HYPORHEIC CHIRONOMIDS IN ALPINE STREAMS

By Valeria Lencioni,1* Marziale, L.1 & Rossaro, B.2

With 1 table and 2 figures

ABSTRACT: Chironomids were collected in the hyporheic zone of two Alpine streams (2270 m a.s.l., NE Italy) with a Bou-Rouch pump and artificial devices. A total of 28 genera were identified, mainly belonging to Orthocladiinae and Diamesinae. The hyporheic was visited by I-IV instar larvae and pupae as (i) atrophic source, (ii) a refuge from spates, droughts, freezing and predators, (iii) a migratory corridor and (iv) as a nursery.

RESUMO: No presente trabalho os quironomídeos foram recolhidos na zona hiporreica de dois rios Alpinos (2270 m, NE Italia) através de uma bomba “Bou-Rouch” em conjunto com outros dispositivos artificiais. Foram identificados 28 géneros de quironomídeos, pertencentes maioritariamente aos Orthocladiinae e Diamesinae. A zona hiporreica é utilizada por pupas e larvas entre o primeiro e o quarto instar, principalmente como: (i) fonte de alimento; (ii) refúgio face a cheias, secas, gelo e a predadores; (iii) corredor migratório; e (iv) zona de reprodução.

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INTRODUCTION

The hyporheic zone is an active ecotone bounded by the stream channel above and the true groundwater below (BENCALA, 2000). Some benthic species use this zone to avoid competition and predation and it has been suggested to be a nursery and a refuge from substrate movement and flow variance due to spates, floods or drought (WILLIAMS & HYNES, 1974). The importance of this zone for recolonization mechanisms and successional processes has been stressed by several authors (e.g. DOLE-OLIVIER et al., 1997) but little information is available on high mountain streams, especially glacier fed systems (MAIOLINI et al., 2005). These streams are characterized by high degree of patchiness and extreme environmental conditions, mainly in summer, when discharge and turbidity are high with wide diurnal variation (up to 5-10 times higher in the afternoon than in the morning) and the substrate is very unstable (CASTELLA et al., 2001). The aim of this study was to investigate which role the hyporheic plays in high altitude Alpine streams dominated by chironomids.

MATERIAL AND METHODS

The hyporheic zone (0-30 cm depth) of two Alpine streams with different origins was investigated (2270 m a.s.l., NE Italy): the glacial stream Noce Bianco (gl) and its non-glacial tributary, the Larcher (ngl). The glacial stream is fast-flowing (2.0 ± 0.5 m s⁻¹), large (4-20 m), meandering and dominated by gravel substrate, with a mean temperature 3.9 ± 1.4 °C in the summer and 0.6 ± 0.4 °C in the winter. The non-glacial stream is a smaller (3 m wide) and slower-flowing (0.7 ± 0.2 m s⁻¹) pebble stream, rich in mosses and with vegetated banks, with a mean temperature 5.1 ± 1.8 °C in the summer and 1.9 ± 0.8 °C in the winter (LENCIONI et al., 2006).

Aquatic invertebrates were sampled in 2003-2005, every 15 days in summer and from one to three months in the other seasons. A Bou-Rouch pump was used (BOU & ROUCH, 1967). Three pipes were fixed at 30 cm depth into the sediment along the river transect, one at the left bank, one in the middle channel and one at the right bank. Ten liters of water were pumped at each site. Two types of artificial substrates (traps and tubes) were also used. Traps were made from one litre plastic bottle with the opening cut off and inserted upside down. At each station, nine traps and three 1 meter long plastic tubes were buried horizontally in the substrate, at depths of 10 to 30 cm and at -10 cm respectively. Each tube was filled with pebbles (total surface 0.2 m²) and had only the downstream end open. Each tube was divided into two 50 cm long halves to detect which organisms were able to migrate upstream and how far the distance they migrated (up to 50 or 100 cm). Samples were preserved in 75% ethanol and chironomids were identified to genus/species under the microscope (1000x). Differences between samples and dates were analyzed with the nonparametric tests of Mann-Whitney and Kruskal-Wallis. The
statistical analysis software program STATISTICA Version 6.0 was used.

RESULTS

A total of 800 individuals were collected, distributed between 28 genera and 63 species/groups of species, mainly belonging to Orthocladiinae (Fig. 1). Higher abundance (76% of individuals) and richness (26 genera in ngl and 19 in gl) were recorded in the non-glacial reach (Table 1).

TABLE 1. Number of chironomid specimens and genera recorded in tubes, traps and Bou-Rouch pump.

<table>
<thead>
<tr>
<th></th>
<th>Tubes</th>
<th>Bou-Rouch pump</th>
<th>Traps</th>
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<tr>
<td></td>
<td>gl</td>
<td>ngl</td>
<td>gl</td>
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<tr>
<td>N. specimens</td>
<td>4</td>
<td>202</td>
<td>39</td>
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<tr>
<td>N. genera</td>
<td>4</td>
<td>19</td>
<td>15</td>
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Significant differences (Kruskal-Wallis test, p < 0.05) were found for Diamesinae (more abundant in gl), Chironominae (more abundant in ngl) and Tanypodinae (exclusive of ngl). At species level, gl was characterized by high abundance of Pseudodiamesa branickii (Nowicki, 1873), Chaetocladius piger gr., Parakiefferiella bathophila (Kieffer, 1912) and Stilocladius montanus Rossaro, 1979 while ngl by Cricotopus sp., Micropsectra radialis type, P. branickii, Parametriocnemus stylatus (Spärck, 1923) and S. montanus.

Most individuals (59%) were captured with traps, 25% with the tubes and 16% with the pump. The highest diversity was found in the traps (Table 1), the lowest in the tubes at gl and
in the pump samples at ngl. Three different assemblages were found, with some taxa abundant only in the Bou-Rouch samples (e.g., *Microspectra radialis*-type and *Paratanytarsus australicus* (Kieffer, 1924) at ngl, *P. bathophila* and *S. montanus* at gl), others in the tubes (e.g., *Cricotopus sp.*, *Euorthocladius rivicola* gr.) and others in the traps (*Diamesa spp.*, *P. branickii* and *P. stylatus* at ngl, *P. branickii* and *Chaetocladius piger* gr. at gl).

Mature larvae (IV instar) were found as predators (e.g. *P. branickii*) and prey (orthoclads) down to 30 cm in the traps, where also some pupal exuviae and few adults (*Gymnometriocnemus volitans* (Goetghebuer, 1940)) were recorded. All larval instars were observed moving upstream in the tubes, among which *Euorthocladius rivicola* gr., *Cricotopus sp.*, *Diamesa bertrami* Edwards, 1935 and *Eukiefferiella brevicalcar* (Kieffer, 1911) showed the strongest positive rheotaxis.

Young larvae (I instar) were collected mainly deep in the sediment with the Bou-Rouch pump, and II-III instars resulted dominant in the artificial substrates (Fig. 2).

![Figure 2. Relative presence of larvae (L1, L2, L3, L4), larval exuviae (Le), pupae and pupal exuviae (P-Pe) and adults (A) in the hyporheic zone of two alpine streams.](image)

**DISCUSSION**

The use of artificial substrates has been recognised as a valid method for investigating high mountain streams invertebrate community in, even in the hyporheic zone (LENCIONI et al., 2006). However, tubes and traps seem to be not always effective at the glacial station due to the large amount of silt and high channel instability that clog and damage them, especially in summer. Furthermore, the accumulation of fine sediment in the substrate limits the pumping action within the first 30-50 cm of depth.

In both streams the hyporheic was visited by stygogen and stygophile chironomids for several reasons: (i) as trophic source for mature larvae; (ii) as refuge area for overwintering quiescent larvae (LENCIONI, 2004) and for larvae and pupae in summer, when spates are frequent; (iii) as a migratory corridor for all instar larvae and (iv) as nursery for young larvae, as highlighted by other authors for invertebrates inhabiting glacial streams (MALARD et al., 2003) or highly instable river systems (FOWLER & DEATH, 2001).
Orthocladiinae, co-dominant with Diamesinae in the kick samples (LENCIONI et al., 2006), generally prevailed in the artificial substrates, exhibiting high mobility, as already noticed in other studies (FENOGLIO et al., 2002). These results highlighted the importance of vertical connectivity in maintaining zoobenthic biodiversity in highly disturbed habitats characterized by strong seasonality.

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