs do not show tubercles or long hairs (cf. op. cit. fig. 2a, 2b, 2c). Legs are short and robust (cf. op. cit. fig. 2b, 2c). The maxillar palpus is absent (cf. op. cit. 2f). The mouthparts are drawn on fig. 14. The tarsal claws possess 8 to 10 denticles (fig. 13). The last abdominal segments are shown on fig. 12.

Imago, male

Length of the body (without cerci): 6–7 mm.
Length of cerci: 7–8 mm.
Length of the anterior wing: 8 mm.
Length of the fore leg-parts: femur 1500 μm, tibia 2860 μm, tarsus I 790 μm, tarsus II 1060 μm, tarsus III 570 μm, tarsus IV 350 μm, total tarsi 2770 μm.

The abdominal colouration given for the subimago female by EATON (1887), with the three longitudinal black lines on the whole abdomen in ventral view, is the same on the imago (fig. 17). The genitalia are not described by EATON. The forceps is long and thin, incurved only at the apex (fig. 15 and 27). The penis presents a triangular shape, broad and pale at base, narrow and dark at apex where the two seminal holes turn to each other (fig. 16 and 27). The subgenital plate is very narrow (fig. 15).

Imago, female

Length of the body (without cerci): 6 mm.
Length of the cerci: 8 mm.
Length of the anterior wing: 8–9 mm.

Colouration and marking are the same as in the male, only the ground is a little paler on the thorax and yellowisher on the abdomen. The last abdominal segment, darker than the others, is triangular with the apical margin pointed upwards (fig. 17).

Subimago

This stadium is well described by EATON (1887).

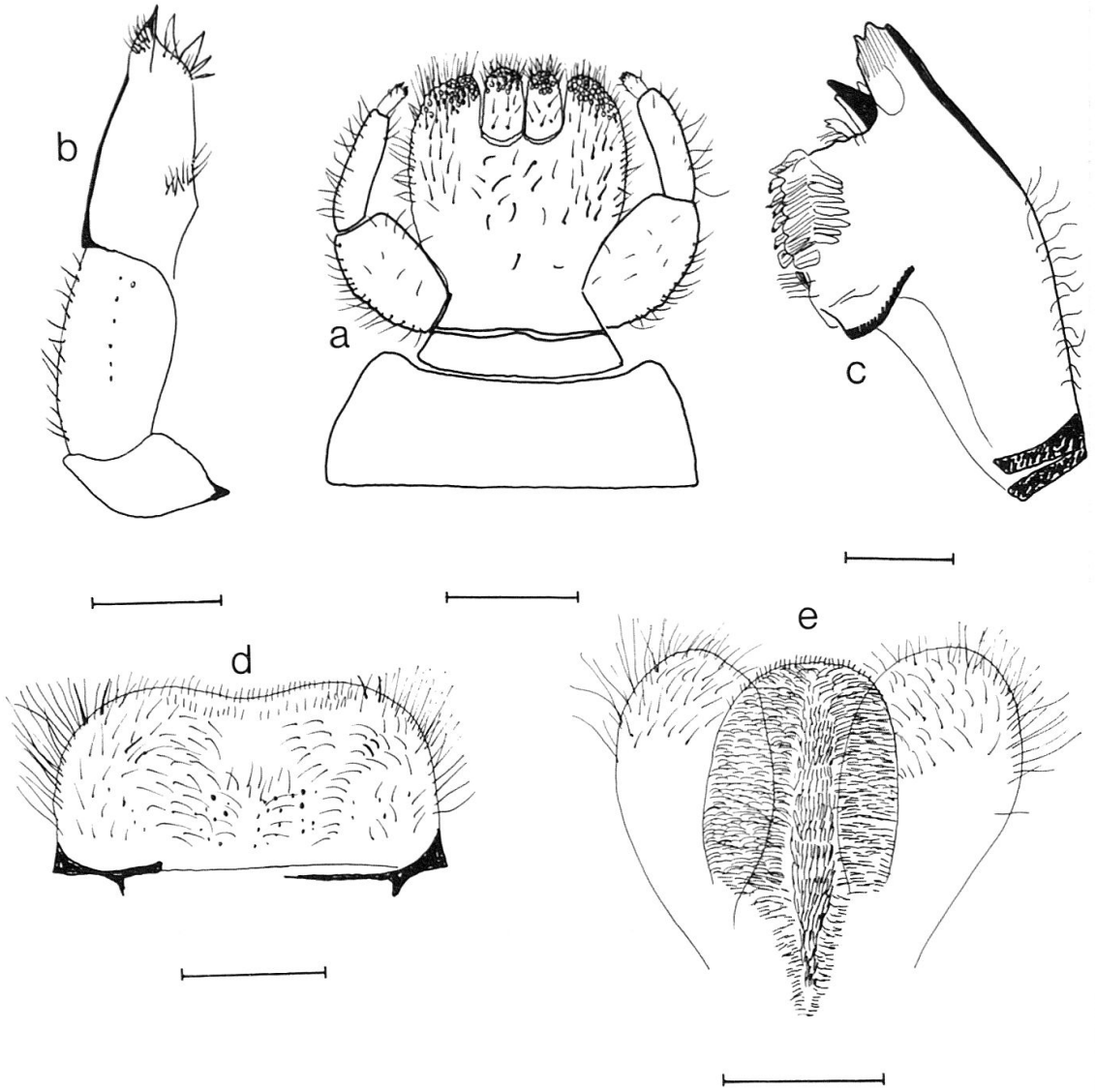


Fig. 22. *Eurylophella iberica,* mouth parts of the nymph. a: Labium. b: Left maxilla. c: Right mandible. d: Labrum. e: Hypopharynx. (Scale line: 200 μm.)

Ecology and development

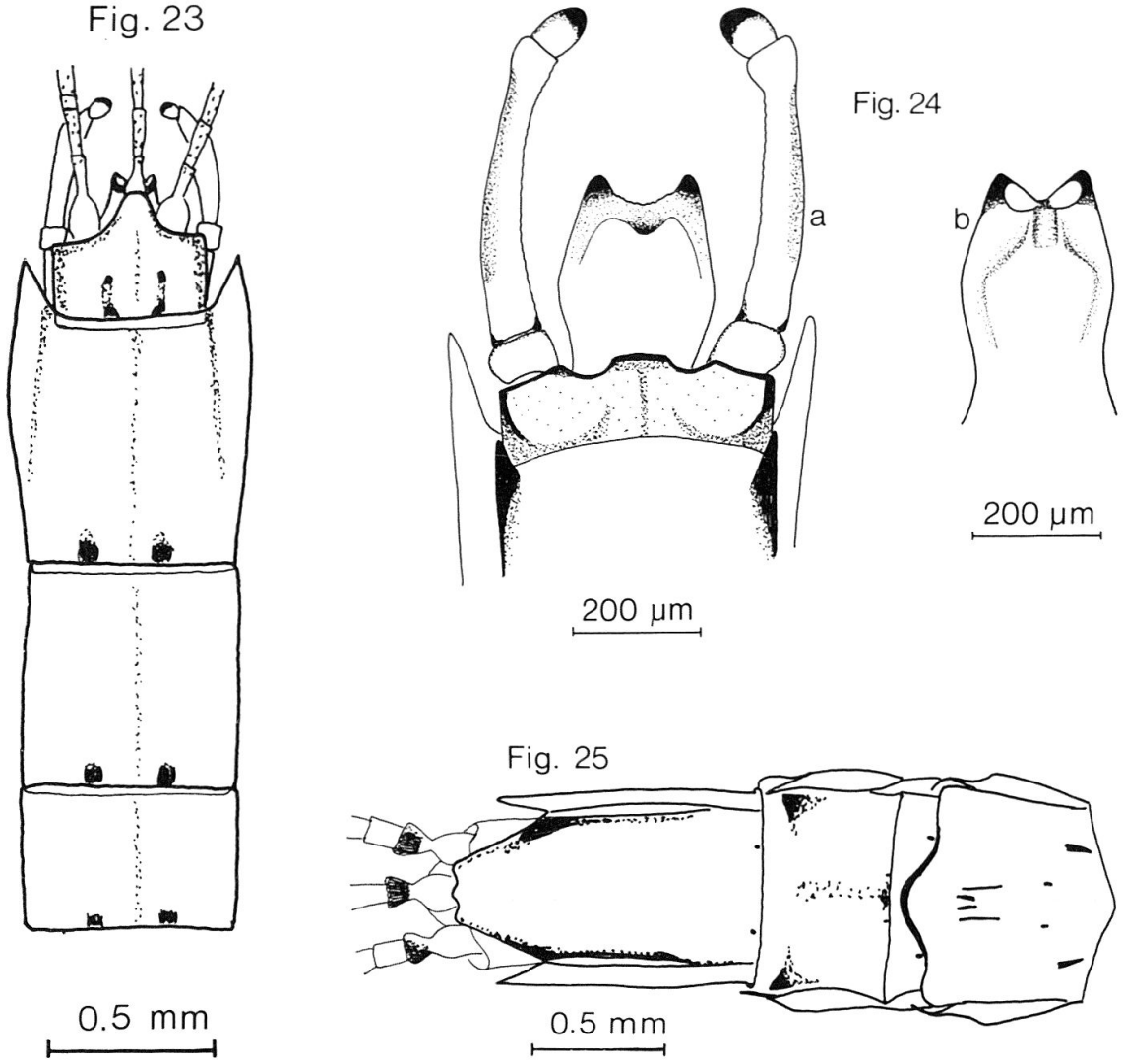
We found some larvae on stony substrates from a little mountain river on 14th to 16th July 1986. The imagines swarmed on the 16th July from 8 to 9 p.m. Amongst one hundred females, there were only two males.

Taxonomy and systematics

That this species belongs to the Panota and to the family of Ephemerellidae is based on the same characteristics as by *Drunella.*

The nymph of *S. hispanica* possesses the characteristics of the genus *Serratella* EDMUNDS as described by EDMUNDS *et al.* (1976):

- lamellate gills on abdominal segments 3 to 7 (so it cannot be *Eurylophella, Timpanoga, Attenella* or *Danella*),
- cerci and caudal filament subequal in length (so it cannot be *Caudatella*),



Figs. 23–25. *Eurylophella iberica*. 23–24: Male imago. 23: Last abdominal segments, ventral view. 24a: Genitalia, ventral view. 24b: Penis, dorsal view. 25: Female imago, last abdominal segments, ventral view.

- no tubercles on fore femora, head, thorax and abdomen, sterna without long hairs (also it cannot be *Drunella*),
- legs short and robust (legs long and thin would belong to *Ephemerella* in part),
- caudal filaments with whorls of short spines at the apex of each segment and without intersegmental setae; maxillar palpi absent (so it cannot be *Ephemerella*).

We also followed the key of EDMUNDS *et al.* (1976) to determine the genus of the imago:

- cerci and terminal filament subequal in length (that excludes *Caudatella*),
- terminal segment of genital forceps less than twice as long as broad (that excludes *Drunella* and *Attenella*),
- penes without dorsal or ventral spines, penes without long lateral apical lobes, subgenital plate narrow, fore tibiae longer than tarsi (that excludes *Ephemerella, Eurylophella* and *Danella*).

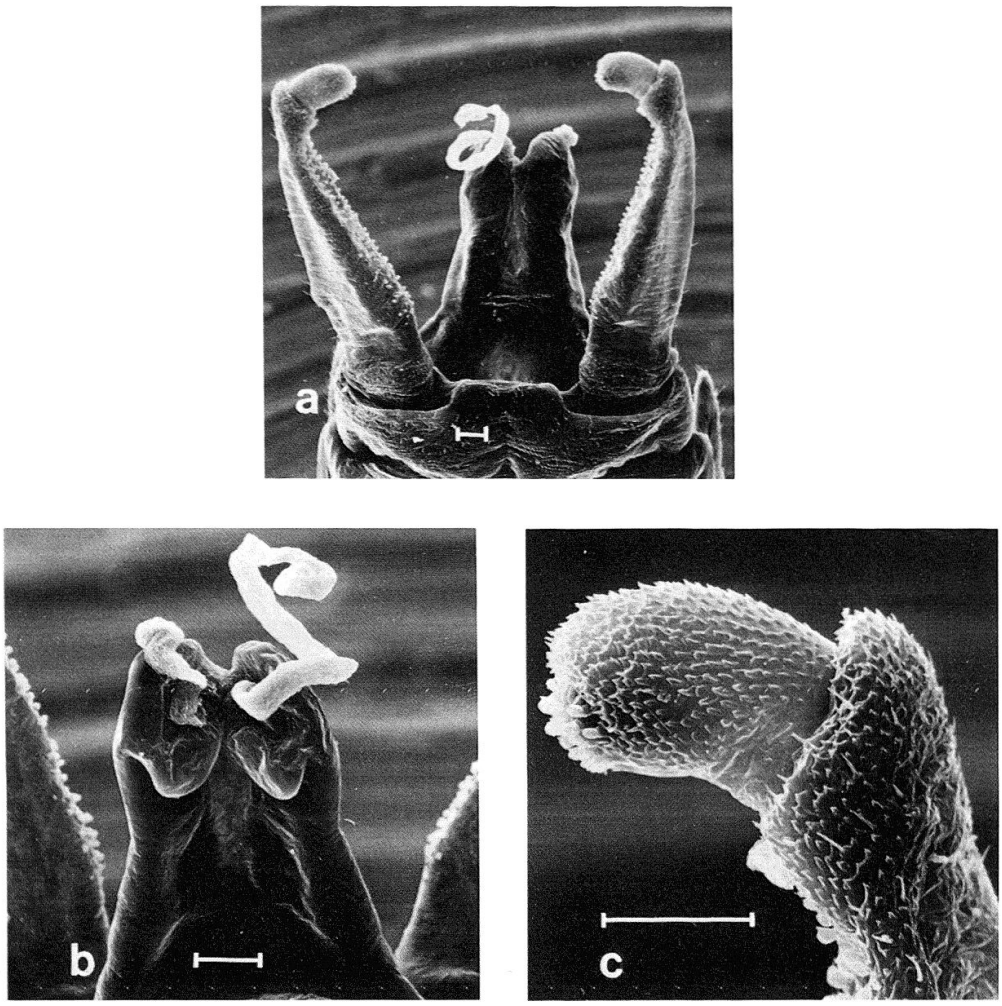


Fig. 26. *Drunella paradinasi,* male imago. (Scale line: 50 μm.) a: Genitalia, ventral view. b: Penis, dorsal view. c: End of the forceps, dorsal view.

In point 76 on page 118 of the key of EDMUNDS *et al.*, only one of both characteristics required is present in *S. hispanica:* fore tibiae are longer than fore tarsi. But the subgenital plate of *S. hispanica* presents a median tubercle (fig. 17). If we modify the point 76 in this way: "Fore tibiae longer than tarsi; subgenital plate with or without median tubercle", this European species can be included in the key and called *Serratella.*

KOSS (1968) gives only information for the egg of *Serratella* deficiens. The structure of the chorion of this species does not show the spherical tubercles of *S. hispanica.*

Material

All the material comes from the following locality:
Rio Lozoya, near its source, in Los Cotos-Valdesqui, 1800 m alt., (Madrid, Spain), 14th–16th July 1986.

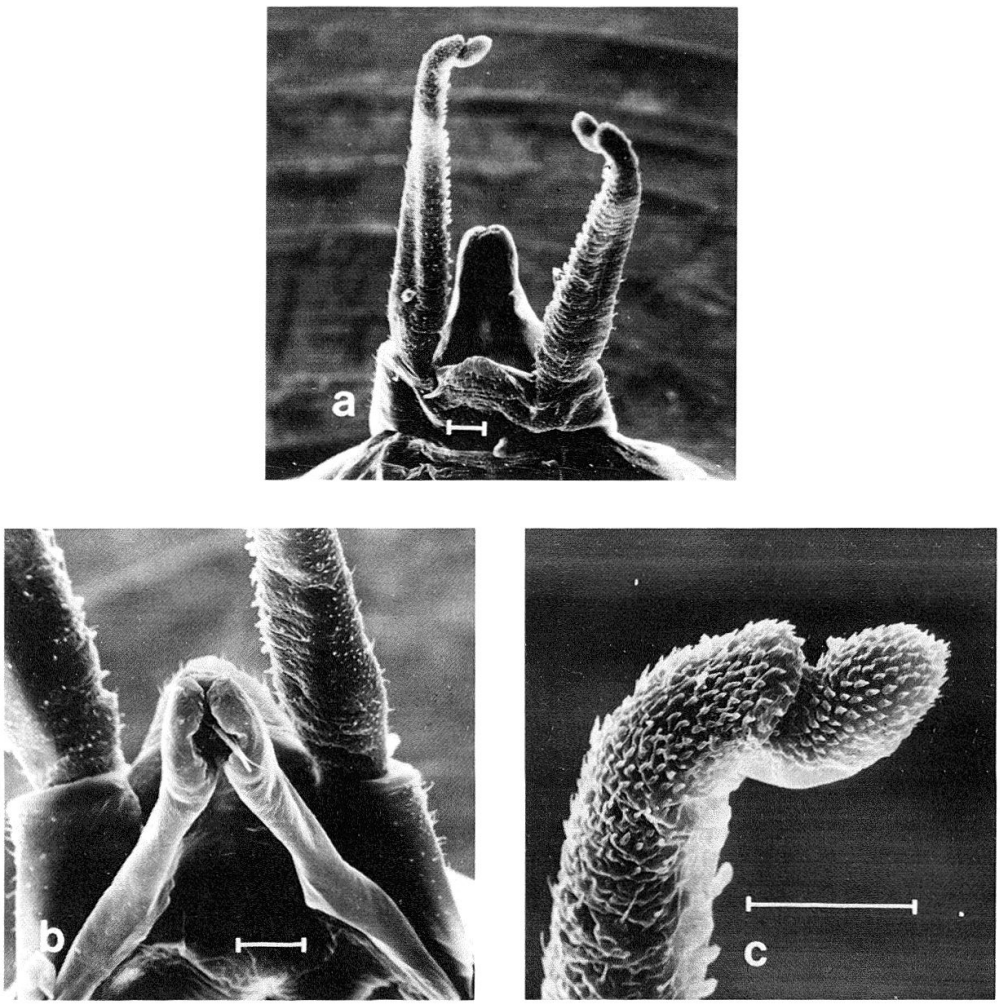


Fig. 27. *Serratella hispanica,* male imago. (Scale line: 50 μm.) a: Genitalia, ventral view. b: Penis, dorsal view. c: End of the forceps, ventral view.

Kept in alcohol: 2 male imagines, 6 female imagines, 5 subimagines, 20 nymphs and 5 nymphal skins.
Kept frozen: 90 female imagines.
All the material is deposited at the address of the authors.

DESCRIPTION OF *EURYLOPHELLA IBERICA* KEFFERMUELLER & DA TERRA, 1978

Egg

The eggs were extracted from the imaginal abdomen. They have a nearly rectangular form and they lack the polar cap. The chorion is covered with many polygonal plates (fig. 18a), and the interior presents a macrogranulation made of great and small lemon-yellow vesicles (fig. 18b). The dimensions of the egg are about 250 μm in length and 165 μm in width.

Nymph

The female nymph has been described by KEFFERMUELLER & DA TERRA (1978), and the male nymph by GONZALES DEL TANAGO & GARCIA DE JALON (1983). Lamellate gills are present on abdominal segments 3 to 7. The abdominal terga present paired median tubercles, and the abdominal segment 9 is conspicuously elongated in comparison with the segments 6, 7 and 8. The femur does not present an acute point at apex (cf. op. cit. fig. 4b). The whole body of the nymph is covered with long and sparse hairs. The maxillar palpi are absent (fig. 22b). The labial palpi are short, hardly reaching the anterior margin of the labium (fig. 22a). The first segment of the palpus is much broader than the second. The tarsal claws possess little and small denticles, numbering 5 to 6 (fig. 20).

Imago, male and female

The imagines are described by KEFFERMUELLER & DA TERRA (1976). In order to show the pattern of the abdominal segments, a dorsal view of the male imago (fig. 23) and a ventral view of the female imago (fig. 25) are drawn. The genitalia of the male (fig. 28) are presented in ventral view (fig. 24a) and the penis in dorsal view (fig. 24b).

Length of the fore leg-parts of the male: femur 1320 μm, tibia 2070 μm, tarsus I 1100 μm, tarsus II 970 μm, tarsus III 700 μm, tarsus IV 400 μm, total tarsi 3170 μm.

Subimago, male and female

The characteristical pattern of the subimago is presented on fig. 21. The yellowish thorax possesses one long black spot on each side. The abdominal segments 4 to 7 retain vestiges of gills on their postero-lateral margin.

Ecology and development

We found larvae near the holotype-locality, in N. W. Portugal, on the 20.7.1986. The larvae were found only on *Potamogeton* sp. The other microhabitats of the river were occupied by *Ephemerella ignita* and some Heptageniidae, but no *Eurylophella iberica* were caught anywhere else than in the small *Potamogeton* area. We reared the nymphs which casted from 22.7.1986 till 18.8.1986, especially on the first days of August.

Taxonomy and systematics

The same characteristics as by *Drunella paradinasi* allows us to place this species in the Panota and in the family of Ephemerellidae.

That the nymph belongs to the genus *Eurylophella* is attested by the following characteristics (after EDMUNDS *et al.*, 1976):

- lamellate gills present on abdominal segments 4 to 7 (that excludes *Caudatella, Drunella, Ephemerella* and *Serratella*),
- apex of each femur without acute point (that excludes *Timpanoga*),
- abdominal terga with paired submedian tubercles (that excludes *Danella*),
- abdominal segments 5, 6, 7 conspicuously shortened, segment 9 conspicuously elongated so that length of segment 9 is about equal to the combined length of segments 5, 6 and 7 (that excludes *Attenella*).

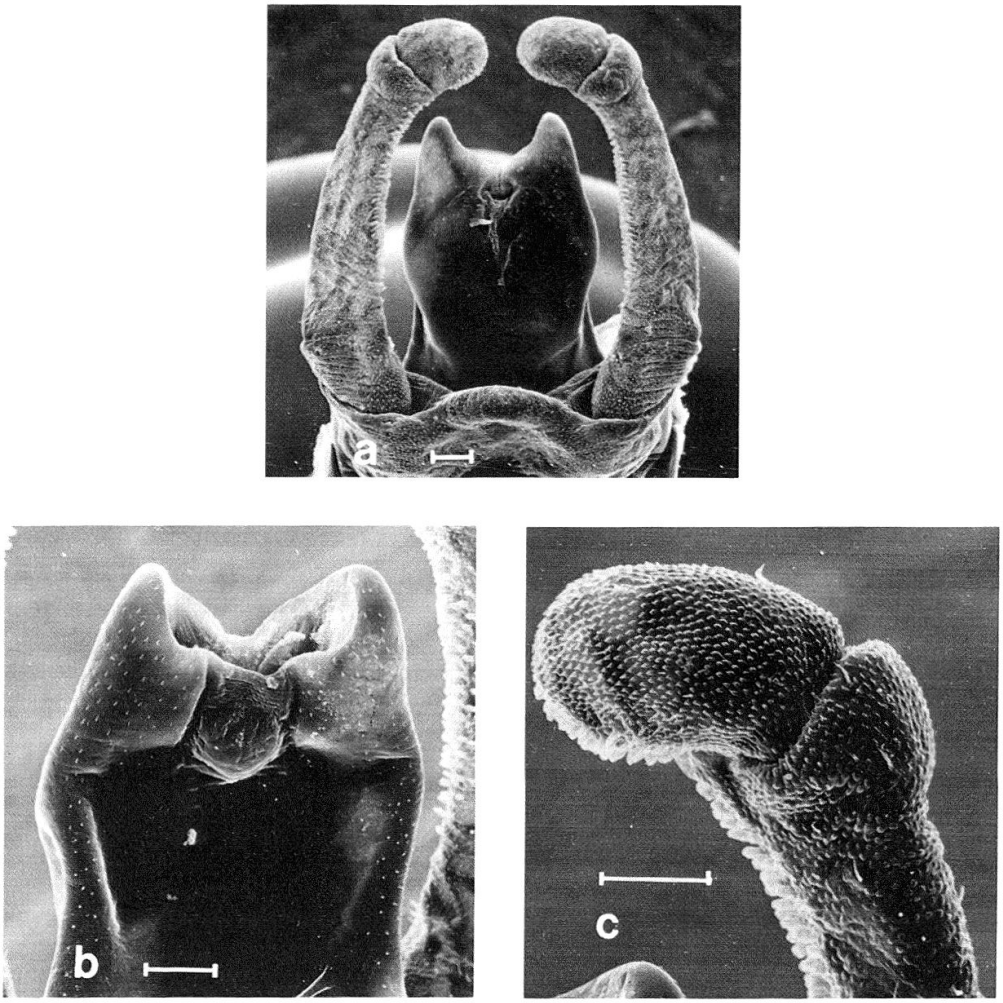


Fig. 28. *Eurylophella iberica,* male imago. (Scale line: 50 μm.) a: Genitalia, ventral view. b: Penis, dorsal view. c: End of the forceps, dorsal view.

Its belonging to the genus *Eurylophella* is confirmed by the imago:
- cerci and terminal filament subequal in length (that excludes *Caudatella*),
- terminal segment of genital forceps less than twice as long as broad, penes without spines (little spines are visible, but only by scanning-electron-microscopy as on fig. 28b), without long lateral apical lobes, without subapical projections, fore tibiae shorter than tarsi (all those exclude *Attenella, Drunella, Ephemerella, Serratella*),
- no vestigial nymphal gills retained on abdominal segments (that excludes *Timpanoga*),
- segment 3 of fore tarsi shorter than segment 2 (that excludes *Danella*).

The absence of the polar cap on the egg is a typical characteristic for the genus *Eurylophella* (Koss, 1968).

Material

All the material comes from the following locality:
Rio Coura, in Santa near Paredes de Coura, N. W. Portugal, alt. 300 m.

Kept in alcohol: 3 male imagines, 2 female imagines, 5 subimagines, 3 nymphs and 30 nymphal skins.
Kept frozen: 9 male imagines, 16 female imagines.
All the material is deposited at the address of the authors.

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RESUME

La description de trois espèces d'Ephemerellidae de la Péninsule Ibérique est complétée pour tous les stades: *Drunella paradinasi* Gonzales Del Tanago & Garcia De Jalon, 1983, *Serratella hispanica* (Eaton, 1887) et *Eurylophella iberica* Keffermueller & DaTerra, 1970. L'appartenance aux genres *Drunella* Needham 1909, *Serratella* Edmunds 1959 et *Eurylophella* Tiensuu 1935 est discutée pour la nymphe, l'imago et l'œuf de chaque espèce.

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