

# TAXONOMIC AND FAUNISTIC NOTES ON THE *CAENIS PSEUDORIVULORUM*-GROUP (EPHEMEROPTERA, CAENIDAE)

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Two species of the *Caenis pseudorivulorum* group are known in Europe: *C. beskidensis* SOWA and *C. pseudorivulorum* KEFFERMÜLLER. Both species are present in Italy: the former has been found in the Northern regions while the latter seems to be present all over Italy. In Central and Southern Italy a third taxon of this group, *C. pseudorivulorum belfiorei* MALZACHER, is present. On the basis of nymph morphology, it now appears to be a form more closely related to *C. beskidensis* than to *C. pseudorivulorum*, and *C. belfiorei* is raised to the species level. The taxonomy and morphological characteristics of the three taxa are reported and discussed. A few notes on their ecology and life cycles are also given.

## INTRODUCTION

Taxonomy of the European species of the *Caenis macrura* and *C. pseudorivulorum* groups is in need of some revision. In both species-groups, ill-defined taxa are present in Italy. *C. martae* BELFIORE, 1984 and *C. pseudorivulorum belfiorei* MALZACHER, 1986. Systematic positions have to be reviewed. The aim of this work was to reassess the *C. pseudorivulorum*-group taxa present in Italy. The collection of new material from many Italian sites allowed for the first time a direct comparison between specimens from different localities.

During larval stages, the *pseudorivulorum*-group taxa bear a single series of short brush-bristles on the ventral side of II gills, a slight notch on the IX abdominal sternite and long bristles on the dorsal side of their fore femurs and on the abdominal lateral margins. Two species of this group are known in Europe: *C. beskidensis* SOWA, 1973 and *C. pseudorivulorum* KEFFERMÜLLER, 1960 (SOWA, 1973). *C. beskidensis* is a West-European species, while *C. pseudorivulorum* is East-European, its western distribution limit being in the Mediterranean area, the Italian region (MALZACHER, 1986). It is thought likely that the two species may hybridize, giving rise to populations with intermediate morphological characters (MALZACHER, 1986).

Despite the fact that both species have been reported in Italy (MALZACHER, 1986; BUFFAGNI, 1994) the species-group classification remains unclear. On the basis of male imagos from Central Italy (and from Greece), MALZACHER (1986) described a subspecies of *C. pseudo-*

*rivulorum*, named *C. pseudorivulorum belfiorei* and, at his own suggestion, this taxon was initially thought to be a new species (BELFIORE, 1983; 1984); it was provisionally named *C. belfiorei* and a first summary description of the nymph was provided (BELFIORE, 1983). Finally, however, this new taxon was considered to be the same species as *C. pseudorivulorum*, despite notable differences. From the same site, and at the same time, as the *C. pseudorivulorum belfiorei* specimens were found, some other nymphs of uncertain identification were collected. They were thought to be a local form of *C. beskidensis* (MALZACHER, 1986), but required further examples, especially of adult stages, to obtain a more accurate classification. At a later date, *C. beskidensis* was collected in Northern Italy (BUFFAGNI, 1994) and therefore considered widespread over the Italian peninsula (BUFFAGNI & BELFIORE, 1994).

The *pseudorivulorum*-group appears to be absent from Sardinia and Sicily (BELFIORE & GAINO, 1988; BELFIORE & D'ANTONIO, 1991; BELFIORE *et al.*, 1991).

This study therefore began from the starting point that *C. beskidensis* and *C. pseudorivulorum* (with the subspecies *C. pseudorivulorum belfiorei* in Central Italy) are present in Italy.

In the present study, inter-taxa comparisons have been carried out on the basis of morphological features of the nymphs. The following characters were considered: genae dimension; pronotum shape; length, abundance and position of pronotum bristles; orientation of the dorsal row of bristles on the fore femurs; length and position of the bristles on the hind margin of the fore femurs; length and shape of the bristles on the outer margin of II gills;

abdominal spines strength; development of the notch on the posterior margin of IX sternite; tarsal claw shape.

## RESULTS

Three taxa belonging to the *pseudorivulorum*-group were identified in material collected from many sites across Italy.

The presence of *C. beskidensis* in Italy has been confirmed for the Northern regions, where the species has now been found many times. *C. pseudorivulorum* has been found in many sites in the Po River and in some localities in Central and Southern Italy. The third taxon has only been collected in two sites, the River Tordino (Abruzzo) and Stream Marro (Calabria).

*Caenis beskidensis* SOWA, 1973

Nymphs of the Italian populations of *C. beskidensis* show an acceptable morphological correspondence with the species descriptions (SOWA, 1973; MALZACHER, 1984, 1986). Genae are large and easily recognizable in the head profile (Fig. 1). The posterior lamina of the IX sternite is relatively short (Fig. 2). Lateral spines on abdominal segments are strong. A high degree of variability was found when the

number and shape of the bristles in the dorsal row of the fore femur were compared between the different Italian populations. This row is nearly perpendicular to the femur. Bristles on the hind margin of the fore femurs are dense, long and present only in the distal part (Fig. 3). Some short or intermediate bristles are present on the fore outer margins of pronotum and very few long bristles are usually present on the hind outer edges (Fig. 1). The main morphological features of individuals of this species found in Italy (Figs 1-6) are listed in Table 1. Specific attribution has been confirmed by obtaining male images and mature nymphs exuviae from a location in Lombardy.

*Caenis pseudorivulorum* KEFFERMÜLLER, 1960

This species is present in Italy in the form of its typical subspecies. Nymphs coming from the different localities show a very low morphological variability. Genae are small and protrude weakly from the head profile (Fig. 1). Pronotum shape is parallel-sided or more often slightly convergent in the forward direction (Fig. 1). In female nymphs, the posterior lamina of the IX sternite is long, while in male nymphs it is often similar in length to that of the male nymphs of *C. beskidensis* (Fig. 2). Lateral spines on abdominal segments are smaller than

**Table 1.** Some of the considered morphological characters of *Caenis pseudorivulorum*, *C. beskidensis*, and *C. belfiorei* as seen in Italian material.

		<i>C.beskidensis</i>	<i>C.pseudorivulorum</i>	<i>C. belfiorei</i>
genae		large	small	large
pronotum	shape	parallel sided rectangular	convergent or par. sided rounded	parallel sided rounded
	bristles	reduced short or intermediate anterior/posterior	reduced short anterior	very notable very long ant./post. and lateral
fore femur	dorsal row	transversal	diagonal	transversal
	hind margin bristles	dense long distal half	scarce short whole margin	dense long whole margin
11 gill margin bristles	length	intermediate	short	very long
	shape	pointed	truncated	pointed
last lateral spines		strong	weak	strong
IX sternite notch		light	deeper	light

those seen in *C. beskidensis*. The spines on the IX segment are notably weaker than those of *C. beskidensis*. The notch on the posterior margin of the IX sternite is often deeper than that of *C. beskidensis* (Fig. 2). The dorsal row of bristles on the fore femur is diagonally disposed. Bristles on the hind margin of the fore femurs are scarce and short (Fig. 3). Bristles on the outer-distal margin of gills II are relatively short. They are intermediate between those of *C. beskidensis* and *C. pusilla* Navas, 1913 (Fig. 4). The margin bears bristles of different length and some very short truncated bristles are always present. A few short bristles are present on the fore-outer margins of the pronotum. Specific attribution was corroborated by examining the genital structures and sclerite pattern of mature male nymphs from various Italian localities and by comparing these with nymphs and male images from Central Europe (Czech Republic).

*Caenis belfiorei* MALZACHER, 1986 stat. nov.

The third taxon was collected in the Calabria region and in the River Tordino (TE), the same location as the males examined by Malzacher (BELFIORE, 1983; 1984; MALZACHER, 1984; 1986) and used to describe *C. pseudorivulorum belfiorei*. No nymphs morphologically similar to those of *C. pseudorivulorum* were found in this material. All the nymphs were similar but not identical to those of *C. beskidensis* found in Northern Italy. This taxon appears to be distinguishable from *C. beskidensis* at nymphal stages by a different developmental pattern and positioning of bristles in various body districts. In this taxon bristles are generally very long and abundant giving nymphs a «hairy» aspect. Marginal bristles on the posterior margin of the fore femurs are also very long in the proximal part (Fig. 3). Pronotum is usually parallel sided. Pronotum lateral margins bear bristles not only on their anterior and posterior edges, as with

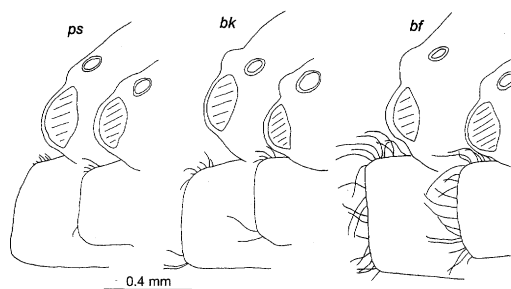


Fig. 1. Left side of pronotum and head in the nymphs of the *Caenis pseudorivulorum*-group taxa (ps: *C. pseudorivulorum*; bk: *C. beskidensis*; bf: *C. belfiorei*; same lettering in the next figures).

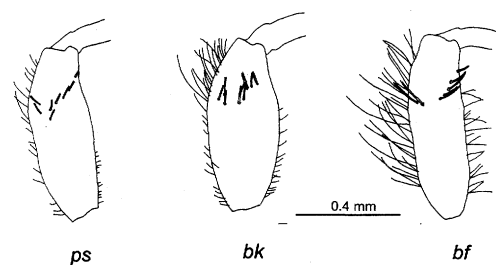


Fig. 3. Left fore femurs of the nymphs of the *Caenis pseudorivulorum*-group taxa.

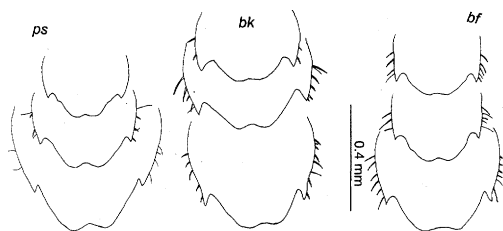


Fig. 2. Last abdominal sternite of the nymphs of the *Caenis pseudorivulorum*-group taxa. Top and middle: male nymphs; down: female nymphs.

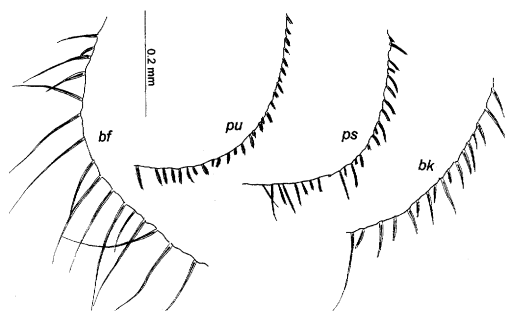


Fig. 4. Bristles on outer-distal edge of II gills in some *Caenis* taxa (ps: *C. pseudorivulorum*; pu: *C. pusilla*; bk: *C. beskidensis*; bf: *C. belfiorei*).

*C. beskidensis*, but also on their central-lateral section (Fig. 1). These bristles are very long. Bristles on the outer-distal edge of gills II are very long and do not vary in length (Fig. 4). Genae are large and rounded (Fig. 1). The lateral spines on abdomen are strong. The IX sternite spines are stronger than in *C. pseudorivulorum*. The IX sternite notch is similar to that of *C. beskidensis*. Tarsal claws are very slender with greatly reduced denticulation (Fig. 5). They appear more elongated than those of *C. pseudorivulorum* and *C. beskidensis*. In Fig. 6 the bristles on the lateral margins of the abdominal segment VII of three taxa are drawn, showing no notable differences.

**Material examined (m: male larva; f: female larva)**

*Caenis pseudorivulorum*: Italy. Lombardia: Balossa Bigli (Pavia), River Po, 75 m a.s.l., 6.X.1994, Buffagni & Losi leg., 1 mature male larva, 2 male larvae, 3 female larvae. Mezzana Corti (PV), R. Po, 65 m, 29.VI.1994, Buff. & Losi

leg., 1 m, 2 f; 25.VIII.1994, Buff. & Losi leg., 2 f; 6.X.1994, Buff. & Galli leg., 5 mature m, 9 m, 17 f. Mezzanine Po (PV), R. Po, 62 m, 29.IX.1994, Buff. & Losi leg., 1 m, 2 f. Chignolo Po (PV), R. Po, 53 m, VII.1990, Battagazzore leg., 1 m, 1 f. Casalmaggiore (Cremona), R. Po, 30 m, 24.VII.1990, Battagazzore leg., 1 f. Emilia-Romagna: Pontelagoscuro (Ferrara), R. Po, 7 m, 30.VIII.1990, Battagazzore leg., 1 m, 6 f. Lazio: Montalto di Castro (Viterbo), Fosso Timone, 80 m, 10.VII.1992, Belfiore & Fornasier leg., 1 mature m, 1 m, 3 f. Calabria: Cosenza (CS), River Crati, 250 m, 18.IX.1990, Battagazzore & Provini leg., 2 m, 4 f. Czech Republic: River Ohre, 25.V.1957, Landa & Soldan leg., 2 male imagines, 1 m, 1 f.

*Caenis belfiorei*: Italy. Abruzzo: Padula (Teramo), River Tordino, 950 m, 14.X.1993, Belfiore & Buff. leg., 3 m, 6 f. Calabria: Taurianova (Reggio Calabria), River Marro, 200 m, 9.XII.1989, Belfiore leg., 1 mature m, 1 m, 4 f.

*Caenis beskidensis*: Italy. Friuli Venezia Giulia: Udine (UD), Roggia di Udine, 115 m, 31.X.1981, Desio leg., 1 f. Sterpo (UD), Roggia dei Mulini, 15 m, 2.XI.1991, Buff. & Desio leg., 1 f. Paderno (UD), River Natisone, 100 m, 21.VII.1981, Desio leg., 1 f. Lombardia: Como (CO), River Seveso, 300 m, 28.V.1993, Viganò leg., 1 f. Ponte Lambro (CO), River Lambro, 400 m, 28.V.1993, Viganò leg., 1 m. Viggiu (Varese), River Clivio, 450 m, 25.VII.1994, Caverzasi leg., 13 male imagines, 5 larval exuviae. Terme di Tartavalle (Lecco), River Piovema, 420 m, 12.IX.1992, Buff. leg., 1 m. Corbetta (Milano), Fontanile Borretta, 135 m, 22.V.1992, Buff. et al. leg., 1 m, 1 f, 31 m/f; 24.VIII.1992, Buff. et al. leg., 3 m; 30.IX.1992, Buff. et al. leg., 1 f. Vittuone (MI), Fontanile Grande, 140 m, 21.I.1992, Buff. et al. leg., 1 f; 16.VI.1992, Buff. et al. leg., 1 f; 24.VIII.1992, Buff. et al. leg., 3 m. Toscana: Lagacci (Pistoia), River Reno, 500 m, 16.VII.1993, Gumiero leg., 1 f.

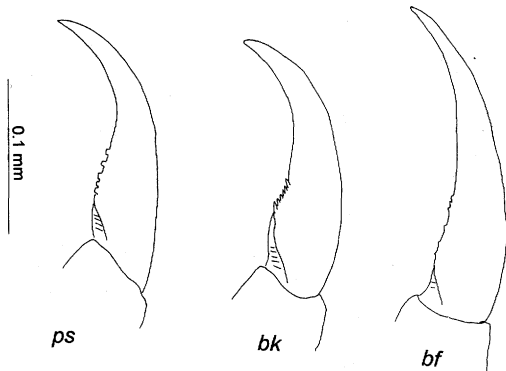


Fig. 5. Tarsal claws of the *Caenis pseudorivulorum*-group taxa.

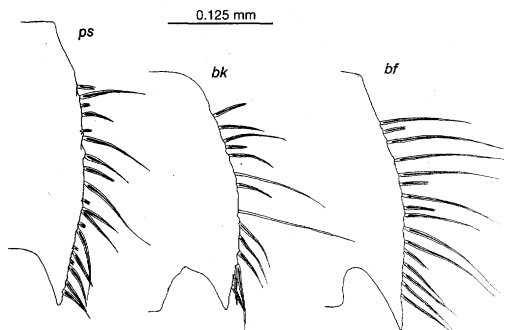


Fig. 6. Bristles on the VII abdominal segment lateral margin of the *Caenis pseudorivulorum*-group taxa.

## DISCUSSION AND CONCLUSION

*Caenis beskidensis* SOWA, recently reported for the first time in Italy (BUFFAGNI, 1994), has now been shown to be fairly common in Northern Italy, where it has been collected in many localities. This species is also known to be present in the Northern Apennines.

After the first captures in the Po Valley (Northern Italy), where the species is very common and abundant, the study of the material from Central and Southern regions lead to the hypothesis that *C. pseudorivulorum* is widespread all over Italy although not common in these other regions.

*Caenis belfiorei* is similar to *C. beskidensis* but differs significantly in certain morphological features, enabling them to be separated. Moreover, the presence of *C. pseudorivulorum* in Italy puts in a new per-

spective the classification of *C. pseudorivulorum belfiorei* MALZACHER, 1986 which can hardly now be considered as a subspecies of *C. pseudorivulorum*. The two taxa, despite the fact that they have never been found in the same site, are sympatric at least in the Calabria region (Southern Italy) where they have been collected in the Stream Marro (RC) and River Crati (CS) respectively, located a few kilometres from each other. At the moment the presence of the *C. belfiorei* has only been demonstrated for Calabria and Abruzzo.

The three taxa of the *pseudorivulorum*-group show different ecological needs: *C. pseudorivulorum* is a potamic species (MALZACHER, 1986), being very common in the Po River, while *C. beskidensis* is present in well oxygenated and usually unpolluted Piedmont streams (hyporhithron) and in the lotic stretches (epipotamon) of Northern Italy lowland springs (BUFFAGNI, 1994). *C. belfiorei* has been collected in small streams of the Apennines (rhithron). In Northern Italy *C. pseudorivulorum* seems to be univoltine, with mature nymphs in September/October. *C. beskidensis* can perhaps give rise, at the lower altitudes, to two generations, while for *C. belfiorei* mature nymphs can be found between late September and December.

The presence of *C. pseudorivulorum pseudorivulorum* all over Italy seems to exclude the possibility of the existence of other subspecies in the Italian peninsula. The status of *C. pseudorivulorum belfiorei* has therefore to be reviewed. On the basis of nymphal morphology it looks more similar to *C. beskidensis* than to *C. pseudorivulorum*, but is distinguishable from both of these species, all three being present in Italy. MALZACHER (1984, 1986) found strong affinities between males of this taxon and those of *C. pseudorivulorum*, thereby excluding the possibility of it belonging to the species *C. beskidensis*. It is therefore probable that the third taxon collected in Italy is not a subspecies of *C. beskidensis*, but is a new species of the *pseudorivulorum*-group.

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