Distribution patterns of *Hydropsyche incognita* (Pitsch, 1993) and *H. pellucidula* (Curtis, 1834) in Transylvania (Romania), with special reference to their ecological requirements (Trichoptera: Hydropsychidae)

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Abstract. Ecological requirements of hydropsychid Trichoptera larvae were analyzed on different collecting sites in Transylvania (Romania) to better understand which environmental factors separate populations of *Hydropsyche incognita* and *H. pellucidula*. Environmental parameters were analyzed by mutivariate statistics. Altitude or altitude-related stream characteristics are likely to be the most important factors that influence the presence/absence of these species at the sampled localities: larvae of *H. pellucidula* preferred higher altitudes compared to the larvae of *H. incognita*. We provide additional notes on the distribution and ecology of further hydropsychid species in Transylvania.

Keywords. Freshwater ecology, river continuum, springs, streams, caddis larvae.

1. Introduction

Distribution of hydropsychid caddis larvae in streams and rivers and their coexistence may be affected by a series of factors: anthropogenic impact (Higler & Tolkamp 1983, Higler 1995, Czachorowski 1988, Englund et al. 1997), stream sequence (Malicky 1984, Hildrew & Edington 1979, Roux et al. 1992), hydraulic stress (Bournaud et al. 1989), life-cycles (Hildrew & Edington 1979, Bournaud

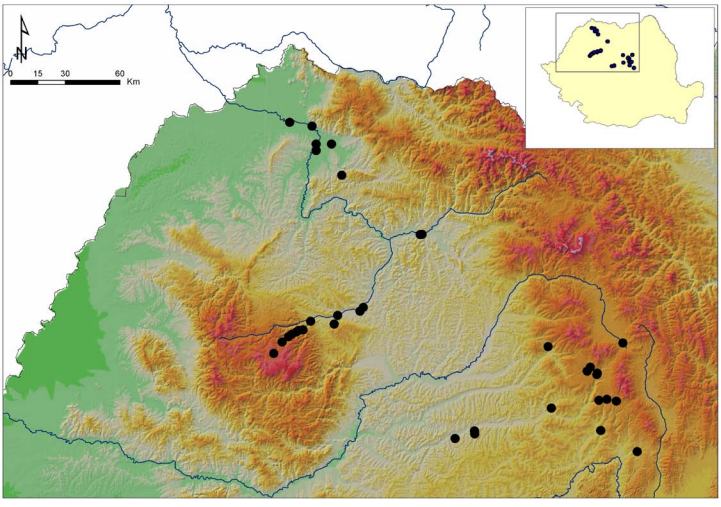


Fig. 1. Location of sampling sites.

et al. 1989), water velocity (Tachet et al. 1992), temperature regimes and longitudinal distribution (Hildrew & Edington 1979, Roux et al. 1992), competition for food and net-spinning sites, diet (Hildrew & Edington 1979), microhabitat preferences and substrate type (Hildrew & Edington 1979, Czachorowski 1989, Dudgeon 1997).

Hydropsyche incognita and *H. pellucidula* both belong to the *pellucidula*-group with rather similar distribution pattern around Europe (Pitsch 1993a, Pitsch 1993b). The presence of *Hydropsyche incognita* in Romania was first announced by Malicky (1999) based on imagines. The larvae of the species were first identified in 2004 in the Someş River, close to the city of Cluj. It seems plausible that many larvae and adults previously identified as *H. pellucidula* actually belong to *H. incognita*. It was expected that once the presence of the species was confirmed in the country, it will be common and widely distributed, as in other areas of distribution in Central Europe (Pitsch 1993b). The present work investigates which environmental factors have major effects on the distribution of *H. pellucidula* and *H. incognita* larvae in the Transylvanian running waters.

2. Materials and methods

Hydropsychid larvae were collected with a handnet and individual sampling from 28 sites on eighteen watercourses in Romania: Someşul Rece, Someşul Mic, Someşul Mare, Someş, Lăpuş, Gârbău, Târnava Mare, Nicău Alb, Homorodul Mare, Homorodul Mic, Vârghiş, Brădeşti Mare, Fântâna Mare, Mureş, Săcădat, Buzd, Bierţan, Băţani (Fig. 1). Samples were taken during the Summers of 2004 and 2005. Larvae were preserved in alcohol and identified using the keys of Waringer & Graf (1997) and Neu & Tobias (2003). Water pH, temperature and conductivity were also measured on eighteen sampling localities. Annual average temperatures of the sites were determined with the help of a climate map obtained from the Romanian Research Institute for Science and Agrochemistry. The distance between the spring and the sampling sites was measured on a georeferenced map. Relative abundance of the species was calculated prior to data analysis. Relationships between the abundance of individuals and environmental parameters were analyzed by Spearman rank correlation in SPSS 8. A standardized PCA was performed for the ordination of collecting sites based on the environmental dataset in PAST (Hammer et al. 2001).

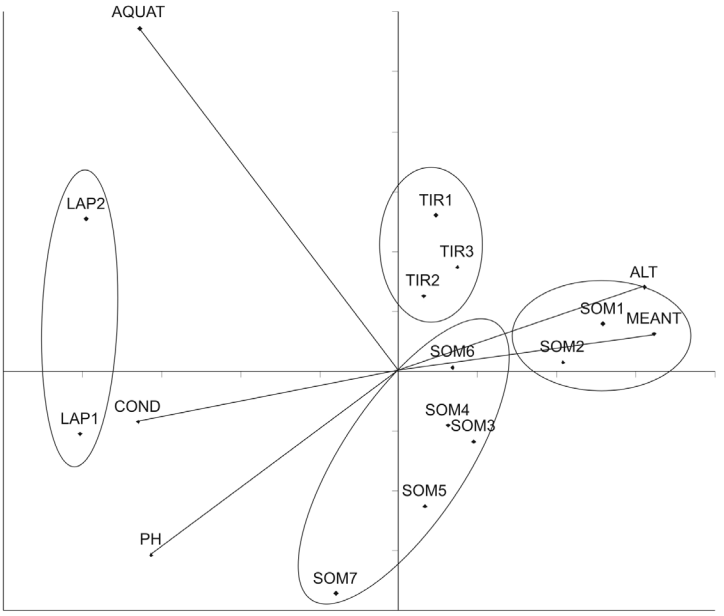


Fig. 2. Sites where *H. incognita* and/or *H. pellucidula* are/is present, grouped by environmental variables by standardized PCA.

3. Results

We identified the following ten *Hydropsyche* species on the 34 sampling sites: *H. incognita*, *H. pellucidula, H. contubernalis* (McLachlan, 1865), *H. bulbifera* (McLachlan, 1878), *H. saxonica* (McLachlan, 1834), *H. fulvipes* (Curtis, 1834), *H. modesta* (Navas, 1925), *H. instabilis* (Curtis, 1834), *H. tabacarui* (Botoşaneanu, 1960), *Cheumatopsyche lepida* (Pictet, 1834).

The standardized PCA performed on environmental variables distinguished three groups of sampling sites. Two sites on the Someşul Rece (SOM1 and SOM2) were grouped together, here only *H. pellucidula* was recorded. The second group was formed from sites on the Someşul Rece and Târnava Mare (SOM4, SOM5, TIR1, SOM6, SOM7, TIR3; SOM3) where only *H. incognita* is present or both species are present together. On the Someşul Rece site SOM3 only *H. pellucidula* was found. The altitude and annual average temperature is quite similar for these sites, more important differences were found only in the water temperature and pH. Sampling sites on the Lăpuş river (LAP1, LAP2) are situated on lower altitudes with a higher annual average temperature. Here only *H. incognita* was present.

A significant positive correlation was found between the altitude and the relative abundance of *H. pellucidula* (p=0.01, correlation coefficient a=0.63). While *H. incognita* was identified at altitudes between 150-700 m, *H. pellucidula* was found between 500 and 1270 m (Fig. 3). The Someşul Rece is a clear example where *H. incognita* is replaced by *H. pellucidula* at higher altitudes (Fig. 4).

A raw distribution map of the identified hydropsychid larvae was prepared (Fig. 5). A significant negative correlation was found between the distance from the spring and the relative abundance of the larvae of *H. saxonica*. No larvae of this species were found at distances larger than 25 km from the spring (p=0.01, a=-0.653). Other investigated factors had no statistically significant effects on the presence of *H. saxonica* larvae. The relative abundance of *H. contubernalis* larvae negatively correlated with the altitude (p=0.01, a=-0.72) and positively with the distance from the spring (p=0.01, a=0.735) and with the annual average temperature (p=0.01, a=0.546). None of the investigated factors had statistically significant influence on the presence of *H. bulbifera* and *H. incognita* larvae at the collecting sites.

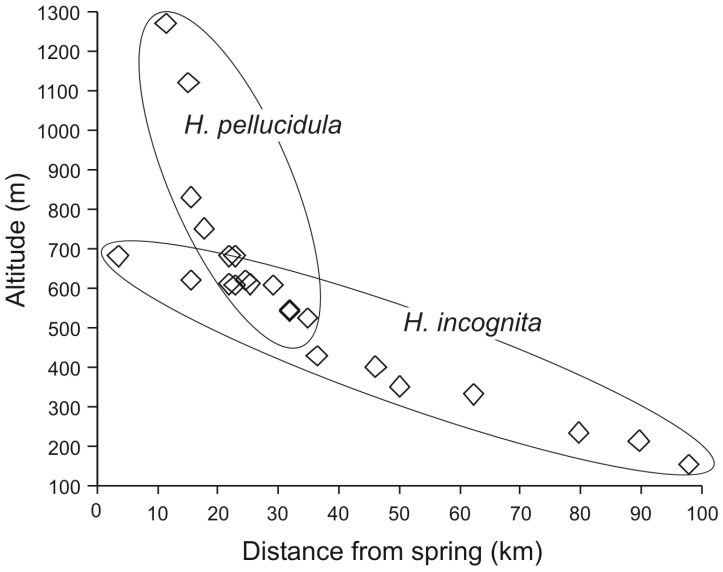


Fig. 3. Altitude and distance from the spring of the sites where *H. incognita* and *H. pellucidula* were found.

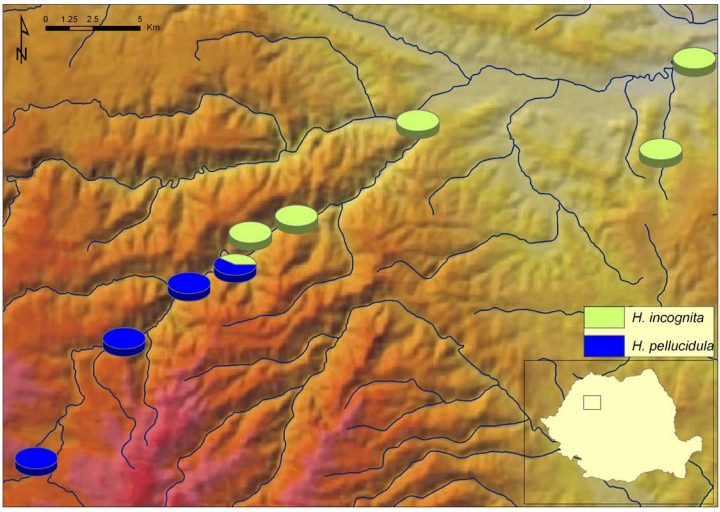


Fig. 4. With increasing altitude *H. incognita* specimens disappear and *H. pellucidula* becomes dominant.

4. Discussion

The results presented evidence that the distribution patterns of *H. incognita* and *H. pellucidula* larvae in Transylvania can be described under the river continuum model. *Hydropsyche pellucidula* is present mainly in the rhitral, hyporhitral zones of the streams, while *H. incognita* occupies the lower reaches of watercourses. The presence of different hydropsychid caddis larvae in different zones of watercourses was also demonstrated by Hildrew & Edington (1979) and Roux et al. (1992).

Our dataset suggests that *H. incognita* and *H. bulbifera* larvae are adapted to a broader spectrum of habitats: they were present at different altitudes, at sites located at different distances from the springs, influenced by various annual average temperatures. *Hydropsyche saxonica* was present only at short distances from the springs, while the altitude or the temperature had a statistically significant effect over the presence of the species. This suggests that the distribution of *H. saxonica* larvae is affected by parameters not investigated during the present work, such as dissolved oxygen, suspended materials, chemicals, food availability, etc.

While anthropic factors have important effects on the composition of hydropsychid communities, the investigation of their influences was behind the aims of this study. These factors are also related to the altitude and to the distance of localities from the spring. The lower river sections usually are under a higher anthropic pressure, which is tolerated only by certain species. Further sampling of Transylvanian sites and the analysis of more parameters will contribute to a better understanding of factors responsible for the distribution patterns of hydropsychid species.

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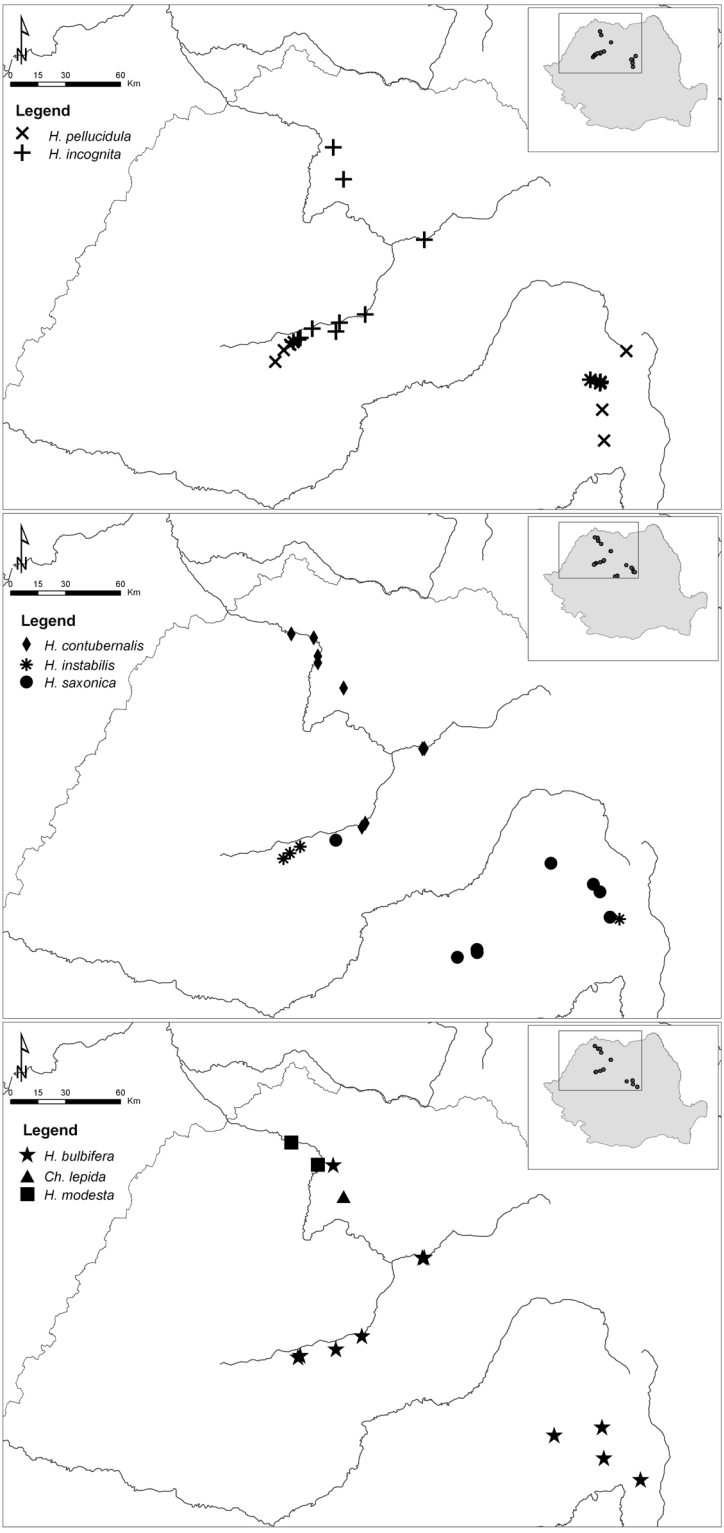


Fig. 5. Distribution maps of *H. incognita*, *H. pellucidula*, *H. contubernalis*, *H. instabilis*, *H. saxonica*, *H. bulbifera*, *H. modesta* and *Cheumatopsyche lepida*.

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