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The Chironomidae Assemblages in Somesul Mic River (Romania) During 1996 and 1997

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ABSTRACT

The communities of Chironomidae larvae in the Gilau - Gherla sector of the Somesul Mic River (Transylvania, Romania) were studied during 1996 and 1997 in order to compare their species composition and to see if their component species could be good bioindicators for water quality deterioration. A total of 102 species were recorded, out of which 12 are new records for the Romanian fauna. Four of these species are known only from East Asia and from the North America. Some species such as Chironomus thumi, Microcricotopus bicolor, Dicrotendipes nervosus and Dicrotendipes notatus occurred in organically enriched waters. Other species, such as Cricotopus algarum, Cricotopus bicinctus, Cricotopus tremulus and Cricotopus trifasciatus occurred in both clean and organically polluted water which indicate they are not good bioindicators for water quality deterioration.

KEY WORDS: *benthic communities, chironomidae, bioindicators, organic pollution*

INTRODUCTION

In a previous paper we suggested a scheme illustrating a succession of steps (activities) for a environment quality assessment study (Tudorancea and Tudorancea 2001). We only remind here the fact that the selected parameters used by most ecologists in impact and water quality assessment studies are features that characterize the three ecological systems: population, biological community and ecosystem. Species diversity, species composition, dynamics and trophic relations are among the most frequent parameters used in such studies.

Except for the Danube and the Danube Delta, few ecological studies were carried out on lotic systems in our country, and among those, most have been of faunistic nature (Galdean 1994, Galdean & Staicu 1997, Petrovici 1999, Sarkany – Kiss & Hammer 1997, Szito, 1995, Tudorancea 1999, Tudorancea & Tudorancea 1998). The aim of this paper is to question if changes in community structure and diversity can represent indicators for the differences in water quality taking as an example the assemblages of chironomid larvae from the Gilau-Gherla sector of the Somesul Mic river. The need for identifications to the species level is pointed out as well, aiming to efficiently use this group of aquatic organisms in monitoring or assessing water quality of a stream or river (Tudorancea & Tudorancea 2002).

STUDY AREA AND METHODS

The study area has been described and illustrated elsewhere (Tudorancea & Tudorancea 1998). The Somesul Mic river is one of the two main tributaries of the Somes River, that represents the largest drainage basin in the North-West region of the country. The river is formed at the Somesul Cald and Somesul Rece junction, West of Gilau at 428 m. altitude and about 15 km. upstream of Cluj Napoca city. Approximately 100 km. downstream, the river joins the Somesul Mare river, close to Dej town, at 236m altitude. The whole Somes river basin has a moderate continental climate, characteristic to the entire West and Northwest Romania.

The Somesul Mic River is exposed to human impact due to pastoral, industrial and agricultural activities. The least affected zones are the headwaters of its two tributaries, the Somesul Cald and the Somesul Rece rivers. The most exposed regions are Cluj Napoca and Dej sectors. Undoubtedly, the city of Cluj represents the main impurification source, because of the organic pollutant discharge coming from the city pharmaceutical and textile industries (Szatmari & Bolos 1999). Moreover, the only wastewater treatment station for industrial and domestic waters is inefficient. Other pollution sources (especially organic pollution) are the Apahida and Gherla localities, downstream of Cluj.

Biological samples were collected from three sites, selected in accordance with the existence of the pollution sources: 1. the Gilau station, located 15 km. upstream of Cluj Napoca, represented the control site because of the lack of major pollution sources, excepting the surrounding villages; 2. the Apahida and 3. the Gherla sampling sites, both downstream of Cluj. The sampling stations 2 and 3 are exposed to organic impurification, caused by Cluj Napoca town, as well as by animal farms from Apahida-Gherla sector. The results presented in this paper come from the samples taken five times: August and October 1996, and May, August and October 1997. At Gilau and Apahida stations three quantitative zoobenthos samples were taken across the river each time, with a benthic sampler of Surber type which covers a surface of 930.25cm^2. At the Gherla site, due to the sandy and clay sediment, five samples were collected every time by means of a tubular corer covering a surface area of 19 cm^2. Samples were washed in a nylon net with 250 µm meshes, in order to avoid loss of small-size larvae. The identifications were made using the keys by Czhernovschi (1949), Pankratova (1970, 1977), Wiederholm (1983) and Botnariuc and Cure (1999).

Each sampling period, a few water physico-chemical factors were measured in the field. The oxygen was measured with an oxygen-temperature meter, type YS1, model 55, and the pH with a pH-meter, type YS1. Other parameters, such as TDS (total dissolved solids), COD (chemical oxygen demand), suspensions, nitrates and ammonia were determined at the Technological Chemistry Department, of the Faculty of Chemistry, "Babes-Bolyai" University.

RESULTS AND DISCUSSION

The values of the water and sediment physical and chemical factors at the three sampling sites have been recorded elsewhere (Tudorancea & Tudorancea 1998, 2002). One can remind that all the water parameters, except for the pH which recorded similar values at all three sampling sites, had higher values at the Apahida and Gherla stations indicating a higher degree of organic enrichment at these two sites. The disolved oxygen had lower values at the Apahida and Gherla stations. The substratum was similar at Gilau and Apahida stantions consisting of gravel and sparse cobbles. At Gherla, the substratum was mostly composed of sand and clay.

In a previous preliminary study (Tudorancea & Tudorancea 1998) a total of 18 chironomidae species were recorded at stations Gilau and Apahida during October 1996. Out of these, five species were new records for Romania. During this study a total of 102 chironomid species belonging to five subfamilies were identified in the Somesul Mic River during 1996 and 1997 (**TABLE 1**):

Orthocladiinae-47 species
Chironominae-38 species
Tanypodinae-11 species
Diamesinae – 5 species
Prodiamesinae-1 species

One should emphasize that twelve species are new records for Romania: Tanypodinae (1 species), Diamesinae (1 species), Orthocladiinae (6 species), Chironomini (1 species) and Tanytarsini (3 species). Out of these 12 species, four are only known from other geographical areas. *Rheopelopia perda* (Roback), *Orthocladius clarki* Soponis and *Sublettea* *coffmani* (Roback) were described in Nearctic and *Chironomus nigrocaudatus* Erbaeva known from East Siberia (Fittkau & Roback 1983, Cranston *et al.* 1983, Pinder & Reiss 1983, Ashe & Cranston 1990). To our knowledge, the occurrence of these species represents the first records in Europe. One should mention that *Rheopelopia perda* (Roback) and *Orthocladius clarki* Soponis have previously been cited for the rivers Somesul Mic and Crisul Repede by Tudorancea (1999) and Tudorancea and Tudorancea (1998) without mentioning they are the first records both for the Romanian and European fauna.

Except for Diamesinae, which occurred in low species diversity and frequency of occurrence only at the control station (Gilau) , there were no great differences in the subfamilies composition of the chironomid communities at the three samplig stations (TABLE 1). In other words no conclusion could be underlined about the importance of the chironomids in water quality assessment if they are considered at the subfamily level as it is usually the practice in many countries. A different picture is obtained when the identifications are made to the species level and numerical abundances of the common species are represented (see also Tudorancea & Tudorancea 2002).

TABLE 1. List of chironomid species and their frequencies of occurrence (%) at the three sampling stations. Frequency data are averaged over the sampling period (1996 and 1997). (*new records for Romania; ** new records for Europe).

	Taxa	Frequencies of occurrence (%)					
		Gilau		Apahida		Gherla	
		1996	1997	1996	1997	1996	1997
	Subfamilia Tanypodinae						
1.	*Ablabesmyia monilis*	33	0	0	0	0	0
2.	*Ablabesmyia phatta*	0	11	0	0	0	0
3.	*Conchapelopia melanops*	33	0	0	0	0	0
4.	*Conchapelopia* sp.	16	0	0	0	0	0
5.	*Natarsia punctata*	0	0	0	11	0	0
6.	*Rheopelopia perda* **	33	0	0	0	0	0
7.	*Rheopelopia* sp.	0	11	0	0	0	0
8.	*Tanypus kraatzi*	0	0	0	0	20	0

TABLE 1 (cont. 1)

	Taxa	Frequencies of occurrence (%)					
		Gilau		Apahida		Gherla	
		1996	1997	1996	1997	1996	1997
9.	*Tanypus* sp.	16	0	0	0	0	0
10.	*Thienemannimyia geijskesi*	16	0	0	0	0	0
11.	*Thienemannimyia senata*	0	0	0	0	20	0
	Subfamilia Diamesinae						
12.	*Diamesa carpathica*	0	22	0	0	0	0
13.	*Diamesa hygropetrica**	16	0	0	0	0	0
14.	*Diamesa* sp.1	0	11	0	0	0	0
15.	*Diamesa* sp.2	33	0	0	0	0	0
16.	*Potthastia campestris*	16	11	0	0	0	0
	Subfamilia Prodiamesinae						
17.	*Prodiamesa olivacea*	0	22	0	11	0	0
	Subfamilia Orthocladiinae						
18.	*Corynoneura celeripes*	16	0	0	0	0	0
19.	*Corynoneura lacustris**	0	11	0	0	0	0
20.	*Corynoneura lobata*	0	0	0	0	20	0
22.	*Cricotopus algarum*	83	88	100	100	0	55
23.	*Cricotopus bicinctus*	66	100	40	33	0	33
24.	*Cricotopus biformis*	0	11	0	0	0	0
25.	*Cricotopus cylindraceus*	0	0	0	0	0	22
26.	*Cricotopus fucicola*	0	11	0	0	0	11
27.	*Cricotopus latidentatus*	33	11	0	0	0	0
28.	*Cricotopus tremulus*	83	11	40	0	0	0
29.	*Cricotopus trifasciatus*	50	0	40	0	0	0
29.	*Cricotopus sylvestris*	0	0	60	0	20	0
30	*Cricotopus vitripennis*	16	0	0	0	0	0
31.	*Cricotopus* sp.1	16	44	0	11	0	0
32.	*Cricotopus* sp.2	0	22	0	0	0	0
33.	*Cricotopus* sp.3	0	44	0	0	0	0
34.	*Cricotopus* sp.4	0	33	0	0	0	0
35.	*Cricotopus* sp.5	0	0	40	0	0	0
36.	*Epoicocladius ephemerae*	0	0	20	0	0	0
37.	*Eukiefferiella alpestris*	33	0	0	11	0	0
38.	*Eukiefferiella gr.brehmi*	0	0	20	0	0	0
39.	*Eukiefferiella claripennis*	33	0	0	22	0	0
40.	*Eukiefferiella hospita**	16	0	0	11	0	0
41.	*Eukiefferiella longicalcar*	33	11	0	0	0	11
42.	*Eukiefferiella longipes*	16	0	0	0	0	0
43.	*Eukiefferiella uadridentata*	33	0	0	0	0	0

TABLE 1 (cont. 2)

	Taxa	Frequencies of occurrence (%)					
		Gilau		Apahida		Gherla	
		1996	1997	1996	1997	1996	1997
44.	*Eukiefferiella similis*	16	0	0	0	0	0
45.	*Eukiefferiella* sp.	0	0	0	0	0	11
46.	*Heterotrissoclad. ubpilosus**	0	0	0	0	0	11
47.	*Microcricotopus bicolor*	0	0	20	0	60	0
48.	*Nanocladius rectinervis*	0	0	0	0	0	11
49.	*Orthocladius clarki***	33	11	0	0	0	0
50.	*Orthocladius consobrinus*	16	0	0	0	0	0
51.	*Orthocladius gen 1 fontana*	0	0	0	0	0	33
52.	*Orthocladius rivulorum*	16	0	0	0	0	0
53.	*Orthocladius saxicola*	50	11	0	0	0	0
54.	*Orth.(Euortho.)*sp.(Holm.)	16	11	20	0	0	0
55.	*Paracricotopus niger*	0	11	0	0	0	0
56.	*Parakiefferiella* sp.	16	0	0	0	0	0
57.	*Paralimnophies hydrophilus*	0	33	0	0	0	0
58.	*Parorthocladius nivalis**	33	0	0	0	0	0
59.	*Parorthocladius skirwithensis**	50	0	0	0	0	0
60.	*Psectrocladius dilatatus*	16	0	20	11	0	11
61.	*Synorthocladius semivirens*	50	11	0	0	0	0
62.	*Thienemannia gracilis*	0	11	0	0	0	0
63.	*Trichocladius* sp.	0	0	0	11	0	0
64.	*Tvetenia* sp.	16	0	0	0	0	0
	Subfamilia Chironominae						
	Tribe Chironomini						
65.	*Chironomus nigrocaudatus***	0	0	40	33	20	11
66.	*Chironomus thumi*	0	11	50	11	100	33
67.	*Chironomus* sp.	0	11	20	0	0	0
68.	*Cryptochironomus defectus*	16	0	0	0	20	0
69.	*Dicrotendipes nervosus*	0	0	80	0	20	11
70.	*Dicrotendipes notatus*	0	0	20	0	60	11
71.	*Endochironomus impar*	16	0	20	0	0	0
72.	*Microtendipes pedellus*	0	11	0	0	0	0
73.	*Paratendipes albimanus*	16	33	0	22	0	11
74.	*Polypedillum aberrans*	16	0	0	0	0	0
75.	*Polypedillum breviantennatum*	0	0	0	0	20	0
76.	*Polypedillum convictum*	0	33	0	0	40	11
77.	*Polypedillum genuinae N3Lip.*	16	0	0	0	0	0
78.	*Polypedillum nubeculosum*	0	0	20	0	40	0
79.	*Polypedillum nubifer*	0	22	0	11	0	11
80.	*Polypedillum scalenum*	16	22	0	0	40	0
81.	*Polypedillum* sp.	16	0	0	0	20	0

TABLE 1 (cont. 3)

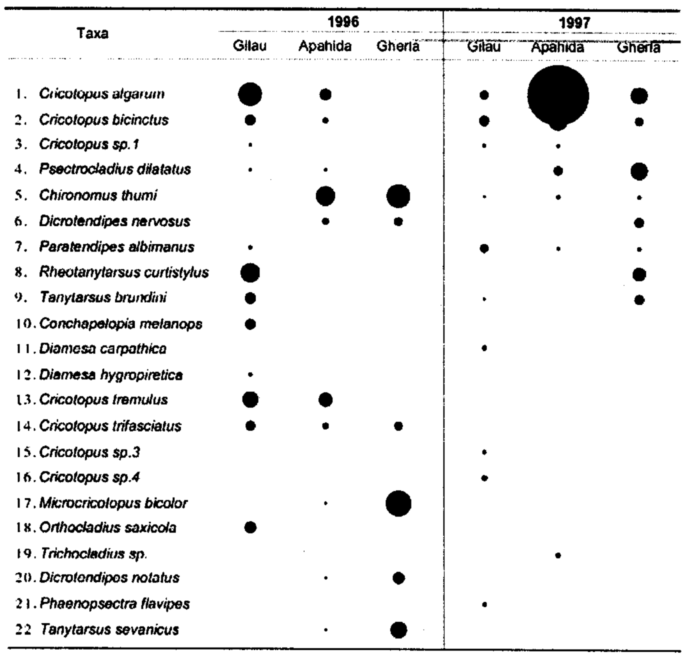
	Taxa	Frequencies of occurrence (%)					
		Gilau		Apahida		Gherla	
		1996	1997	1996	1997	1996	1997
82.	*Saetheria* sp.	0	11	0	0	0	0
83.	*Sergentia coracina*	16	0	0	0	0	0
84.	*Stictochironomus* sp.	0	11	0	0	0	0
	Tribe Tanytarsini						
85.	*Cladotanytarsus mancus*	33	0	0	0	0	11
86.	*Cladotanytarsus* sp.	0	0	0	11	0	0
87.	*Krenopsectra fallax*	33	0	0	0	0	0
88.	*Micropsectra atrofasciata*	0	22	0	44	0	44
89.	*Parapsectra ulliginosa**	0	11	0	0	0	0
90.	*Phaenopsectra flavipes*	0	22	0	0	0	0
91.	*Paratanytarsus austriacus*	16	0	0	0	0	0
92.	*Paratanytarsus* gr.B	16	0	0	0	40	0
93.	*Rheotanytarsus curtistylus*	66	11	0	0	0	22
94.	*Rheotanytarsus exiguus*	33	0	0	0	0	0
95.	*Rheotanytarsus* sp.	0	11	0	0	0	0
96.	*Tanytarsus brundini*	66	22	0	0	0	11
97.	*Tanytarsus lobatifrons*	16	0	0	0	0	0
98.	*Tanytarsus palletaris*	16	0	0	0	0	0
99.	*Tanytarsus sevanicus* *	0	0	20	0	40	11
100	*Tanytarsus usmaensis*	0	0	0	0	0	11
101	*Sublettea coffmani***	0	11	0	0	0	0
102	*Virgatanytarsus arduennensis*	50	11	0	0	0	0
	Total taxa	**53**	**42**	**19**	**17**	**18**	**23**

The data that we are presenting confirm the findings based on numerical abundances as shown by Tudorancea & Tudorancea (2002). The list of species recorded and the frequency of occurrence are represented in TABLE 1. The orthocladiin *Cricotopus algarum* had the highest frequencies of occurrence at both, the clean water station Gilau and the polluted water station Apahida during the two years, 1996 and 1997. *Cricotopus bicinctus*, *Cricotopus tremulus* and *Cricotopus trifasciatus* occurred also in high frequencies at the clean water station Gilau as well as at the organically polluted site Apahida. *Chironomus thumi* had maximum frequency of occurrence (100 %) but only at the station Gherla during 1996. At the other polluted station, Apahida, *Chironomus thumi* occurred with an average frequency of 50 % during the same year. In 1997, the frquency of occurrence of this species declined to less than 50 % at both organically polluted sites. Other species, such as *Microcricotopus bicolor, Dicrotendipes nervosus* and *Dicrotendipes notatus*, had relatively high frequencies of occurrence at both organically enriched stations, Apahida and Gherla.

The densities of common chironomid species found at the three stations each year are presented in Fig. 1. The communities structure, from a density point of view (average number / m^2), differs between the sites during the same year, as well as between the two years at the same site. At the control site (Gilau) three species recorded the largest densities during 1996: *Cricotopus algarum*, *Rheotanytarsus curtistylus* and *Cricotopus tremulus.* However, *Cricotopus algarum,* and *Cricotopus tremulus* along with *Cricotopus bicinctus* and *Cricotopus trifasciatus* occurred in lower densities at the polluted station Apahida, as well.This indicates that these species of *Cricotopus* do not seem to be good indicators of water quality since they occur in both, control and polluted zones. At the organic polluted stations (Apahida and Gherla), *Chironomus thumi* had high densities, as well as *Microcriotopus bicolor*, which appeared in high densities at the Gherla site. None of these two species were identified at the unpolluted Gilau site, which indicates that they might be good biological indicators of organically enriched waters.

The other two species, *Dicrotendipes nervosus* and *Dicrotendipes notatus* occurred in smaller numbers only at organically loaded stations, indicating that they are also tolerant to organic pollution.

The chironomid communities structure in 1997 was different from that of 1996 with respect to the density of the common species. *Dicrotendipes nervosus* was found again in 1997, but only at Gherla site, showing that this species might be a biological indicator for organic polluted waters. As for the other chironomid species, recorded in small densities, their importance as water quality bioindicators cannot be stated yet.A more complete picture might be obtained regarding the difference in species composition between sites during the same year or between years at the same site if the substratum nature, as well as different species interrelations will be considered. Thus, the different structure of chironomid larvae community at Gherla station might be also due to a great extent, to the nature of the substratum (sand and clay), that differs from the other two sites. Moreover, a smaller number of species at the Apahida site in 1997 could have been caused not only by the floods but also by the presence at that particular site of a large number of leeches (Hirudinea), that feed on Chironomidae and Oligochaeta (Schmidt 1992, Tudorancea & Tudorancea 1998).



1.	3440.25	877.36	0	595.39	20044.03	1929.82
2.	770.44	230.19	0	679.25	2295.6	467.84
3.	56.60	0	0	91.19	9.43	0
4.	58.60	100.00	0	0	572.33	1871.35
5.	0	2366.04	3368.42	46.12	132.08	116.96
6.	0	349.06	421.05	0	0	584.80
7.	116.35	0	0	563.94	9.43	116.96
8.	2569.18	0	0	0	0	1228.07
9.	830.19	0	0	26.21	0	643.27
10.	726.42	0	0	0	0	0
11.	0	0	0	175.05	0	0
12.	135.22	0	0	0	0	0
13.	1745.28	1200	0	0	0	0
14.	622.64	281.13	421.05	0	0	0
15.	0	0	0	113.21	0	0
16.	0	0	0	222.22	0	0
17.	0	45.28	3894.74	0	0	0
18.	943.40	0	0	0	0	0
19.	0	0	0	0	160.38	0
20.	0	20.75	842.11	0	0	0
21.	0	0	0	120.55	0	0
22.	0	45.28	1684.21	0	0	0

FIG.1. Distribution and densities (nr.ind./m^2) of twenty two most common species at the sampling station during 1996 and 1997. Diameters of the black circles ilustrate the densities. The table under the diagram contains the numerical densities.

The values of Shannon-Wiener diversity, equitability and dominance indices calculated for these chironomid assemblages were listed in Tudorancea & Tudorancea (2002).

The indices' values confirm, to a great extent, the ecological observations presented above. The largest number of species was recorded at the control station (Gilau) in both years (53 in 1996 and 42 species during 1997) and the smallest number was found at the polluted sites Apahida (17 species during 1997) and Gherla (18 species during 1996) (TABLE 1). The Shannon-Wiener and the equitability indices had maximum values at the Gilau site (1.39 and 0.81 respectively, during 1996) and minimum values at the Apahida site (0.29 and 0.23 respectively, during 1997). The dominance index, unlike the diversity and equitability indices, recorded the highest values at the most polluted station, Apahida, where, in both years, the chironomid community was dominated by only one species: *Chironomus thumi* in 1996 and *Cricotopus algarum* in 1977.

CONCLUSIONS

1. A total of 102 species have been identified in Somesul Mic River during 1996 and 1997. Ten species are new findings for the Romanian fauna out of which four species appear to be new records for Europe (*Rheopelopia perda, Orthocladius clarki, Chironomus nigrocaudatus* and *Sublettea coffmani).*
2. The data presented underline the importance of using the chironomid larvae communities as sensitive bioindicators of the water quality of lotic ecosistems. To use this group of organisms with maximum efficiency in water quality assessment and monitoring programmes the identification to species level is necessary.
3. Both, the frequencies of occurrence and the density data, confirm that *Chironomus thumi* is a good indicator for the organically enriched waters. This species does not occur in clean waters. Other three species, *Microcricotopus bicolor*, *Dicrotendipes nervosus* and *Dicrotendipes notatus*, which occurred only at the organically polluted sites, Apahida and Gherla, seem to be good indicators for water quality, as well.

   The Orthocladiinae species, *Cricotopus algarum*, *Cricotopus bicinctus*, *Cricotopus tremulus* and, possibly, *Cricotopus* *trifasciatus*, do not seem to be good bioindicators because they occur in both, clean and organically polluted waters.

More ecological information on other chironomid species is needed in order to characterize which community may or may not be a good indicator of water deterioration.

We would like to emphasize the need for identifications to the species level for other invertebrate groups which are intended to be used in monitoring and /or water assessment programmes.

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