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THE ASIATIC CLAM, *CORBICULA FLUMINEA* (MÜLLER, 1774) (PELECYPODA, CORBICULIDAE), A NEW IMMIGRANT IN THE NETHERLANDS

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ABSTRACT

Corbicula fluminea (Müller, 1774), a freshwater bivalve new to the Netherlands, has been recorded recently in two localities in the downstream area of the river Rhine and the river Meuse.

INTRODUCTION

The Asiatic clam, *Corbicula fluminea* (Müller, 1774), is a common freshwater bivalve in Asia. Its natural distribution area ranges from the U.S.S.R. and Japan in the north, to Indonesia in the south and from Africa in the west to the Philippines in the east (Morton, 1987). In 1938 the species was introduced in the U.S.A. by Chinese immigrants working on the Colombia river (Washington, U.S.A.) with the purpose of using these animals as a food source (Fox, 1971). From this location migration has taken place over a number of states. By 1973 the Asiatic clam was found in the waterways of at least 26 states (Fox, 1973; Goss & Cain, 1977). South America has been invaded as well (Ituarte, 1981; Martinez, 1987). Records from Europe are scarce. Mouthon (1981) reported the presence of *Corbicula* in France (river Dordogne) and in Portugal (river Tejo). This paper describes records of *C. fluminea* from two localities in the Netherlands. Reference material of both localities in the Netherlands has been deposited in the Zoological Museum Amsterdam, the Netherlands.

According to Sinclair & Isom (1963) the heterodont *Corbicula* shell is relatively thick and ovate to trigonal in shape, raised at the umbones, sculptured with concentric rings, covered with a periostracum which is generally yellow-green in colour and can attain a size as large as 60 mm (fig. 1). The shells exhibit a great deal of variation in shape and colour, depending upon environment and age. Two distinct ecomorphs of *C. fluminea* are distinguished, a straw-coloured and a dark form. The differences in colour are caused by differences in water quality parameters (Morton, 1987). A distinctive characteristic is the serration of the lateral teeth. *C. fluminea* usually is monoecious, with eggs being fertilized within the gills and incubated within the interlamellar space of the inner gills throughout the trochophore larval stage; the non-swimming veliger larvae are discharged. The animals, however, are not obligatory monoecious: other observations described them as being dioecious (Morton, 1983).

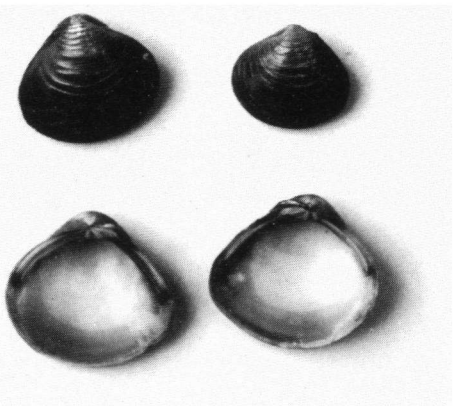

Fig. 1. Specimens of *C. fluminea* found in the river Lek in 1988. Lower left a right valve, lower right a left valve.

The clams live in or on sandy and gravelly sediments. They are able to attach to solid substrates as well with their byssus threads. *C. fluminea* belongs to the group of fouling organisms which are a nuisance of potable and industrial water intake systems causing clogging problems (Goss & Cain, 1977).

METHODS

Bottom samples were taken with a Birge-Ekman bottom sampler in the littoral zone and with a Bovens grab in the deeper parts of the locations. Shells were measured to the nearest 0.1 mm with an extension callipers or a stereo-microscope provided with an ocular micrometer for shells smaller than approximately 10 mm. Clam lenghts were measured from the anterior to the posterior margins of the shell.

RESULTS AND DISCUSSION

Live *C. fluminea were* found for the first time in bottom samples taken on September 30, 1988 in the river Lek near Lekkerkerk (fig. 2). Ten samples were taken in the littoral zone of the river bank; only in one sample three specimens were found. In the deeper part of the river ten bottom samples were taken as well; in each sample specimens of *C. fluminea* were found. In this part of the river density of the clams was estimated to be 40 (s.d.: 29) specimens per m^2. On this location a total of 60 specimens were collected. From shell size/frequency distribution (fig. 3) of these specimens at least two size classes could be distinguished, probably representing two generations. One specimen larger than 18 mm may be a representative of a third generation. This may indicate that *C. fluminea* has colonized this location in 1985 or 1986. The distinction of generations is based on observations of Dresler & Cory (1980) who recognized four generations in the tidal Potomac river (Maryland, U.S.A.) with shell classes of <13 mm, 13 to 18 mm, 19 to 25 mm, and >24 mm for the 0^+ to the 3^+ generations respectively.

On October 24, 1989 *C. fluminea* was found in samples taken in the littoral zone of the Hollands Diep, the confluence of a branch of the river Rhine (named river Waal) and the river Meuse (fig. 2). Because sampling on this location took place for other purposes, namely to collect other species of macroinvertebrates for laboratory studies, the number of samples is unknown. Therefore an assessment of the

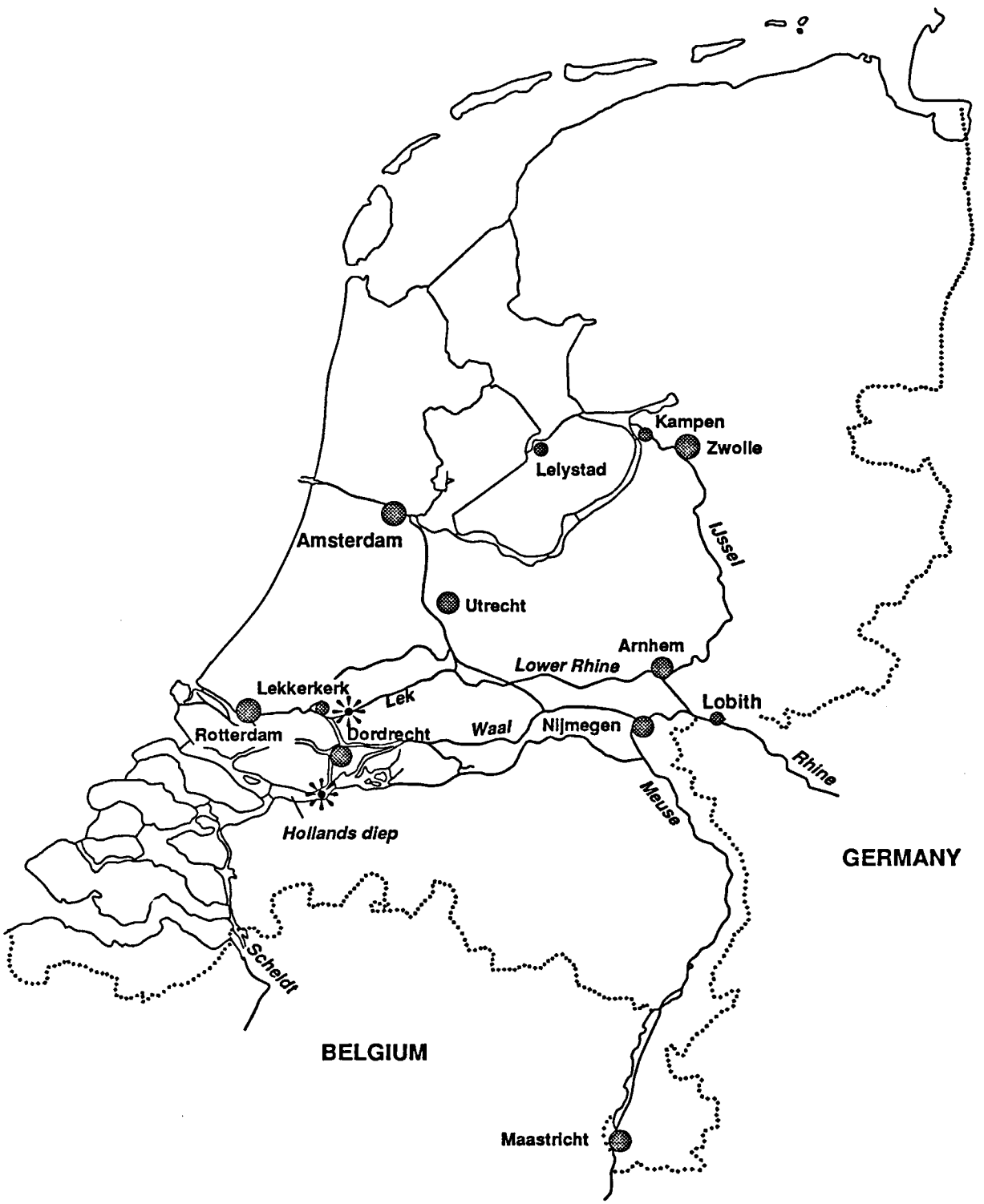

Fig. 2. Locations (*) of *C. fluminea* recorded in this paper.

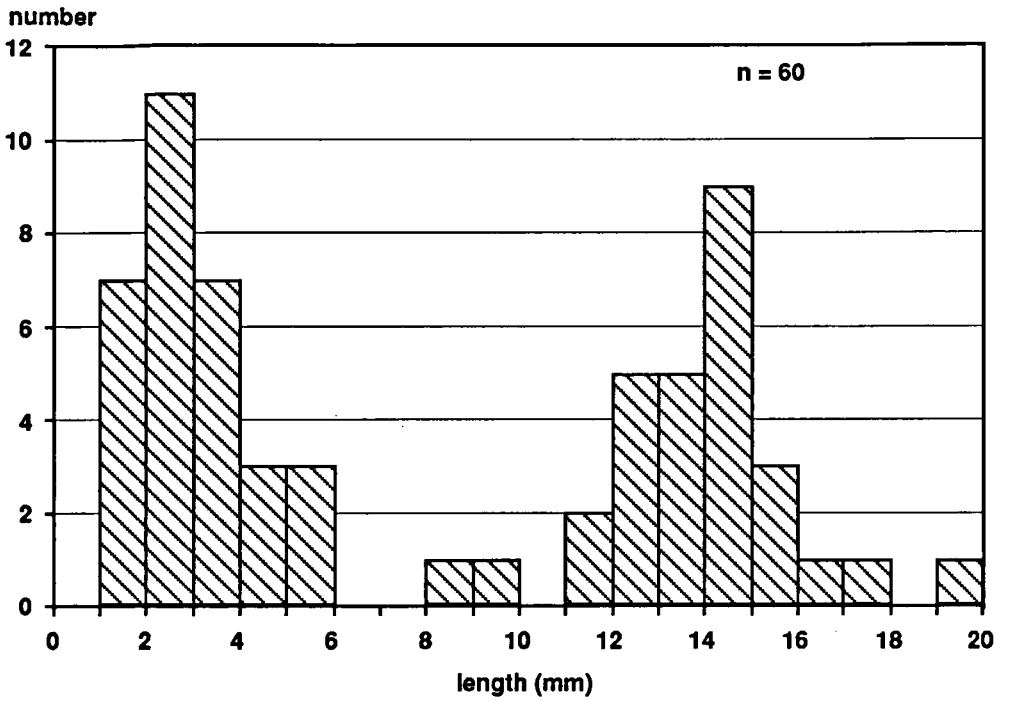

Fig. 3. Length/frequency distribution of *C. fluminea* found in the river Lek on September 30, 1988.

density is not possible. The number of specimens collected on this location was 15, belonging to the 0^+ and the 1^+ generation.

Densities of *Corbicula* in North America are greatest in well-aerated sand or sand-gravel mixtures (McMahon, 1983). The animals prefer lotic water systems (Belanger et al., 1985).

The toplayer of the bottom sediment in the littoral zone of the location in the river Lek consisted of a mixture of silt and sand, in the deeper part of the river the bottom consisted of sand. The toplayer of the bottom in the littoral zone in the Hollands Diep had the same general composition.

During 1985-1988 chloride concentration in the river Lek varied between 100 and 200 mg/l measured at Hagenstein, about 35 km upstream from the sampling site. Chloride concentration in the Hollands Diep depends on the discharge of the river Meuse and the river Waal. Chloride concentration in the same period in the river Waal, measured at Vuren, about 32 km upstream from the sampling site in the Hollands Diep, varied between 100 and 200 mg/l, and in the river Meuse near Keizersveer, about 15 km upstream of this sampling site, between 25 and 100 mg/l.

On all these locations chloride concentration is measured regulary (Institute for Inland Water Management and Waste Water Treatment, unpublished data).

TAXONOMY

Despite a considerable number of "nominal species" named in literature, only two valid species may be clearly separable (Morton, 1983; Britton & Morton, 1986): the freshwater species *C. fluminea* and the estuarine species *C. fluminalis* (Müller, 1774). This means that species like *C. leana, C. manilensis, C. consobrina* and *C. africana* all belong to the superspecies *C. fluminea* while *C. japonica* belongs to the *C. fluminalis* group.

Based on conchological characteristics, it is very difficult to distinguish *C. fluminea* from *C. fluminalis.* The indentification of the specimens from the river Lek and the Hollands Diep has been checked by comparing them with the reference collection of the Zoological Museum Amsterdam. Recent specimens of both taxa from different localities in the world provide no clear indication as to which characteristics justify a distinction. When the recent specimens of *C.*

fluminalis and *C. fluminea* are compared to the so-called *C. fluminalis* from Pleistocene deposits the confusion grows larger. The *C. fluminalis* from the Pleistocene deposits have widely spaced sulcations on the shells while the recent specimens with that name in the collection have closely spaced concentric ridges. Both fossil and recent specimens of *C. fluminalis* have a more tapering shell shape towards the umbo. Nearly all shells labelled *C. fluminea* in the museum collection had more rounded shells and a sculpture of widely spaced concentric sulcations. The specimens from the river Lek have shells with widely spaced sulcations, but shells from the Hollands Diep tend to more closely spaced ridges. We suppose that this difference in sculpture is caused by local environmental conditions (thermal pollution).

Morton (1986) described *C. fluminalis* having deeply impressed growth lines in addition to widely spaced sulcations on the shell exterior, whereas more closely spaced sulcations and indistinct growth marks appear on shells of *C. fluminea.* Based on the shape of the shell and the description of Morton (1986) as well, we choosed for the name *C. fluminea.*

Coincidentally Blanken (1990) published a record of *C. fluminalis* from a location in the river Lek after this manuscript was submitted to the editor of this bulletin. He found his specimens about 10-12 km upstream of our sampling site. From a comparision of the clams of both locations in the river Lek we concluded that all the specimens from this river belonged to one species, in our opinion *C. fluminea.*

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