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COLONIZATION OF THE GERMAN PART OF THE RIVER RHINE BY THE ASIATIC CLAM, *CORBICULA FLUMINEA* MÜLLER, 1774 (PELECYPODA, CORBICULIDAE)

A. Bij de Vaate

ABSTRACT

The freshwater bivalve *Corbicula fluminea* (Müller, 1774), new to the aquatic fauna of the Federal Republic of Germany, is recorded for the first time on four localities in the German part of the River Rhine.

INTRODUCTION

This paper describes the first record of the Asiatic clam, *Corbicula fluminea* (Müller, 1774), in the Federal Republic of Germany. In 1988, *C. fluminea* was found for the first time in The Netherlands in the downstream reaches of the rivers Rhine and Meuse (Bij de Vaate & Greijdanus-Klaas, 1990). Both localities (Fig. 1) are situated near the sea port of Rotterdam, which indicates introduction by international shipping. It is assumed that in this way many exotic aquatic species are transported to other continents (Welcomme, 1988). In the first half of 1990 the Asiatic clam was found about 100 to 200 km upstream of the localities at which it was found in 1988: in the River Waal (the southern branch of the River Rhine) near Nijmegen, about 20 km from the German-Dutch border, and in the River Rhine near Lobith (Jenner & Bij de Vaate, 1991). At the latter locality the animals were collected in the littoral zone of the Dutch riverbank (on this locality the other bank belongs to the

Federal Republic of Germany) on May 4, 1990. Occurrence of *C. fluminea* in the German part of the River Rhine could be expected from this date.

METHODS

Bottom samples were taken with a hand net (mesh size: 2 mm) up to a depth of about one meter in the littoral zone. Sampling took place in habitats generally preferred by the clam: well-oxygenated fine sand with a particle size range of 0.35-0.6 mm (Belanger, et al., 1985) or sand-gravel mixtures (McMahon, 1983) with a maximum particle size of approximately 1 cm. Particle size was estimated before sampling. Shell dimensions were measured to the nearest 0.1 mm with extension callipers or, for shells with a smaller length than approximately 6 mm, with a stereo-microscope provided with an ocular micrometer. Clam length was measured from the anterior to the posterior margins of the shell.

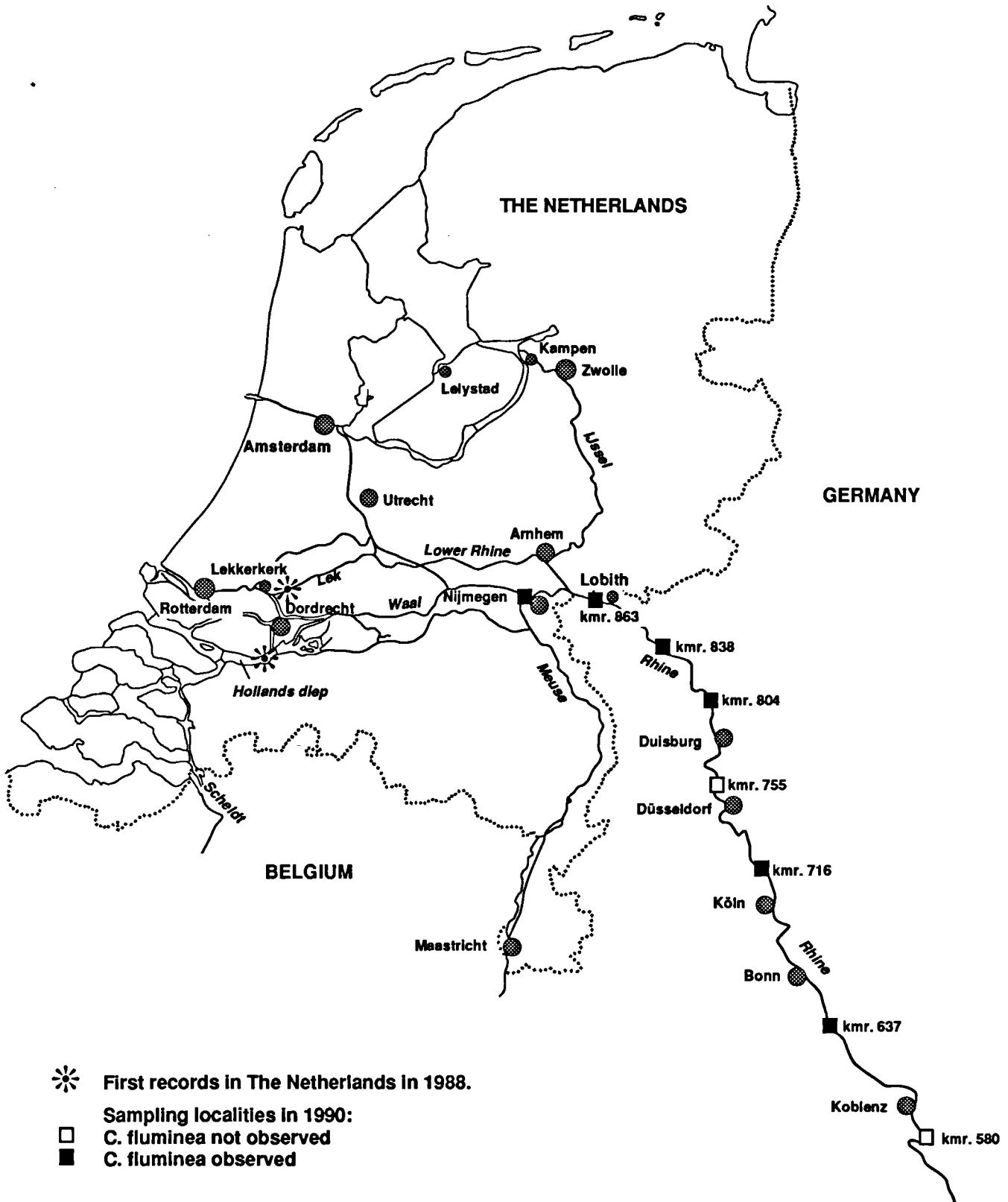


Fig. 1. Sampled localities in the River Rhine with an indication in which localities *C. fluminea* was found (kmr. is the international river distance indication in km).

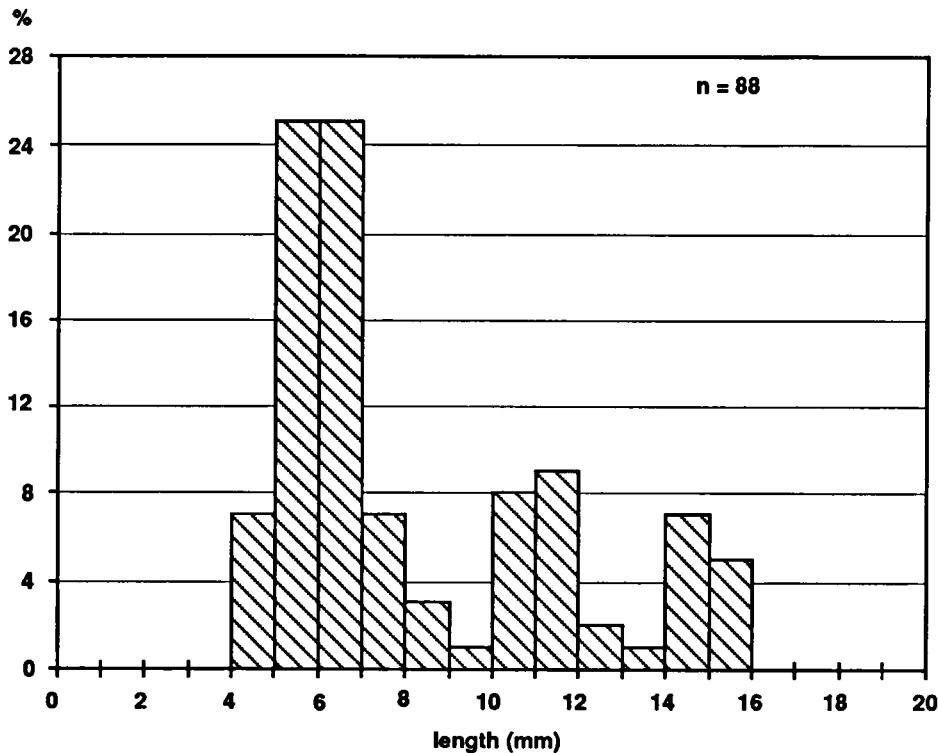


Fig. 2. Length/frequency distribution of *C. fluminea* collected in the River Rhine near Rees on October 19, 1990.

RESULTS AND DISCUSSION

October 19, 1990 *C. fluminea* was found in considerable amounts in the littoral zone of the right bank of the River Rhine near Lobith (Table 1). This indicated that the species might have colonized upstream habitats. Bottom samples were taken the same day in the German part of the River Rhine near Rees (Fig. 1). On the right bank, 88 specimens were collected. Clam length varied between 4.1 and 15.8 mm, being specimens of the 0⁺ and 1⁺ generation. Subdivision of the animals into generations is based on Dresler & Cory (1980) who subdivided their collected *C. fluminea* from a survey in the tidal Potomac River (Maryland, U.S.A.), July 1981, into four generations based on size/frequency distribution. They considered shell length classes of <13 mm, 13-18 mm, 18-25, and >25 mm representing the 0⁺ to the 3⁺ generation, respectively. Although three peaks in shell size/frequency distribution could be distinguished for the present specimens (Fig. 2), it is realistic to assume that the sampled population consisted of only two generations. The second peak in the size/frequency

distribution represents, according to Dresler & Cory (1980), the 0⁺ generation as well. This indicates that *C. fluminea* colonized this locality in 1989.

October 23, 1990, a limited survey at five localities upstream of Rees was carried out to examine the upstream colonization of the River Rhine by the Asiatic clam. At three localities a few specimens of *C. fluminea* were found (Table 1). Shell length of the clams varies between 9.7 and 14.0 mm, which means that they belong to the 1⁺ generation.

Densities of the clam populations at the localities upstream of Rees were relatively low. The number of specimens collected at each locality was too low to conclude that the ecological distribution boundary was situated between Oberwinter and Spay (kmr. 637 and 580, Fig. 1). On every locality sampling took place for only about half an hour, and as a consequence of low density upstream of Rees, the chance to collect specimens was very low as well.

In general, downstream migration rate appears to be much larger than upstream rates. Upstream expansion speed depends on human activity in the

Table 1: The occurrence of *C. fluminea* in bottom samples from the River Rhine. Sampling dates: October 19 and 23, 1990 (kmr. is the international river distance indication in km).

Locality	River bank	kmr.	number of specimens	shell length (mm)
Lobith (NL)	right	863	59	4.3 - 14.9
Rees	right	838	88	4.1 - 15.9
Mehrum	left	804	2	12.8 - 14.0
Langst	left	755	0	
Zons	left	716	3	10.2 - 10.5
Oberwinter	left	637	3	9.7 - 11.2
Spay	left	580	0	

drainage systems of rivers (McMahon, 1982). Rapid upstream migration has been found in the Tennessee River (U.S.A.). Within two years the river was colonized from the mouth to the upper reaches (Sinclair & Isom, 1961, 1963). From shell size/frequency distribution of the specimens found in 1988 in the River Rhine branch near Lekkerkerk (Fig. 1) it was concluded that *C. fluminea* colonized this river in 1985 or 1986 (Bij de Vaate & Greijdanus-Klaas, 1990). The occurrence of a 1⁺ generation at the locality near Oberwinter, 345 km upstream of Lekkerkerk, indicates an average upstream migration speed in the River Rhine of at least 85-115 km.year⁻¹.

In Germany all major rivers are connected by canals (for instance the Wesel-Dattein Canal and the Rhine-Herne Canal between Wesel and Duisburg). Connections with other major European rivers are situated in the neighbourhood of Strasbourg (connection with the River Marne by the Rhine-Marne Canal) and in one of the tributaries, the River Main (connection with the River Donau by the Main-Donau Canal). This means that large parts of Europe can be colonized from the River Rhine drainage system.

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Mr. A. Bij de Vaate,
Ministry of Transport and Public Works,
Institute for Inland Water Management and
Waste Water Treatment,
P.O. Box 17,
NL-8200 AA Lelystad,
The Netherlands.

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