SEASONAL AND LONGITUDINAL CHANGES IN THE MACROINVERTEBRATE COMMUNITY OF THE RIVER MOLDOVA (MOLDAVIA, ROMANIA)

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KEYWORDS: Romania, Moldavia, relative abundance, frequency, biodiversity.

ABSTRACT

The seasonal and spatial variations in the invertebrate community from the Moldova River have been studied in 6 sections of the Moldova River from May to October 2007.

40 taxa have been identified. The most abundant species and taxa were *Rhitrogena semicolorata* (S1, S2), *Baetis rhodani* (S1, S2, S3), *Caenis rivulorum* (S6) and *Subfamily Orthocladiinae* (S2, S3, S4) and *Subfamily Chironominae* (S5, S6). The calculated saprobic index showed I and II quality classes for all sections except section S6, class III.

The changes observed in the composition of the functional groups of the invertebrate communities are similar to those proposed by the Continuous River concept. In the upstream sections the shredders are not dominant since these sections lack the shadow usually existing in the sources area.

The cluster analysis shows that the samples from the S2, S3 sections are similar to those from S4, S5 in terms of diversity. The sections S1 and S6 are different in terms of the populations' diversity from those of the other sections due to the physical and chemical parameters, the river's morphometry as well as a possible pollution.

REZUMAT: Schimbari sezoniere si longitudinale in comunitatea de macronevertebrate a Râului Moldova (Moldova, România).

Variațiile sezonale şi spațiale ale comunității de nevertebrate din râul Moldova au fost studiate în 6 secțiuni de-a lungul râului Moldova în mai - octombrie 2007.

Au fost identificați 40 de taxoni. Cele mai abundente specii şi taxoni au fost *Rhitrogena semicolorata* (S1, S2), *Baetis rhodani* (S1, S2, S3), *Caenis rivulorum* (S6) şi Subfam. *Orthocladiinae* (S2, S3, S4) şi Subfam. *Chironominae* (S5, S6). Indicele saprob calculat arată clase de calitate I - II pentru toate secțiunile cu excepția secțiunii S6 clasa a III a.

Schimbările observate în compoziția grupurilor funcționale a comunității de nevertebrate sunt similare cu cele propuse în conceptul de continuum lotic. În secțiunile din amonte nu sunt dominanți mărunțitorii deoarece secțiunile nu sunt foarte umbrite ca cele din zona izvoarelor.

Analiza cluster arată că probele din secțiunile S2, S3 şi cele din S4, S5 sunt similare ca diversitate. Secțiunile S1 şi S6 sunt diferite din punct de vedere al diversității populațiilor față de celelalte secțiuni datorită parametrilor fizico-chimici, morfometriei râului şi a unei posibile poluari.

RESUME: Modifications saisonnières et longitudinales dans la communauté des macroinvertebrés de la rivière Moldova (Moldavie, Roumanie).

Les variations saisonnières et spatiales dans la communauté d'invertébrés de la rivière Moldova ont été étudiées sur 6 sections de la rivière entre les mois de mai et d'octobre 2007.

40 taxons ont été identifiés. Les espèces et les taxons les plus abondants ont été *Rhitrogena semicolorata* (S1, S2), *Baetis rhodani* (S1, S2, S3), *Caenis rivulorum* (S6) et la Sous-fam. *Orthocladiinae* (S2, S3, S4) et la Sous-fam. *Chironominae* (S5, S6). L'indice saprobie calculé a montré des classes de qualité I et II pour toutes les sections à l'exception de la section 6, classe de qualité III.

Les changements observés dans la composition des groups fonctionnels des communautés d'invertébrés sont similaires à ceux proposés par le concept de la Rivière Continue. Dans les sections situées en amont les déchiqueteurs ne sont pas dominants car les sections ne sont pas très ombragées, tel celles de la zone des sources.

L'analyse par partitionnement des données montre le fait que les échantillons des sections S2, S3 et celles des sections S4, S5 sont similaires en termes de diversité. Les sections S1 et S6 sont différentes des autres sections en ce qui concerne la diversité des populations à cause des paramètres physico-chimiques, la morphométrie de la rivière ainsi qu'à cause d'une possible pollution.

INTRODUCTION

Longitudinal and seasonal shifts in benthic community structure, either in species composition or functional feeding group composition, due to changes in physical, chemical and geomorphological characteristics, have been documented by many authors (Allan, 1975; Vannote et al., 1980; Winter-Bourn et al., 1981; Dudgeon 1984; Brussock et al., 1985; Minshall et al., 1985; Statzner and Higler 1986; Huryn and Wallace 1987; King et al., 1988; Grubaugh et al. 1996).

The benthic communities in the streams in the north part of Romania have not been all characterized from an ecological and functioning of ecosystems point of view. The macroinvertebrate part of this community is important for water quality evaluations used in European biomonitoring programs. Therefore, it is important that more studies focus on the structure and function of lotic invertebrate communities in the north of Romania to increase our knowledge and allow comparisons of information between regions.

This paper presents results from a study on the dynamics of the benthic invertebrate community in a mountain river.

MATERIALS AND METHODS

A first-order river, the Moldova river is located in NE Romania. The river Moldova arises from springs in a mixed forest area, runs through forest, hills, villages and cities, and about 213 km downstream from its origin, flows into Siret river near city Roman. The Moldova river is a fast flowing, up to 15 m - 20 m wide and 0.3- 0.7 m deep depending on season and precipitations. It has three main tributaries: Moldovița, Suha Mare and Ozana.

For the ecological investigation of benthic fauna, six sampling sites in the Moldova river were investigated from the upper part Fundu Moldovei - S1, Amonte Câmpulung Moldovenesc - S2, middle part Aval Gura Humorului - S3, Baia - S4, Timişeşti - S5 and Roman - S6 in lower part of the river.

The headwaters and middle sections of the Moldova river were partly shaded by riparian vegetation (*Alnus incana, Myricaria gemenica, Salix alba, Salix pupurea*). The dominant substrate was cobbles (S1, S2) and gravel with cobbles (S2, S3, S4). The channel become wider downstream, less intensively shaded by riparian vegetation (*Salix* sp*., Populus* sp.) and the dominant substrates was gravel (S5, S6).

Macroinvertebrate samples were taken by standard Surber net (mouth opening 30 x 30 cm, mesh size 0.3 mm) using transect sampling methodology, three month per year in three sampling sites, and another 3 sampling sites for 2 month per year in the interval between May 2007 and October 2007. Samples were preserved in 4% formaldehyde and organisms were sorted and identified to species level where possible.

Selected physical and chemical parameters were measured: temperature ºC, oxygen saturation % and oxygen content mg/l (Oxygenometers InoLab Oxi 730), pH (pH-meteters SevenEasy), Conductivity µS/cm (InoLab Cond 730), CaO Hardness ºGerman was determined by titration.

Species diversity was assessed using the Simpson diversity index. Water quality was evaluated with the saprobic index (Pantle-Buck modificated - Romanian Monitoring Programme) and expressed as quality class.

Spatial and temporal changes in the structure of macroinvertebrates communities were performed with cluster analyses on the basis of Bray-Curtis dissimilarity using the MVPS software. Functional feeding groups were determined after Merrit and Cummins (1978) and expressed as a percentage of density.

RESULTS AND DISCUSSIONS

The physical and chemical conditions at selected sampling sites are presented in the table 1.

Temperature, pH, conductivity showed seasonal variations and variation among sampling sites. The Moldova river headwaters had quite constant temperature in the summer (14 - 16ºC) whereas temperatures and its amplitude increased downstream 20ºC. Similar patterns were observed for conductivity, and CaO hardness. Oxygen saturation and oxygen content at all sites were typicall for fast flowing river and reached 86%, 96.7% or exceed 96.7%.

A total of 40 taxa of macroinvertebrates were identified during two season. Mean number of individuals per sample, number of taxa, mean of Simpson Diversity index and saprobic quality class are presented in the table 2.

Table 1: Physical and chemical parameters at sampling sites in the Moldova river.

Sites	Elevation (m)	Catchment area (km2)	Temp. (°C)	Oxygen saturation %	Dissolved O2 (mg/l)	pH	Conductivity (µS/cm)	Hardness (°german)
S1	726	327	5...16	78 - 89.2	8 - 9.1	8.2	203.2	7.8
S2	633	660	6...17	79.8 - 90.2	7.9 - 11.5	8.2	214.7	7.2
S3	468	1757	5...18	83.7 - 90.4	8.8 - 11.2	8.3	302.4	9.7
S4	412	2558	8...20	72 - 93.2	6.6 - 11.7	7.8	443	12.4
S5	320	3468	8...15	108 - 126	10.9 - 11.5	8.2	411.6	12.5
S6	204	4299	9...20	88.8 - 96.7	8.8 - 10.2	8.1	440.5	10.5

Table 2: Biological characteristics at sampling sites S1 - S6 in the Moldova river; no. ind - mean number of individuals per sample; no. taxa - number of taxa; S - Simpson diversity index; QC - quality class.

Sites	S1	S2	S3	S4	S5	S6
No. ind.	178	267	119	119	164	104
No. taxa	13	10	9	9	7	6
S	0.89	0.83	0.75	0.82	0.75	0.66
QC	I	I	I	I-II	I-II	III

Species diversity were lowest at the lower parts (S6), highest in the upper parts and middle (S1, S2, S4), declined in the middle parts (S3, S5).

The most abundant species in the macroinvertebrates community were *Rhitrogena semicolorata* (S2, S1), *Baetis rhodani* (S1, S2, S3), *Caenis rivulorum* (S6) and the chironomid subfamily *Orthocladiinae* (S2, S3, S4), subfamily *Chironominae* (S5, S6). Saprobic values indicated quality class I - II for all sampling sites except S6 - III. Organic pollution may be one of the possible reason for low taxa diversity in S6. The most diverse group were mayflies (11 taxa), dipterans (10 taxa), stoneflies (7 taxa), trichopterans (5 taxa), oligochaeta (3 taxa) and with 1 taxa: crustaceans, Odonata, and Hirudinea.

The observed changes in functional feeding groups composition (Fig. 1) of macroinvertebrates community were similar in some respects to those proposed in the river continuum concept (Vannote et al., 1980). In the upper part the shredders are not dominant (9.14 %), because the sections there are not very shaded. The sections from upper part is not in the spring area.

In the upper part of the Moldova river (S1, S2) collectors/scrapers dominated (43.4% and 47.9% respectively) filterers (23.2%) in S2, whereas in the S3, S4 dominated filterers (29.1%), collectors/scrapers (28.3 %), and in S4 predators are importants (21.1%). In the middle parts in S5 dominated collectors (66.3 %) then collectors/scrapers (16.3%) and generalist like *Gammarus* (13.04%) and in S6 dominated collectors (48.1%), predators (33.01%).

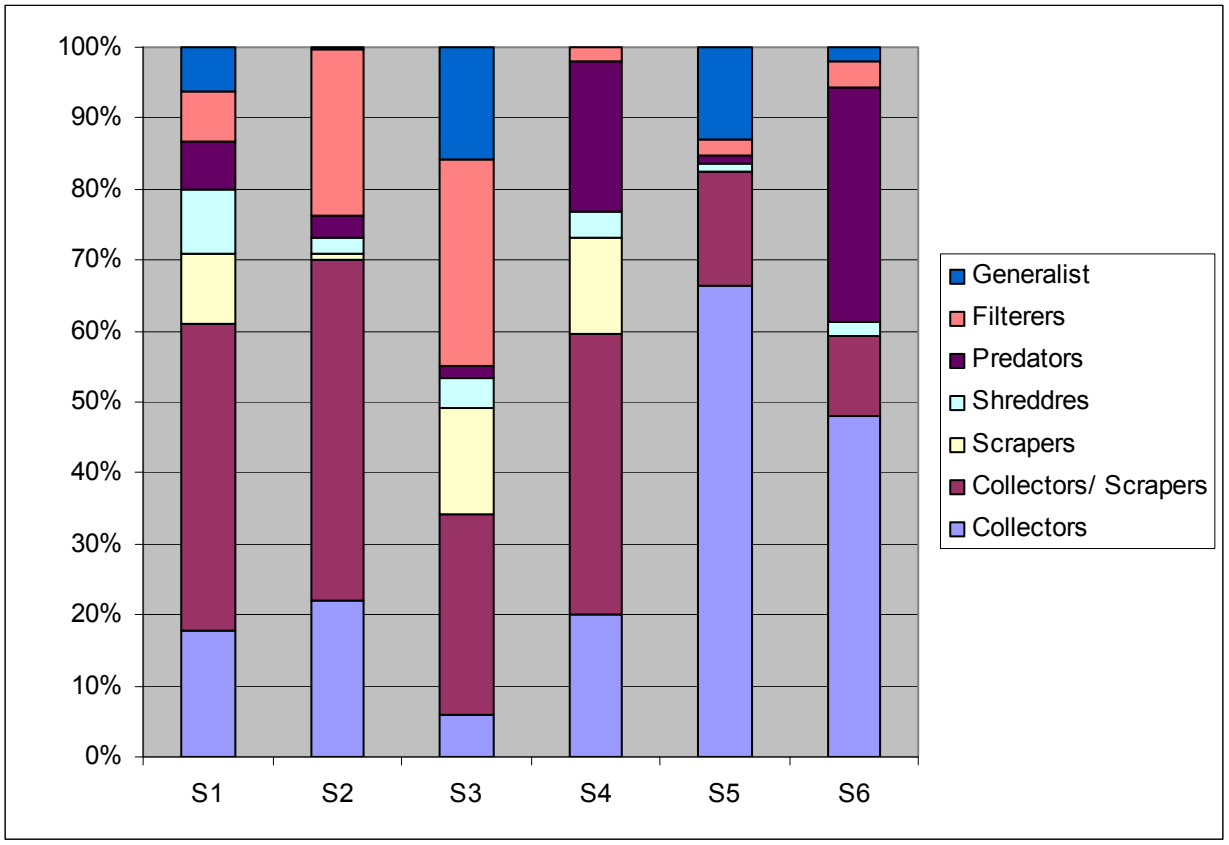

Figure 1: Composition of functional feeding groups in the Moldova river; data are shown as percentage of density (%); S1 - S6 - sampling sites.

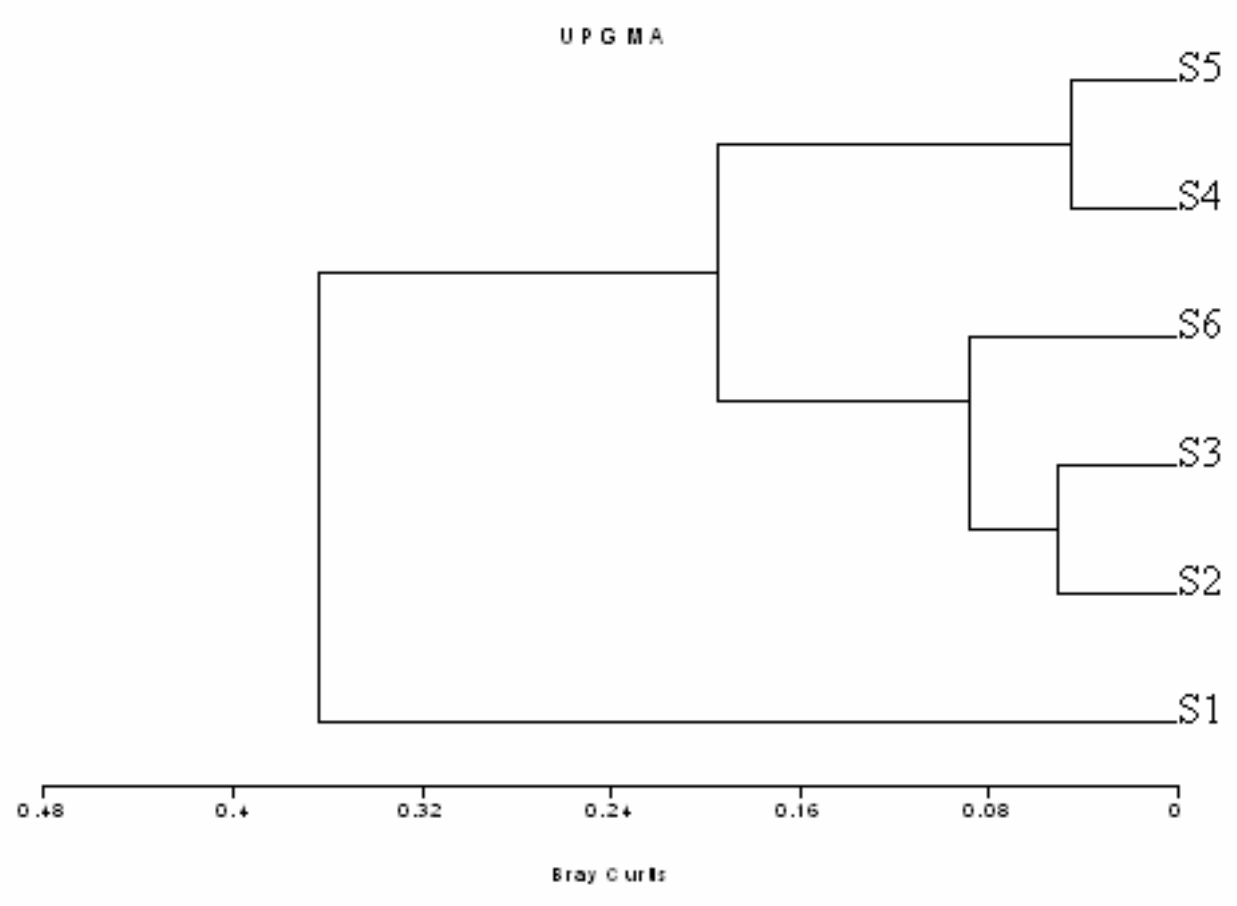

Figure 2: Cluster analysis of macroinvertebrate samples collected in the Moldova river; S1 - S6 sampling sites.

Cluster analysis have shown in the figure 2 that the samples from the sampling sites (S2, S3) and (S4, S5) are similar from the point of view of diversity. In contrast S1 and S6 are different in the macroinvertebrate community diversity in comparison with other sampling sites because of physico-chemical parameters, morphometry features (S1) and possible organic pollution (S6).

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