MARENZELLERIA VIRIDIS (VERRIL, 1873) (POLYCHAETA: SPIONIDAE): A NEW RECORD FROM THE EMS ESTUARY (THE NETHERLANDS/FEDERAL REPUBLIC OF GERMANY)

by

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Essink, K., & H.L. Kleef: Marenzelleria viridis (Verril, 1873) (Polychaeta: Spionidae): a new record from the Ems Estuary (The Netherlands/Federal Republic of Germany).

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A new record of the North American spionid polychaete *Marenzelleria viridis* (Verril, 1873) is reported from the Ems Estuary. The species was first found in 1983. From 1983 to 1986 densities increased to a few thousands per m^2 while densities of another polychaete, *Nereis diversicolor* decreased. Juveniles showed peak densities of c. 19000 m^{-2} in muddy sediments. Adults preferred sandy sediments.

In Europe *M. viridis* was recorded recently also in other estuaries: Tay and Forth (Scotland), Weser and Elbe (Fed. Rep. of Germany). There is no reliable clue to the cause of its appearance in North Sea estuaries.

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INTRODUCTION

During routine sampling of intertidal macrozoobenthos in 1983 a spionid polychaete was found in the inner part of the Ems Estuary, the Dollard (Fig. 1). In 1985 the species had become numerous. It was identified as *Marenzelleria viridis* (Verril, 1873). *M. viridis* is autochtonous along the east coast of North-America between Georgia (USA) and Nova Scotia (Canada) (Dörjes & Howard, 1975; George, 1966; Maciolek, 1984).

There are two earlier records of a *Marenzelleria* species from the N.W. European Wadden Sea. From intertidal flats near the island of Sylt Wohlenberg (1937) reports *M. wireni* Augener 1913. Otte (1979) reports *Microspio wireni* from Sylt in 1970. Recently *M. viridis* was found elsewhere in Europe *viz.* the Forth Estuary (P.R. Garwood, loc. cit.) and the Tay Estuary (Atkins, Jones & Garwood, 1987) in Scotland and the Weser Estuary (M. Grotjahn, pers. comm.) and the Elbe Estuary (Leling, 1986) in the Fed. Rep. of Germany.

This paper describes the dynamics and distribution, as well as some ecological data of the population in the Dollard.

MATERIALS AND METHODS

The inner part of the Ems Estuary, the Dollard, has a surface of c. 100 km^2, of which c. 83 km^2 consists of intertidal flats. Fresh water is discharged into the estuary by the rivers Ems (125 $m^3.s^{-1}$) and Westerwoldse Aa (WWA; 12.5 $m^3.s^{-1}$) (Helder & Ruardy, 1982).

Three intertidal transects of c. 800 m length (Fig. 1) were sampled three times a year since 1977. Each time 20 sediment cores of c. 230 cm^2 and 30 cm deep were taken on a transect. Samples were sieved in the field over a 1 mm screen. The fauna was hand-sorted in the laboratory. Specimens to be identified were fixed in 70% ethanol in seawater.

In 1985 and 1986 two surveys were carried out in the Dollard to establish the distribution pattern of *M. viridis* in this part of the Ems Estuary.

RESULTS AND DISCUSSION

Systematics. — A recent review of the genus *Marenzelleria* is given by Maciolek (1984). In this review *Scolecolepides viridis* (Verril, 1873), a common estuarine species along the North American east coast, was transferred to *Marenzelleria*.

At first the specimens from the Dollard were identified as *M. wireni* (Augener), a species that had been reported from the Wadden Sea once before (Wohlenberg, 1937). The occurrence of *M. wireni* in the Wadden Sea, however, is unlikely as *M. wireni* has a circumpolar holarctic distribution with records only north of 65°N (Holmquist, 1967, 1973). The southernmost record from Avacha Bay, Kamchatka, at 53°N (latitude comparable to the Dollard, Fig. 1) is still north of the southern limit of sea-ice in winter.

Later, the specimens were identified as *M. viridis*, which was confirmed by dr. C. Mettam (Univ. College, Cardiff, UK) and dr. G. Hartmann-Schröder (Univ. of Hamburg, F.R.G.). *M. viridis* and *M. wireni* are very much alike. A detailed description is given by Maciolek (1984). The specimens found in the Tay estuary are described in detail by Atkins *et al.* (1987). These specimens closely resemble Maciolek's description of *M. viridis*, although several small differences were observed.

Specimens from the Elbe estuary originally identified as *M. wireni* by Leling (1986), were re-examined and identified as *M. viridis* (Dr. G. Hartmann-Schröder, pers. comm.)

A sample was deposited in the Rijksmuseum van Natuurlijke Historie, Leiden (coll. no. 19600).

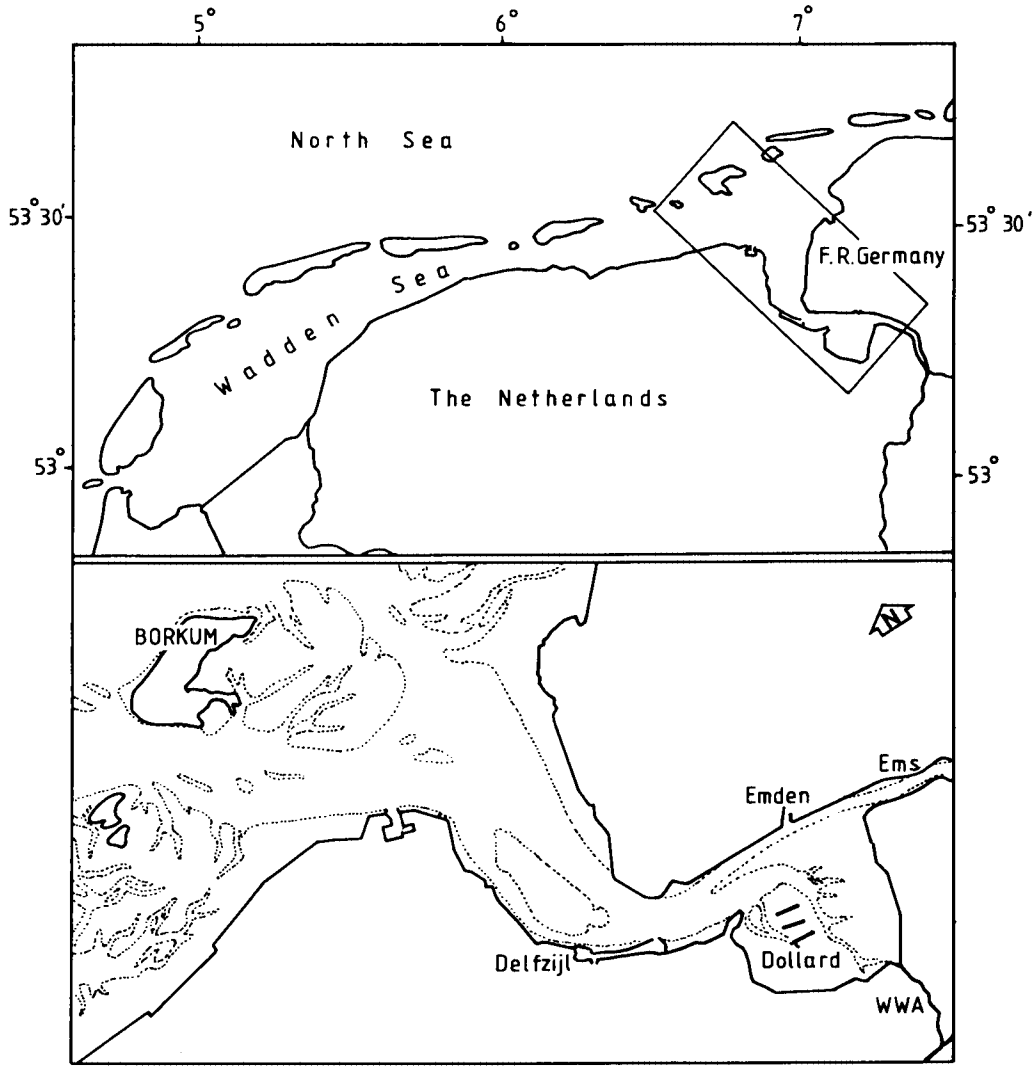

Fig. 1. Map of the Ems Estuary with three transects for sampling intertidal benthos in the Dollard. WWA = Westerwoldse Aa (see text).

Distribution. — The distribution of *M. viridis* in the Dollard, as established in two surveys in 1985 and 1986, is shown in figs. 2 and 3. The species is present in fine sandy to muddy sediments (2 – 40% < 16 μm). Juveniles seem to prefer the muddy sediment in the southeastern corner of the Dollard and along the river Ems. Adults are numerous in the fine sandy sediments; they reach a length up to 10 cm. Top densities were found in the southeastern corner of the Dollard (asterisk in fig. 3). Here the density of juveniles amounted to 16600

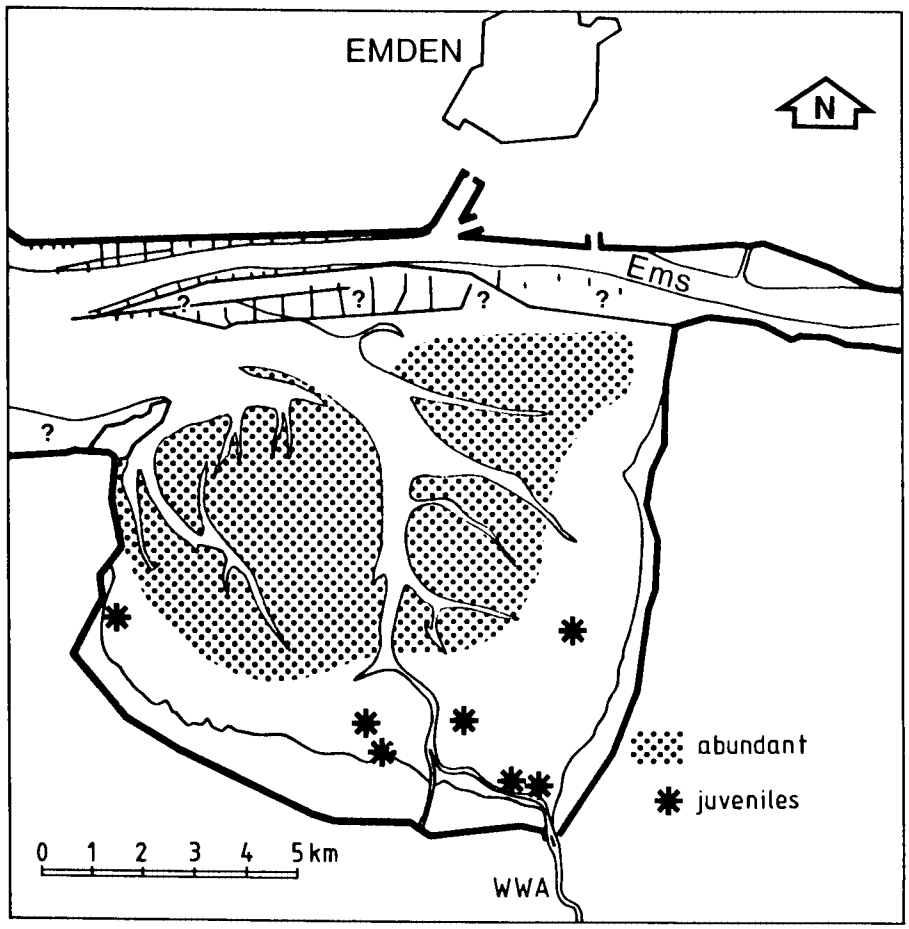

Fig. 2. Distribution of *Marenzelleria viridis* in June-July 1985 in the Dollard

m^{-2} in September 1986 and to 19300 m^{-2} in October 1987. In the middle part of the estuary a few specimens were found during routine sampling in November 1986 and March 1987 in the subtidal (fig. 4).

Dynamics. — Densities of *M. viridis*, recorded at three transects in the Dollard increased considerably (fig. 5). A strong decrease was observed during the severe winter of 1987. A similar decrease occurred in the Weser Estuary (H. Michaelis, pers. comm.).

During the period of increasing densities of *M. viridis* (1983-1986) the densities of another polychaete, *Nereis diversicolor*, decreased (fig. 6). This suggests a competitive interaction between the two species. Although both species can be classified as deposit-feeders, both are also able to exert specific

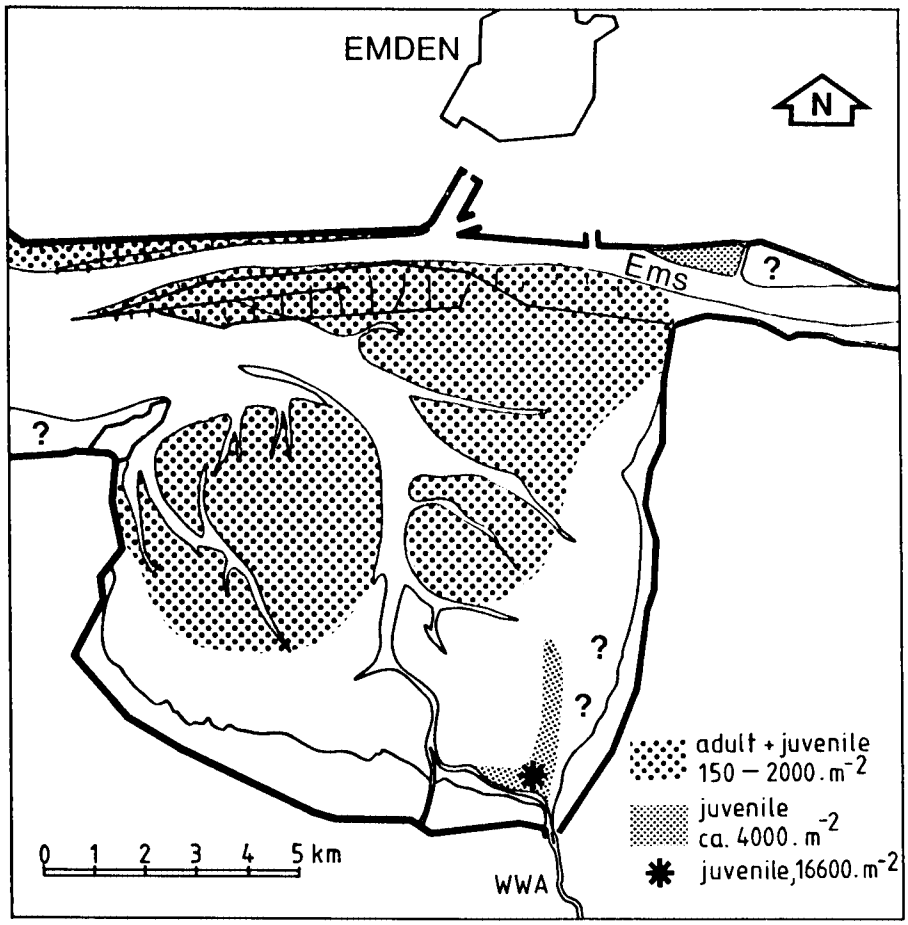

Fig. 3. Distribution of *Marenzelleria viridis* in October 1986 in the Dollard.

ways of filter-feeding (Dauer *et al.* 1981; Goerke, 1971). Therefore it is unlikely that competition for food caused the observed inverse relationship of densities. However, as both species live in burrows competition for space may play a part. This hypothesis is supported by data of Atkins *et al.* (1987), who in a survey in July found a significant negative correlation between the densities of *M. viridis* and *N. diversicolor*. For the Dollard for each of the three transects data are available for 5 sections of four cores each. The pooled data for the northern transects 1110 and 1111, which have a similar sediment type, did show positive or non-significant correlations (Spearman's rankcorrelation) between the numbers of both species on any of the sampling days. So the data from Dollard and Tay do not allow for a uniform conclusion with respect to a

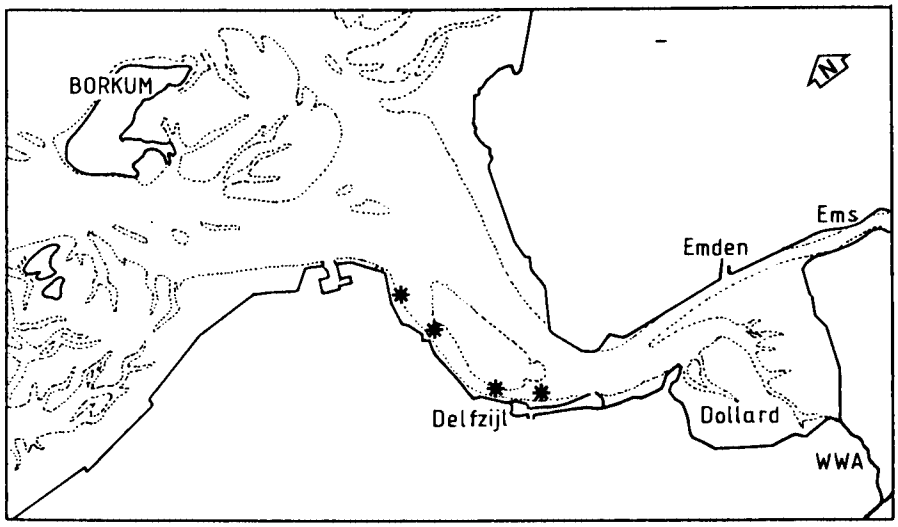

Fig. 4. Records of *Marenzelleria viridis* in 1986 and 1987 in the middle part of the Ems estuary.

competitive interaction between *N. diversicolor* and *M. viridis*.

Ecology. — In the Ems estuary *M. viridis* is most abundant in area's with a mean salinity between 4 and 16 ‰ S (cf. Michaelis, 1981). Only a few specimens were found between c. 16 and 23 ‰ S in the middle part of the estuary. In the Weser Estuary *M. viridis* was found between c. 4 and 14 ‰ S.

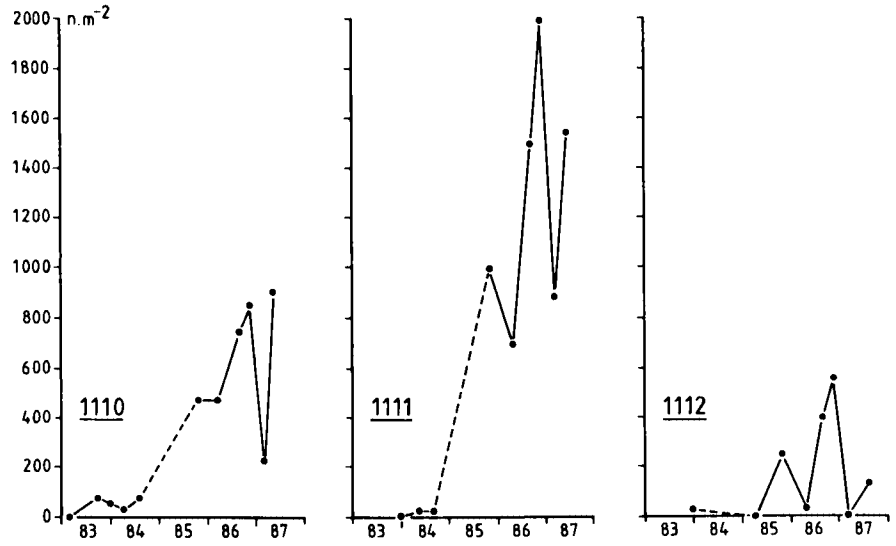

Fig. 5. Density of *Marenzelleria viridis* at three transects (1110-1112) in the Dollard.

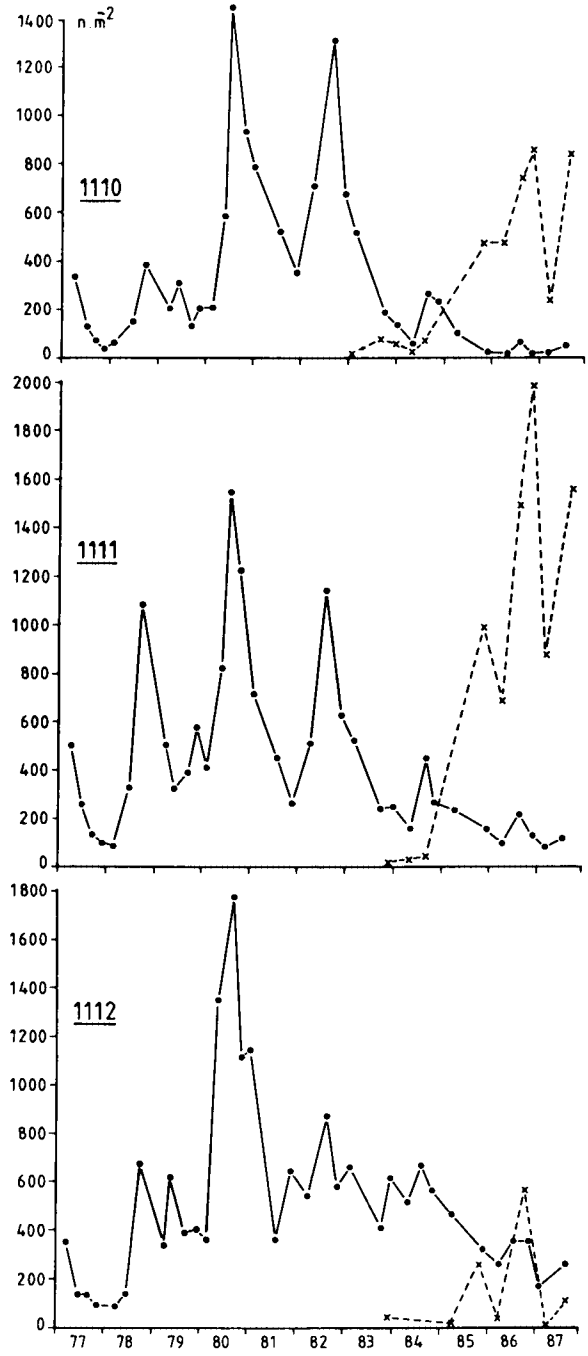

Fig. 6. Density of *Nereis diversicolor* and *Marenzelleria viridis* at three transects in the Dollard.

For the Elbe Estuary Leling (1986) reports a very similar distribution. For North American estuaries *M. viridis* has been reported from the oligohaline reaches (Boesch *et, al.*, 1976; Dauer *et al.*, 1982; Dörjes & Howard, 1975; Jordan & Sutton, 1984; Kinner & Maurer, 1978, and Stickney, 1959). *M. viridis* may even be a dominant species there (Dörjes & Howard, 1975; Kinner & Maurer, 1978). George (1966) found adults at locations with maximal salinities of 5 ‰ S. Adults can survive salinities as low as 0,5 ‰ S for a long time, but reproduction is not possible at salinities below 5 ‰ S.

Only a few records from the subtidal of the Ems Estuary exist (fig. 4). Subtidal occurrence is also mentioned by Dörjes & Howard (1975), Maciolek (1984) and Stickney (1959).

In the Ems Estuary *M. viridis* inhabits fine sandy to muddy sediments, adults being more numerous in the fine sandy, and juveniles in the muddy sediments. The localities where *M. viridis* was found in the Weser Estuary are muddy (Grotjahn & Michaelis, 1985). The localities in the Elbe Estuary also have fine sediments (median grainsize 40-94 μm; Leling, 1986). In estuaries in the USA this species has been found in different sediments: sand, muddy sand as well as mud (Kinner et al. 1974; Sanders et al., 1962; Whitlatch, 1977).

Marenzelleria viridis inhabits vertical mucus-lined burrows, c. 2 mm in diameter, in the sediment (cf. George, 1977). The mucus lining has a brownish colour, which is most clearly visible in muddy sediments. In the Dollard burrows were found to have a maximal depth of 30 cm. Dörjes & Howard (1975) report 1 mm wide burrows down to 15 cm deep. Diameter and depth of the burrow are most likely related to the dimensions of the animal inhabiting the burrow, as has been found for *Nereis diversicolor* (Esselink & Zwarts, in prep.). The burrows are unbranched, which is in contrast with the highly branched burrow networks found in experimental microcosms by Dauer et al. (1981).

With respect to its feeding behaviour *M. viridis* has been classified in the literature as a selective deposit-feeder (George, 1966; Sanders et al., 1962; Whitlatch, 1980). A pair of tentaculate palps is used for the collection of preferably small sediment particles. Dauer et al. (1981) did observe surface deposit-feeding as well as suspension-feeding by irregular lashing of both palps in the water column. Own observations in the laboratory, where *M. viridis* were placed in 3 mm wide glass cuvettes, showed sediment feeding behaviour in the burrow at a few cm below the sediment surface. During feeding surface sediment fell down the burrow. Also at a greater depth (c. 10 cm) in the burrow sediment-feeding occurred. This resulted in a local widening of the burrow.

Faeces are deposited on the sediment as elongated castings comparable to

those of the lugworm *Arenicola marina*. The diameter of the faeces castings is 1 mm at the most. Dauer et al. (1981) observed the production of faecal pellets, not castings.

As to the cause of the recent appearance of *M. viridis* in estuaries around the North Sea only speculations can be made yet. An explanation might be that *M. viridis* has been present in NW. European estuaries as remnant populations of one original pan-Atlantic population that was separated due to continental drift (Sterrer, 1973). The improbability of this explanation lies in the fact that *M. viridis* has not been found earlier, although by its dimensions it is far from inconspicuous. The record mentioned by Wohlenberg (1937) must be considered doubtful in view of the high salinities Reise (1984) reports for the locality where the polychaete was found. Otte's (1979) findings in 1970 may refer to *M. viridis*. However, some uncertainty remains. In 1972 Otte did not record the species again.

Another explanation calls for the help of ships as means of transportation from the North American East coast to the North Sea. As larval development is entirely planktonic (George, 1966), and juveniles and adults occur pelagically at times (Dauer et al., 1980, 1982) individuals may have been transported with ballast water taken on board in a North American estuary. This way of introduction has also been hypothesized for the bivalve *Ensis directus* (Von Cosel et al., 1982).

The order of recent appearance of *M. viridis* in different North Sea estuaries suggests two sites of introduction. Firstly, specimens appeared in the Ems Estuary in 1983. From there dispersal may have occurred in northeasterly direction towards the Weser (1986) and the Elbe Estuaries (1985). *M. viridis* was found in the Elbe Estuary in June 1985, and not in samples taken in April of the same year (Leling, 1986). The Weser Estuary was not sampled in 1985, so *M. viridis* may have been present there already by 1985. Secondly, an initial introduction in the Tay Estuary (1984) may have led to a subsequent appearance in the Forth Estuary in 1985. In both instances it is likely that dispersal was mediated by the anti-clockwise net water circulation pattern in the North Sea. Short lasting inversions of this circulation pattern do not seem to have been of any importance for the dispersal of *M. viridis* as they have been to *Ensis directus* (Essink, 1985, 1986).

CONCLUSIONS

The North American spionid polychaete *Marenzelleria viridis* did succeed in establishing a large population in the inner part of the Ems Estuary (Dollard) within a few years after its first arrival. The data available suggest a competi-

tive interaction between *M. viridis* and another polychaete *Nereis diversicolor*. The cause of its appearance in the Ems Estuary is still not clarified. *M. viridis* may have dispersed from the Ems Estuary to the estuaries of Weser and Elbe (F.R.G.).

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