

The Ephemeroptera fauna of the Meurthe River in north-eastern France

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Since 1987, 20 years of investigations on the river Meurthe from its springs to its confluence with the river Moselle have revealed at least 43 species of Ephemeroptera, i.e. almost two-thirds of the regional diversity. The typical assemblages occurring in upper and middle courses are described; these parts of the river can be considered as “reference streams” for the region, the rest of the river being more degraded by human activities. The upper rhithral section pertains to the Vosges Mountain, and has escaped the acidification which affects many surface waters in this crystalline massif. The middle course is a typical epipotamal section on silicious alluvions. The most remarkable species found in the upper course are *Ameletus inopinatus*, *Baetis alpinus*, *B. melanonyx*, *Rhithrogena* gr [*hercynia*], *Rh. cf carpatoalpina*, *Ephemerella mucronata*. In the middle course *Baetis liebenauae*, *Baetis vardarensis*, *Caenis lactea*, *Ephemera lineata*, *Heptagenia coeruleans*, *H. fuscogrisea*, *H. longicauda*, *Rhithrogena beskidensis* were found. Both upper and middle sections are partly included in the “Natura 2000” European network.

Keywords: mayflies; Meurthe River; north-eastern France; faunistics; reference stream

Introduction

Between 1988 and 1995, studies on acidification problems were undertaken in the Vosges mountains, and the higher course of the river Meurthe (at km 3.5) was chosen as a quality reference. However, the rhithron was actually explored on a longer section, from km 2 to km 12, before it passes several successive small towns (epi- to metarhithron). Ephemeroptera, Plecoptera and Trichoptera were studied in detail. The global results were presented in Guérol et al. (1991, 1993, 1995, 2000); complementary investigations were led by Tixier (2005) and Tixier and Guérol (2005). The data concerning the Ephemeroptera were also included in Jacquemin and Coppa (1996). Data on Trichoptera were collected by Denis Vein; a number of unpublished data are available from the personal database of D. Vein (personal communication).

More recently, some investigations were undertaken in the middle part of the river, from km 70 to km 100. This is an epipotamal section where the river recovers a rather good water quality, after an important deterioration by crossing some middle sized towns with polluting industries. For about 30 km the river has a more or less

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natural morphology (though a number of quarries), flowing on its natural river bed composed of pebble, gravel and sand alluvions, and surrounded by well preserved alluvial meadows. This section also appears very rich, hosting several endangered species. Thus, it constitutes another reference site for the regional Ephemeroptera fauna.

Study site and methods

The Meurthe River, about 160 km long, is an affluent of the Moselle River, the latter itself flowing into the Rhine in Germany (Figure 1). The springs of the Meurthe River are at 1100 m a.s.l., and for the first 30 km the river flows within the massif of the Vosges, above an altitude of 400 m, on crystalline substrates (Figure 2). Then it turns to a lowland river, first flowing on acidic sandstones for about 35 km, then reaching the typical secondary substrates of the region Lorraine, mainly marls. The siliceous alluvial deposits of the river form an acidic bed, isolating the river from this substrate all along its course (Figure 3). Locally the exploitation of these sediments in gravel and sand quarries has strongly damaged the valley. In its last 50 km, the Meurthe River is canalised and more or less polluted by rock salt industries and large human populations.

During the studies on acidification, in the upper river course a Surber sampler was regularly used (monthly in 1991–1992). The catches were completed by capturing larvae with a strainer and sight captures of adults with an aerial net. In the middle part, beside capture by net and strainer, a light-trap was also used, which appeared to be very fruitful, particularly for some genera of Ephemeroptera (e.g. *Ephemera*, *Caenis*), and also for Trichoptera.

As to the assessment of the “patrimonial” interest of each present species, as well as of the global assemblage, regional lists of “determinant species” were used.

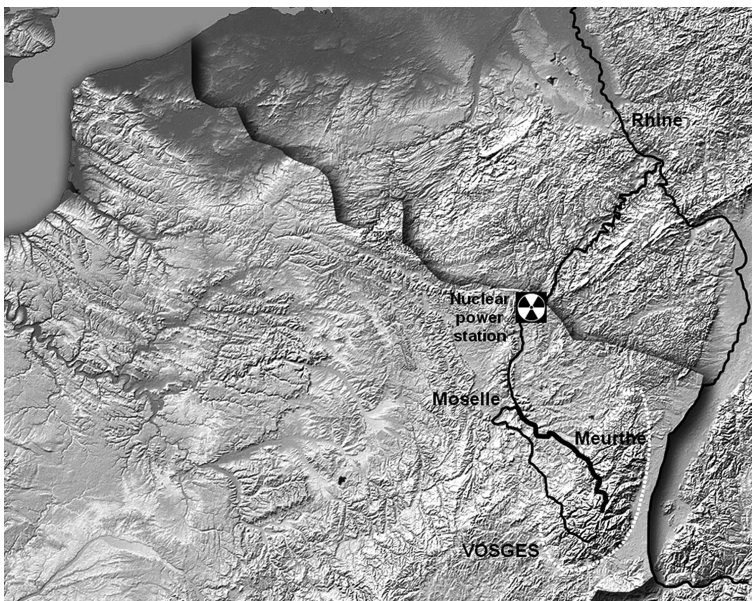


Figure 1. The Meurthe River, study area.



Figure 2. The Meurthe River, at Le Valtin, altitude 960 m (department Vosges); higher course (epi-metarhithron).



Figure 3. The Meurthe River, at Azerailles, altitude 250 m (department Meurthe-et-Moselle); middle course (epipotamon).

In France, each region is in charge of an inventory of the ecological interesting sites still present on its territory; these sites are called ZNIEFF (Natural Zones of Ecological Faunistical and Floristical Interest). In order to achieve this task, “patrimonial species” are listed in as many groups as possible. These species, rare and more or less endangered in the considered region, are thus simultaneously the aim of the ZNIEFF inventory, and a tool to qualify these ZNIEFF, since most of

them are more or less stenoecious and stenotopic. Called “determinant species”, they are distributed in three levels, which more or less correspond to the usual IUCN levels: 1 = critical, 2 = endangered, 3 = vulnerable.

The region “Lorraine”, about 24,000 km², has thus drawn up lists of determinant species for Ephemeroptera, Plecoptera and Trichoptera.

Results

Table 1 presents the list of species found in the River Meurthe and their distribution in both sections of the river. The right column indicates the level of the “determinant species” present in the list (in bold).

Discussion

Upper section (Figure 2)

In a short section of about 10 km near the springs of the river, 18 species of Ephemeroptera have been observed to date.

Eight species are determinant, and two of them are particularly remarkable (level 1): *Ameletus inopinatus* and a *Rhithrogena* species of the *R. hercynia* group, at present impossible to determine more precisely with the available keys (Bauernfeind and Humpesch 2001; Eiseler 2005). The most similar species is *R. circumatrica*, according to the original description by Sowa and Soldán (1986). In order to solve this problem, several individuals will be sent to Dr Sartori and his team, Musée de Zoologie, Lausanne, for DNA sequencing. One species is level 2 (*Ephemerella mucronata*) and five species are level 3. Among them, a species of *Rhithrogena* again, pertaining to the *R. semicolorata* group, presents intermediary features between *R. carpatoalpina* and *R. puytoraci*. Some have already been sent for DNA sequencing.

Besides this interesting Ephemeroptera community, a very remarkable assemblage of 34 species of Plecoptera is present, with 14 determinant species (one level 1, three level 2 and 10 level 3): *Brachyptera seticornis*, *Capnia vidua*, *Dinocras cephalotes*, *Leuctra alpina*, *L. autumnalis*, *L. digitata*, *L. prima*, *L. pseudocingulata*, *Nemoura avicularis*, *N. flexuosa*, *Perla grandis* (only one specimen, in need of confirmation), *Perlodes microcephala*, *Protonemura nimborum*, *Taeniopteryx hubaulti*.

Similarly, the list of 37 Trichoptera species observed in this section includes six determinant species: *Acrophylax zerberus*, *Anitella obscurata*, *Drusus discolor*, *Glossosoma intermedia*, *Hydropsyche tenuis*, *Pseudopsilopteryx zimmeri*.

Middle section (Figure 3)

In this part of the river, quite representative of a small epipotamon, at least 30 species of Ephemeroptera are present, including several rare and threatened species. Eight of them are determinant level 2 species (*Baetis vardarensis*, *Ecdyonurus aurantiacus*, *Ephemera lineata*, *Heptagenia caerulans*, *H. fuscogrisea*, *H. longicauda*, *Oligoneuriella rhenana* and *Rhithrogena beskidensis*), and six level 3 species (*Baetis liebenauae*, *Caenis lactea*, *C. pseudorivulorum*, *Ephoron virgo*, *Heptagenia sulphurea* and *Potamanthus luteus*). Moreover, most of these sensitive species are present in considerable populations, which increases its importance in terms of conservation. A few other remarkable Ephemeroptera species probably occur in that section of the

Table 1. List of the 43 species collected or observed on the river Meurthe, in the higher (rhithral) and the middle (epipotamal) sections of the course.

	Upper section, km 2–12	both	Middle section, km 70–100	det. spp level
<i>Ameletus inopinatus</i>	*			1
<i>Baetis alpinus</i>	*			3
<i>Baetis buceratus</i>			*	
<i>Baetis fuscatus</i>			*	
<i>Baetis liebenauae</i>			*	3
<i>Baetis melanonyx</i>	*			3
<i>Baetis muticus</i>	*			
<i>Baetis niger</i>	*			3
<i>Baetis rhodani</i>	*	*	*	
<i>Baetis scambus</i>	*	*	*	
<i>Baetis vardarensis</i>			*	2
<i>Baetis vernus</i>	*	*	*	
<i>Caenis horaria</i>			*	
<i>Caenis lactea</i>			*	3
<i>Caenis luctuosa</i>			*	
<i>Caenis macrura</i>			*	
<i>Caenis pseudorivulorum</i>			*	3
<i>Centroptilum luteolum</i>			*	
<i>Cloeon dipterum</i>			*	
<i>Cloeon simile</i>			*	
<i>Ecdyonurus aurantiacus</i>			*	2
<i>Ecdyonurus torrentis</i>	*			
<i>Ecdyonurus venosus</i>	*	*	*	
<i>Epeorus assimilis</i>	*			3
<i>Ephemera danica</i>			*	
<i>Ephemera lineata</i>			*	2
<i>Ephemerella ignita</i>		*	*	
<i>Ephemerella mucronata</i>	*			2
<i>Ephoron virgo</i>			observed downstream	3
<i>Habroleptoides confusa</i>	*			
<i>Heptagenia caerulans</i>			*	2
<i>Heptagenia fuscogrisea</i>			*	2
<i>Heptagenia longicauda</i>			*	2
<i>Heptagenia sulphurea</i>			*	3
<i>Oligoneuriella rhenana</i>			*	2
<i>Paraleptophlebia submarginata</i>			*	
<i>Potamanthus luteus</i>			*	3
<i>Rhithrogena beskidensis</i>			*	2
<i>Rhithrogena cf puytoraci</i>				3
<i>Rhithrogena gr[hercynia]</i>	*			1
<i>Rhithrogena semicolorata</i>	*			
<i>Siphonurus aestivalis</i>			*	
<i>Siphonurus lacustris</i>	*			
43 spp	18	5	30	24

river, since they are present in closely adjacent gravel pits (*Ephemera glaucops*), or in the very similar (but larger and more powerful) sister river Moselle (*Caenis rivulorum*, *Ephemera vulgata*, *Heptagenia flava*, *Ecdyonurus dispar*).

Beside Ephemeroptera, only Trichoptera have been collected, mainly by light trap, and a list of 51 species to date is available in the personal regional database of

D. Vein (unpublished data, pers. comm.), containing two determinant species (*Brachycentrus subnubilus* and *Linnephilus vittatus*).

Common species

Only five species of Ephemeroptera are common in both parts of the river (*Baetis scambus*, *Baetis rhodani*, *Baetis vernus*, *Seratella ignita* and *Ecdyonurus venosus*), all of which are more or less ubiquitous. Four of them are particularly tolerant to organic pollution, and thus very competitive in a wide range of habitats.

Conclusions

Many results available in the literature (see Guérolde 1993, 1995; Dambrine et al. 1998) have demonstrated that – in the Vosges like elsewhere – acidification of surface waters is caused by acid precipitations (rain and snow). These studies also show that damages to small brooks in the Vosges Massif are strongly linked to the nature of the substrates. The higher course of the Meurthe River flows on alkaline granites, able to maintain a high pH, very close to neutrality, thus preserving the rich community observed, while they are dramatically reduced in brooks flowing on more acidic substrates (Guérolde et al. 1991, 1993, 1995, 2000). So the upper course presented in this paper is exceptional, having escaped a general pollution of the mountain brooks due to recent human industrial activities, thanks to a less acid granite substrate.

The middle course presented here is another very remarkable situation, this time at least partly due to human industrial activities. At the beginning of this section, two tributaries of good quality (little polluted, not acidified), coming from the Vosges, flow into the Meurthe. They contribute together one third of the total flow downstream, and thus, of course, regenerate the general quality of the river's water. Moreover, one of these tributaries has a sustained summer flow, thanks to a large dam built about 20 years ago, in order to maintain a sufficient flow in period of low water in the Meurthe. A sufficient summer flow is needed because the Meurthe river is a tributary of the Moselle river, whose waters are used for cooling the nuclear power station of Cattenom, near the German boundary (see Figure 1). So most probably it is that industrial necessity to maintain a sufficiently high water level in the river Meurthe that allows such preserved communities of macroinvertebrates in the middle course of the river.

Both upper and middle sections are included in the European “Natura 2000 Network”, which is not a guarantee of total preservation, but at least a guarantee that the faunistic composition and ecological richness will be taken into account in every development plan. It is however unfortunate that the concerned zones are restricted to very narrow bands on both sides of the river, and do not include at least the whole alluvial valley.

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