Ecological considerations on the presence and distribution of the genus *Epeorus* EATON in the district of Cuneo (NW Italy) (Ephemeroptera: Heptageniidae)

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Abstract

The aim of the present study is the analysis of the distribution of the genus *Epeorus* (Ephemeroptera: Heptageniidae) in the province of Cuneo (NW Italy). In this territory, characterised by a significant geomorphological and environmental variability, this genus is represented by two species: *E. alpicola* and *E. sylvicola*. Considering 234 stations in the whole study area, *Epeorus* was always found in environments with little or no anthropogenic alteration. Although partially overlapping, the distribution areas of the two species are quite different. In particular, we found an evident difference in the presence of the two species along an altitudinal gradient.

Keywords: *Epeorus*, distribution, ecology.

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Introduction

The nymphs of the family Heptageniidae are typically wide and depressed, with prognathous mouthparts and trophic roles ecologically belonging to the functional feeding group of scrapers and collector-gatherers (Mc Shaffrey, 1988; Elliott *et al.*, 1988).

Heptageniidae generally present a low tolerance to environmental alterations (Russev, 1979; Buffagni, 1997), and they assume therefore a great importance as indicators of the environmental quality in many biomonitoring methods such as Family Biotic Index (F.B.I. - Hilsenhoff, 1988). The genus *Epeorus* EATON, 1881 is a typical representative of the family, with lithophilous nymphs, adapted to the life in the oxygenated and fast flowing waters of erosional lotic environments (Minshall, 1967); they play an important role as primary consumers in fast-water habitats, like riffles and cascades (Wellnitz *et al.*, 2001). This *taxon* is represented in Europe by five species (Zurwerra *et al.*, 1986): *E. zajtzevi* (THSERNOVA, 1981), *E. torrentium* EATON, 1881, *E. alpicola* (EATON, 1871), *E. sylvicola* (PICTET, 1865) and *E. yougoslavicus* (ŠAMAL, 1935). Of these species, only the last three are reported for the Italian fauna: the first one is characteristic of Northern Italy, the second one is widespread in the whole peninsula and also in the isles, while the last one is only reported for the central and southern regions, Sicily included (Belfiore, 1988, 1994). Electrophoretic enzyme analysis and comparative studies of larval morphological characters indicated a close philogenetical proximity between *E. alpicola* and *E. yougoslavicus* and between *E. sylvicola* and *E. torrentium* (Zurwerra *et al.*, 1986).

Aim of our study was to describe the pattern of distribution of the nymphs of the different *Epeorus* species in an area of north-western Italy and to discuss its ecological meaning.

Material and Methods

The study area essentially corresponds to the province of Cuneo. The territory presents a surface of 6,903 sq. km and shows a considerable environmental variety, ranging from the Alps, with 14 main valleys and numerous peaks over 3.000 m a.s.l., to extensive hilly areas and alluvial lowlands: the area presents great altitudinal, morphological and climatic differences.

Sampling campaigns were undertaken in the years 1998-2001, in different seasons. Most stations were examined in spring (42%) but also in

summer (15%), fall (17%) and winter (26%). We examined a total of 234 stations referred to 49 rivers and streams, characterised by different environmental conditions and covering the entire hydrographical network. A hand net (250 µm mesh) was used to collect the nymphs; samples were fixed in ethyl alcohol (70°) and subsequently examined in the laboratory with a stereoscopic microscope (20/60 X). Distribution data were stored using the ArcView™ Geographical Information System and represented on a 1:50.000 map.

The presence of the species was compared with climatic, geomorphologic and biological parameters. Climatic classification of the study area was conducted according to the Bagnouls and Gaussen method (as reported in Regione Piemonte 1998), based on the alternation of temperatures and average monthly precipitations during the year. We considered four main subregions: xeroteric - submediterranean, mesoxeric - ipomesoxeric, axeric-temperate cold, axeric-oroigrothermic cold. Geological characterisation of basins was undertaken using local geological maps; we considered 18 principal geological units, converted for statistical analysis in three main groups (calcareous facies; non calcareous crystalline-metamorphic facies; colluvial, alluvial non calcareous depositional facies). Biological assessment of environmental quality was obtained according to the Indice Biotico Esteso (I.B.E.) (Ghetti, 1997). Oxygen rate and water temperature were taken in some stations.

Results

Two species of *Epeorus* were found in the studied area: *E. alpicola* and *E. sylvicola*. *E. torrentium*, widely present in nearby France, has never been recorded for the Italian side of the Alps.

Table 1 - Statistical differences between distributions of the two species.

Parameter	value	Probability
Climatic region	U=3093.0	n.s.
Geological substrate	U=3093.0	n.s.
Altitude	U=4491.0	P<0.001***
I.B.E. class	U=2001.5	P<0.005**

E. alpicola was found in 17.9% and *E. sylvicola* in 53.8% of the stations examined, while in 13.2% both species were present. Both species were found during the whole year without significant seasonal differences. The complete list of stations can be found in the database of the Environmental Protection Agency of Piemonte, Cuneo Department.

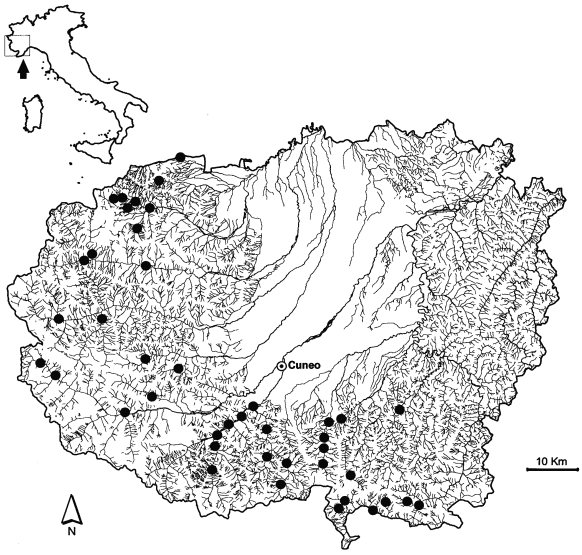

Fig. 1 - Distribution of *Epeorus alpicola* in Cuneo district.

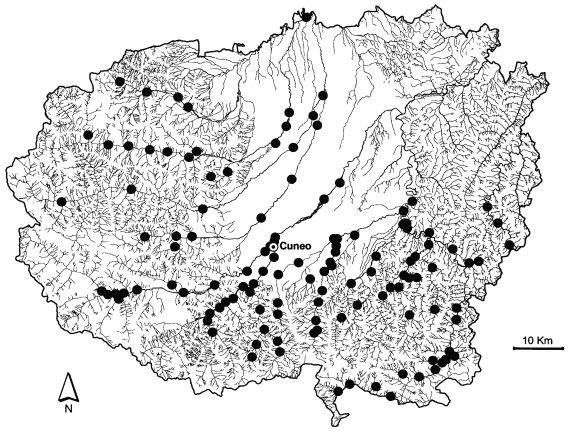

Fig. 2 - Distribution of *Epeorus sylvicola* in Cuneo district.

An evident difference between the altitudinal distribution patterns of the two species was detected (Figs. 1-3). The sampling locations were characterized by different pluviometric and climatic conditions (Table 1), but no climatic-related differences were observed between the distributions of the two species. Both *E. alpicola* and *E. sylvicola* were found in different lithological environments, without evident preferences for a specific substrate. Furthermore, *Epeorus* was always present in conditions of good environmental quality, in accordance with the well-known sensitivity of this *genus* to

environmental alterations. *Epeorus* specimens were found in association with rich and diversified benthic communities, characterised by many *Plecoptera* and reophilous *Ephemeroptera*, such as *Ecdyonurus* sp. and *Rhithrogena* sp. Considering the I.B.E. quality classes, we found a significant difference between the two species. *E. alpicola* was almost always found in the first I.B.E. class, while *E. sylvicola* seems to be more tolerant, living in first (65.9%), second (26.2%) and also third (7.9%) class environments. The different altitudinal pattern can be related to the different specific sensitivities (in fact, generally lower altitude environments are characterised by a stronger degree of alteration).

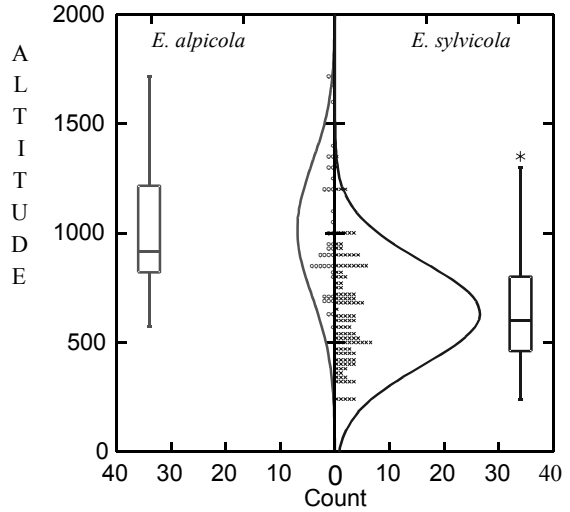

Fig. 3 – Difference in the altitudinal distribution of the two species in the study area.

The strongest difference between the two species was in their altitudinal distribution (Fig. 3): the lowest sampling location was near Casalgrasso (Po river, 240 m a.s.l. - *E. sylvicola*), the highest near Crissolo (Vallone dei Quarti, 1714 m a.s.l. - *E. alpicola*). *E. sylvicola* preferentially colonized hilly and lowland lotic environments, between 240 and 1350 m a.s.l. (mean=632.7, SD=236.4). *E. alpicola* was preferentially found in mountain lotic habitats, with a lower altitudinal limit of 570 m a.s.l. and with some stations above 1700 m a.s.l. (mean=1014.9, SD=305.7). In various stations, between 600 and 1500 m a.s.l., both species were present.

We were also able to consider the rate of dissolved oxygen and water temperature for some stations in which *E. alpicola* (n=5) or *E. sylvicola* (n=24) were found. We detected a significant difference in the values of maximum temperature recorded ($t=-6.20$, $P<0.001$) and mean dissolved oxygen ($t= 4.68$, $P<0.001$).

Discussion and Conclusions

The two species show a partially overlapping distribution within the study area. No differences in climate or in geological substrate were observed, while the greatest difference which emerged was the one related to altitude: in fact, *E. alpicola* predominates at higher reaches, whereas *E. sylvicola* is most abundant at lower altitudes.

The genus *Epeorus* is know to be very intolerant of organic wastes (Plafkin *et al.*, 1989; Mandaville, 2002): we found that *E. sylvicola* seems to be more tolerant than his congeneric in our study area. The absence of *E. alpicola* at low altitudes could be related to a lower tolerance to antropogenic alteration or also to a stronger stenothermal tendency. For the temperature and the rate of dissolved oxygen, we found an evident difference in the few cases for which data were available, but we are confident that these elements play an important role in determining the distribution of these species: interestingly, the distribution of *E. alpicola* seems identical to that of the autochthonous brown trout *Salmo trutta* LINNAEUS, 1758, while that of *E. sylvicola* seems similar to that of *Salmo marmoratus* (CUVIER, 1871) in this area (Regione Piemonte, 1992). Since in mountain areas the slope of the river bed is greater and water flow faster, our hypothesis is that in these strongly erosive environments, the well developed front gills and the low hydrodynamic profile of *E. alpicola* can play an important role in the adhesion to the substratum, increasing the area of marginal contact of the animal and reducing the possibility of the water flowing under the nymph's body, as reported for other *taxa* (Hynes, 1979).

Our data suggest that ecological factors related to altitude, such as water temperature, dissolved oxygen and slope are the main elements that regulate the distribution of the two species in the study area. Our findings agree with a study of the distributional ecology of benthic insects, in which Allan (1975) found that congeners having similar microhabitat preferences exhibit marked mutual exclusion in vertical distribution (*Rhithrogena* sp.), while other congeners differ in microhabitat preferences and show lower degree of exclusion (*Ephemerella* sp.).

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