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Installation de l'Amphipode *Corophium curvispinum* et de la palourde asiatique *Corbicula sp.* dans la partie française de la Moselle

Establishment of the Amphipod Corophium curvispinum *and the Asiatic Clam* Corbicula sp. *in the French part of the Mosel river*

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Résumé. – L'Amphipode *Corophium curvispinum* et la Palourde Asiatique *Corbicula* sp., deux nouveaux immigrants du fleuve Rhin, ont été collectés par dragage à une profondeur de 1 à 4 mètres dans le cours français de la Moselle. Ils sont déjà présents sur au moins 287 km de cours depuis l'embouchure pour *C. curvispinum* et 337 km pour *Corbicula* sp. La distribution de ces espèces nouvellement immigrées semble être en relation avec la nature du substrat. La dynamique des populations de ces nouvelles espèces invasives, qui se sont déjà imposées comme deux des principaux taxa dans la Moselle, et leur possible impact sur les communautés zoobenthiques exigent un suivi attentif dans cet écosystème.

Mots-clés. *– Corophium curispinum, Corbicula,* distribution, densité, Moselle.

Abstract. – The amphipod *Corophium curvispinum* and the asiatic clam *Corbicula* sp., two new immigrants from the Rhine River, have been collected from dredging at a water depth of 1-4 meters in the French part of the Mosel River. They are already distributed over at least 287 km for *C. curvispinum* and 337 km for *Corbicula* sp. from the mouth of the river. The distributions of those new species appear to be related to the bottom substrate type. The population dynamics of those new mass invaders in this ecosystem, that are already two of the prevailing taxa in the Mosel River, and their possible impact on zoobenthic communities must be carefully observed.

Key words. *– Corophium curvispinum, Corbicula,* distribution, densities, Mosel River.

1 INTRODUCTION

The invasion of the zebra mussel *Dreissena polymorpha* from the Caspian Sea basin into western Europe started two centuries ago. This species is now a common freshwater bivalve in the major European rivers (Hebert *et al.*, 1989; Van der Velde *et al.*, 1994). The amphipod *Corophium curvispinum* Sars, 1895 has been expanding its distributional range from the same area since the beginning of the 20th century into Europe, via various river systems and interconnecting canals. This species was discovered for the first time in the Rhine River in 1987 and nowadays *C. curvispinum* is by far the most dominant macroinvertebrate species in the Dutch part of this river (Paffen *et al.*, 1994). Since 1988, a population of more than ten thousand individuals per meter square have been established in the mouth of the Mosel River (Schöll, 1990). The species was mentioned in 1993 up to Remich in Luxembourg at the pK 229.5 (pK = navigation kilometric point). This locality was considered as the upper limit of its distribution area (Dhur & Massard, 1995).

Clams of the genus *Corbicula* are native to Asia, Africa and Australia where they form an important component of the benthic community (McMahon, 1983). *Corbicula fluminea* was introduced at the beginning of the century in the United-States where it spred in an explosive fashion, causing considerable damage to hydroinstallations and becoming one of the most important molluscan pest species ever introduced into the USA (McMahon, 1983). At the present time, there is still some confusion about the names and the number of *Corbicula* species that have been involved in the colonization of the European rivers, and a diagnosis of the exact species remains somewhat dubious. *Corbicula* (*e.g. fluminalis*) was recorded in 1980 in the Dordogne River (South-Western France), in the Tage River (Portugal) (Mouthon, 1981), and in 1984 in the Tidal Weser River (N. Germany) (Haesloop, 1992). Two forms (*e.g. fluminea* and/or *fluminalis*), or species (*e.g. fluminea* and *fluviatilis*) have been established in a large part of the Rhine River system since 1987 (Kinzelbach, 1991; Den Hartog *et al.*, 1992). Kinzelbach (1991) noticed that both *Corbicula* species had arrived in Europe via ships carrying ballast water from the south of North-America. *Corbicula* was not recorded in the Mosel River until now (Dhur & Massard, 1995).

Since 1994, a research program has been carried out on the Mosel River in order to investigate the distribution area and the local density of the new filter-feeder invaders *Corophium curvispinum* and *Corbicula* sp.. These patterns will be compared to the distribution and the density of *Dreissena polymorpha* still established for many years in this river.

2 MATERIALS AND METHODS

Samples of macroinvertebrates have been performed at a water depth

of 1-4 meters by means of two benthic dredges used according to the particle size of the bottom substrate of each sampling site. A triangular dredge with a 39 cm side lenght (see Berly, 1989 for further details), and a cylindrical dredge Rallier du Baty's type with an opening diameter of 30 cm were used from a boat on eight stations of the Mosel River from Grevenmacher (pK 211.0) to Gondreville (pK 367.0) (fig. 1). Samples were taken as much as possible on the left bank, on the channel and on the right bank. The surface area of the sampled bottom was estimated in the way described by Berly (1989). The materials collected, including macroinvertebrates, were put into plastic jars and preserved in 70% ethanol. In laboratory, the specimens of *Dreissena polymorpha*, *Corbicula* sp. and *Corophium curvispinum* were sorted out, counted and preserved in 70% ethanol for later identification. The granulometric structure of each substrate sample was also estimated by sifting particulate materials after drying for 24 h at 105°C. Six granulometric fractions were considered : 0.5-4 mm : sand; 4-8 mm : coarse sand/fine gravel; 8-32 mm : gravel/small pebbles; 32-64 mm : pebbles; 64-128 mm : cobbles > 128 mm : boulders.

3 RESULTS AND DISCUSSION

The analysis of macrobenthic populations in a first campaign of dredging (july and september 1994) demonstrated the expansion of *Corbicula* sp. and *Corophium curvispinum* in the river Mosel. *C. curvispinum* is well established at Grevenmacher. Its density reached up 97,000 ind. m^{-2}. This species appears to be, with *Dreissena polymorpha* (maximum of 65,909 ind. m^{-2}), one of the dominant species of this station (Table I). The densities of *C. curvispinum* are less important in the 'natural' sector of Hauconcourt (pK 286.0) with a maximum of 925 ind.m^{-2} (19,358 ind. m^{-2} for *D. polymorpha*). Two hypotheses may be envisioned. Firstly, Hauconcourt might be the present geographical upper limit of the *C. curvispinum* expansion. Secondly, the finest granulometric structure of the bottom at this station do not promote the settlement of this burrowing species that preferentially live in muddy tubes on hard substrates. Recent researches (Bachmann, unpubl.) tend to assess this last hypothesis. As reported by Den Hartog *et al.* (1992), *Corbicula* sp. prefers coarse sand or fine gravel (142 to 8,760 ind. m^{-2} at Hauconcourt) to cobbles or boulders (0 to 17 ind. m^{-2} at Grevenmacher).

The previous data show that *Corbicula* sp. could be the prevailing taxa in the Mosel River at Hauconcourt. Further spatial investigations revealed that *Corbicula* sp. was present up to Dieulouard (pK 337.0) with a density of only 5 to 7 ind. m^{-2}, but was not catched at Gondreville (pK 367.0) until december 1994 (Table II).

Two morphological forms or species of *Corbicula* have been collected. The most important densities were observed in a mixture of gravel and

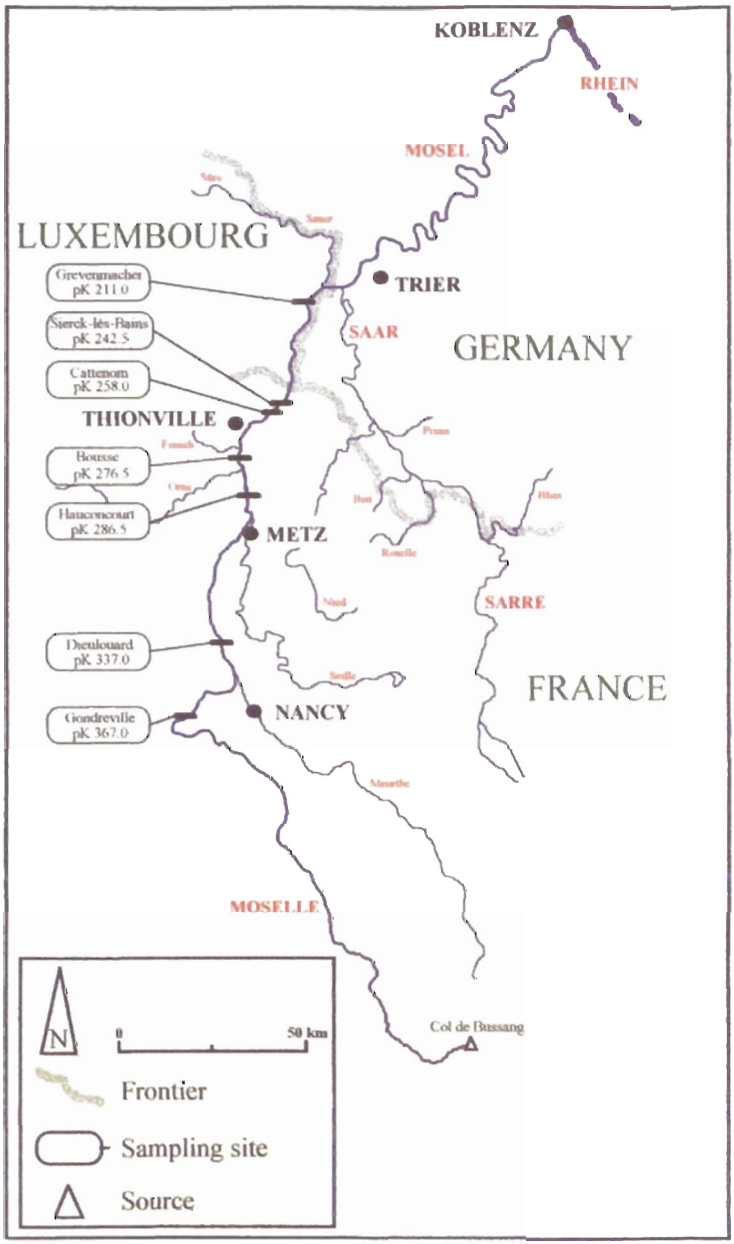

Fig. 1. – Map of the sampling sites on the Mosel River. pK refers to navigation kilometric point.

Table I. – Densities of *Dreissena polymorpha, Corbicula* sp. and *Corophium curvispinum* (ind. m^{-2}) sampled in the Mosel River between Grevenmacher (Luxembourg) and Hauconcourt (France) according to the substrate type during summer and autumn 1994. pK corresponds to navigation kilometric point.

Date	Station	pK	Transversal location	*Density (ind. m^{-2})*			Substrate type
				Dreissena	Corbicula	*Corophium*	
07/94	Grevenmacher	211.0	Left Bank	35 672	17	97 552	Boulders
	Grevenmacher	211.2	Channel	11 765	0	2 955	Boulders
09/94	Grevenmacher	211.2	Channel	65 909	0	20 012	Boulders
	Grevenmacher	211.2	Right Bank	17 563	0	35 634	Boulders
07/94	Hauconcourt	287.5	Left Bank	19 358	142	925	Cobbles
	Hauconcourt	286.5	Left Bank	1 311	363	12	Gravel/small pebbles
	Hauconcourt	286.3	Right Bank	9 759	1 690	166	Gravel/small pebbles
	Hauconcourt	286.3	Left Bank	702	8 760	41	Coarse sand/fine gravel
09/94	Hauconcourt	287.1	Left Bank	2 671	5 535	245	Coarse sand/fine gravel
	Hauconcourt	286.9	Right Bank	7 423	545	32	Sand
	Hauconcourt	286.7	Left Bank	3 073	3 382	0	Coarse sands/fine gravel
	Hauconcourt	286.1	Right Bank	2 813	5 019	52	Pebbles

Table II. – Location and density of *Corbicula* sp. (ind. m^{-2}) sampled in the French part of the Mosel River betrween Sierck-lès-Bains (pK 242.5) and Gondreville (pK 367.0) according to the substrate type (winter period). pK corresponds to navigation kilometric point.

Date	Station	pK	Transversal location	Density of *Corbicula* (ind. m^{-2})	Substrate
11/94	Sierck-lès-Bains	242.5	Left Bank	0	Cobbles
			Channel	49	Gravel and cobbles
			Right Bank	1 659	clay
11/94	Cattenom	256.0	Left Bank	54	Gravel/small pebbles
11/94	Cattenom	258.0	Left Bank	22	Cobbles
			Channel	0	Mud and boulders
			Right Bank	6	Mud
11/94	Bousse	276.5	Left Bank	34	Pebbles and cobbles
			Channel	0	Cobbles and boulders
			Right Bank	20	Pebbles and cobbles
11/94	Metz	298.5	Left Bank	70	Gravel and pebbles
			Channel	126	Gravel/small pebbles
			Right Back	0	Cobbles and boulders
12/94	Dieulouard	337.0	Left Bank	0	Mud and cobbles
			Channel	7	Gravel and pebbles
			Right Bank	5	Gravel and pebbles
12/94	Gondreville	367.0	Left Bank	0	Cobbles
			Channel	0	Gravel and pebbles
			Right Bank	0	Pebbles and cobbles

small pebbles and clay substrates (respectively 126 and 1,659 ind. m^{-2}).

4 CONCLUSIONS

The immigration of *Corbicula* sp. and *Corophium curvispinum* in the Mosel River is recent and the biogeographical area of those new invasive species is probably not stabilized in the North-East part of the France. It should furthermore be pointed out that *Corophium curvispinum* intrusion has had a strong impact on the zoobenthic community structure in the Rhine River (Paffen *et al.*, 1994). Consequently, the structure and the dynamics of the benthic macroinvertebrate communities of the Mosel River must be now carefully observed.

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