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THE MACROFAUNA OF THE SCHELDE AND EMS ESTUARIES: ESTUARINE ZONATION AND COMMUNITY STRUCTURE

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Introduction

The principal objective of this study is to review the available data of the intertidal benthic macrofauna of the Schelde and Ems estuary. More specifically the study aimed to describe and compare the estuarine zonation and the benthic community structure in both estuaries, in relation to physicochemical and morphological characteristics. Only a summary of the results, described in detail in Ysebaert & Meire (1993), is presented here.

Materials and methods

Some general environmental aspects of Schelde and Ems estuary

Schelde estuary
The Schelde estuary measures 160 km between the mouth in Vlissingen (The Netherlands) and Gent (Belgium), where it is stemmed by a weir (Fig. 1). The mean tidal amplitude increases from 3.82 m at Vlissingen to a max. of 5.2 m at Kruibeke. It diminishes more upstream to ± 2 m near Gent. The freshwater input of the Schelde amounts on average 100 m^3/s. The mean annual chlorinity decreases from ± 16.6 g Cl^-/l near Vlissingen to ± 4.5 g Cl^-/l at the Belgian-Dutch border, and near the tributary Rupel the water becomes fresh. Based on salinity, the estuary can be divided into three main zones: a marine zone (Vlissingen- Hansweert), a brackish zone (Hansweert-Rupel), and a freshwater zone more upstream. The input from inorganic and organic pollutants is very high, especially in the brackish and freshwater zone (Van Eck et al., 1991). The huge organic matter load causes oxygen depletion in the freshwater and brackish zone. As far as the border the estuary is often anoxic, especially in summer.

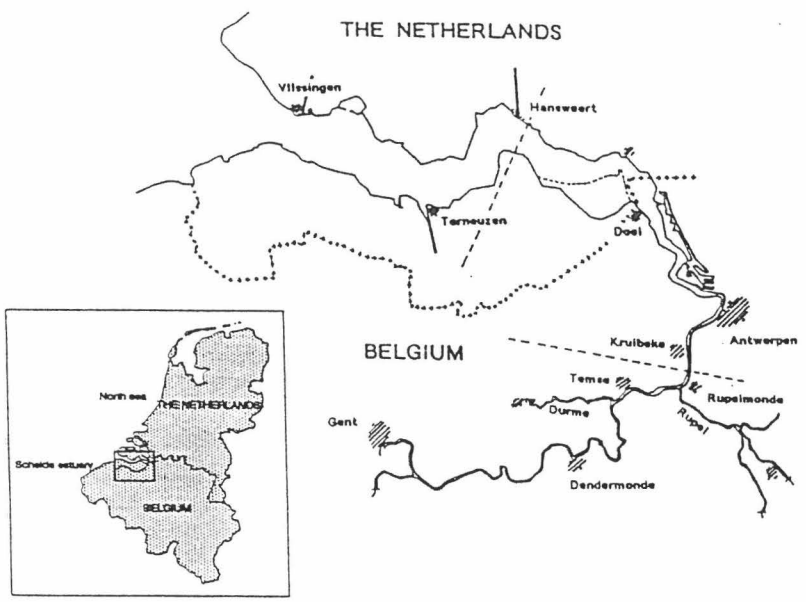

Fig. 1 Map of the Schelde estuary

Ems estuary
The Ems estuary is situated at the border between The Netherlands and Germany. The total length between Papenburg and Eemshaven amounts 80 km (Fig. 2). The area between Eemshaven and the island Borkum is not considered as part of the estuary. The mean tidal amplitude increases from 2.2 m near Delfzijl to 3.2 m near Emden. It diminishes more upstream to about 1.8 m. The freshwater input amounts on average 115 m^3/s. The mean annual chlorinity decreases from ± 16 g Cl^-/l near Eemshaven to ± 8 g Cl^-/l at the mouth of the Dollard (marine zone), and near Nüttermoor the water becomes fresh). The Ems estuary suffers less from pollution as compared to the Schelde estuary.

Available data

This study is based on available data from different institutes collected during the last ten years. In Ysebaert & Meire (1992) a detailed description is given of the data used in the study. For the Schelde and

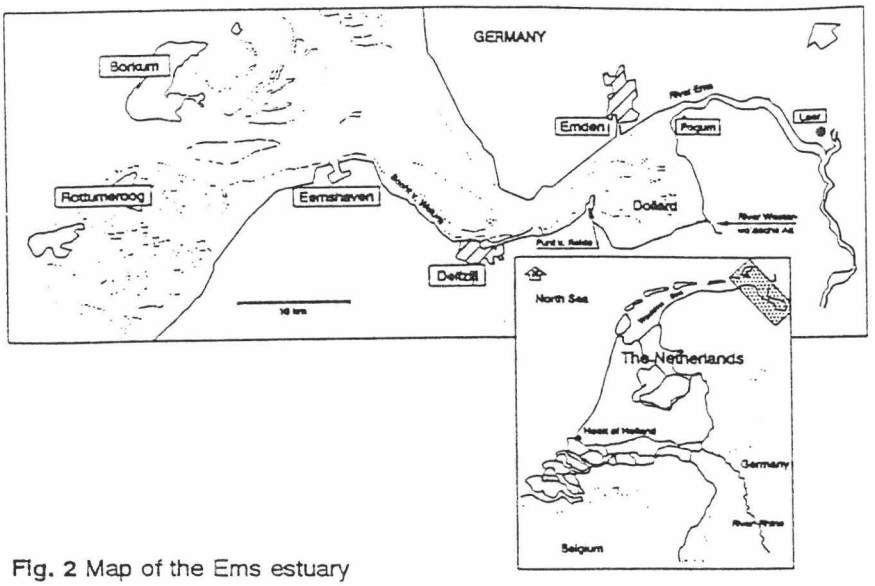

Fig. 2 Map of the Ems estuary

Ems estuary resp. ± 250 and ± 350 data are available. Methodological differences exist between the different datasets because often different sampling strategies and/or laboratory analysis were used. F.i., some studies in the Ems estuary did not sample on one spot, but used a mixture of several samples which were collected along a transect of a few hunderd meters. Also in the Ems estuary, often not all species were determined (e.g. Oligochaeta) or quantified (e.g. *Pygospio elegans*, *Heteromastus filiformis*, *Tharyx marioni*, *Hydrobia ulvae*). Biomasses were often determined by trophic group, and not by species. For more details see Ysebaert & Meire (1992).

Results

Global characteristics of the benthic fauna

In the Schelde and Ems estuary, resp. 62 and 47 macrobenthic species are observed. Additionally, in the Ems estuary 7 species of Oligochaeta are determined, whereas in the Schelde estuary Oligochaeta are considered as one group, since no determination has been conducted.

In general, the genera observed in both estuaries are similar. In both estuaries, half of the species observed are Annelida; the other half consists equally of Mollusca and Crustacea. Deposit feeders compose the major number of species observed. Typically for the Ems estuary is the occurrence of the polychaete *Marenzelleria viridis*. This North American species is present in the Dollard since 1983, and has established a flourishing population (Essink & Kleef, 1988, 1992).

Estuarine zonation

In both estuaries a decrease in the number of species is observed from the mouth towards the freshwater tidal zone; more species disappear than they are replaced by new species upstream (Fig. 3). This is more pronounced in the Schelde estuary. In the oligohaline and freshwater tidal zone of the Schelde estuary no new species are observed, since only Oligochaeta (not determined at species level) are

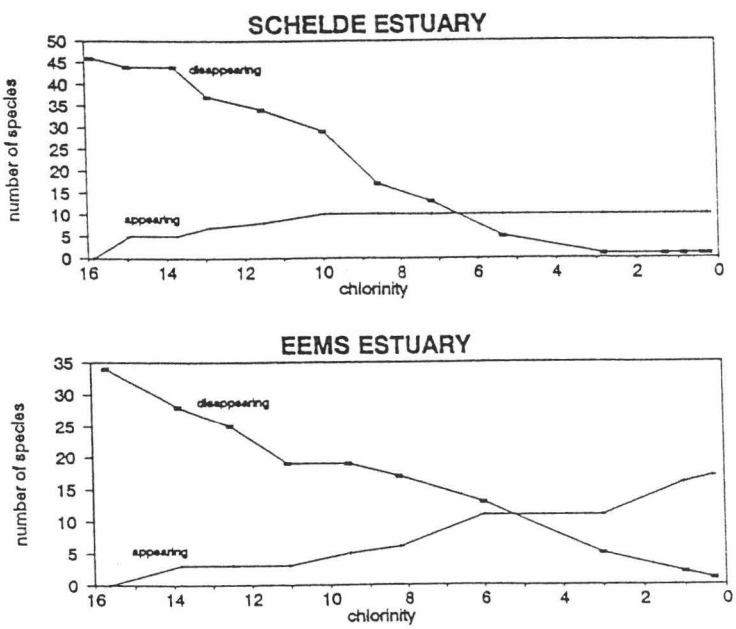

Fig. 3 Number of species (cumulative) appearing and disappearing along the estuarine gradient of Schelde and Ems estuary.

OCCURRENCE %	SCHELDE ESTUARY	EMS ESTUARY
Macoma balthica	86 %	96 %
Nereis diversicolor	68 %	90 %
Heteromastus filiformis	82 %	75 %
Corophium spec.	65 %	86 %
Cerastoderma edule	38 %	26 %
Mya arenaria	21 %	67 %
Pygospio elegans	81 %	14 %

Table I Occurrence (based on the % presence in all samples) of the most dominant species in Schelde and Ems estuary.

	SCHELDE	SCHELDE	EMS	EMS
density	**marine**	**brackish**	**marine**	**brackish**
MACO BALT	733 ± 132	498 ± 68	302 ± 43	176 ± 19
NERE DIVE	400 ± 92	320 ± 60	100 ± 9	599 ± 33
HETE FILI	3493 ± 658	3295 ± 426	1700 ± 165	355 ± 61
CORO SPEC	524 ± 230	3786 ± 739	2346 ± 503	1278 ± 189
CERA EDUL	1154 ± 192	139 ± 50	63 ± 19	0
MYA AREN	42 ± 33	111 ± 42	247 ± 44	89 ± 16
PYGO ELEG	4907 ± 1049	2597 ± 525	?	69 ± 36

	SCHELDE	SCHELDE	EMS	EMS
biomass	**marine**	**brackish**	**marine**	**brackish**
MACO BALT	2.9 ± 0.4	1.0 ± 0.1	2.5 ± 0.2	1.4 ± 0.1
NERE DIVE	1.7 ± 0.4	1.5 ± 0.6	1.0 ± 0.1	2.5 ± 0.2
HETE FILI	8.0 ± 1.4	3.6 ± 0.7	5.2 ± 0.6	0.5 ± 0.1
CORO SPEC	0.13 ± 0.07	1.0 ± 0.2	2.0 ± 0.4	0.4 ± 0.1
CERA EDUL	19.7 ± 5.2	0.6 ± 0.2	1.5 ± 0.4	0
MYA AREN	0.2 ± 0.1	0.3 ± 0.2	29.6 ± 5.9	1.9 ± 0.2
PYGO ELEG	0.4 ± 0.1	0.3 ± 0.2	?	?

Table II Mean density (N/m^2 ± SE) and biomass (g AFDW/m^2 ± SE) for the marine and brackish zone of the Schelde and Ems estuary.

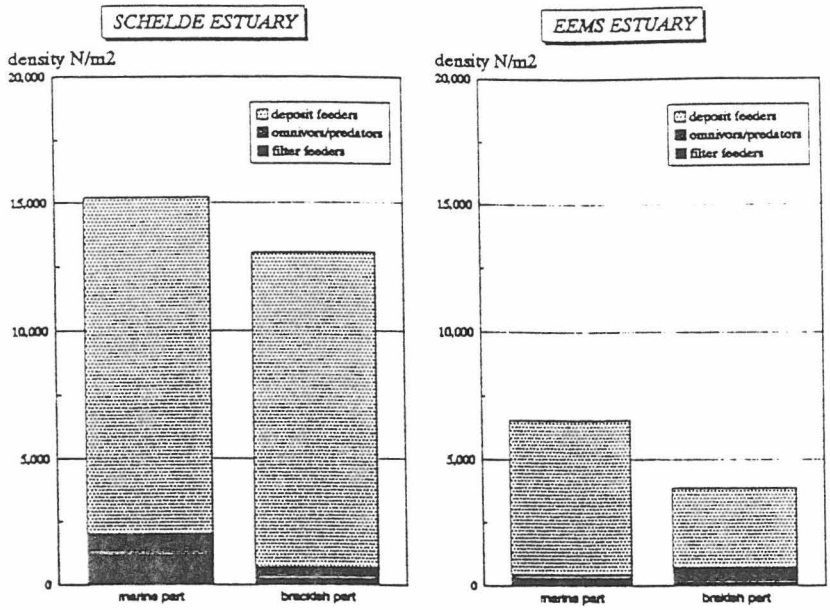

Fig. 4 Trophic structure (in terms of density) of the benthic community in the marine and brackish zone of the Schelde and Ems estuary.

found here (Ysebaert et al., 1992; 1993). Except for these Oligochaeta, no real freshwater organims are observed here (due to pollution). On the other hand, in the Ems estuary freshwater species like freshwater gastropods, gammarids and insect larvae are observed. However, no detailed observations are available. The faunal change is in both estuaries the most pronounced in the brackish zone.

Occurrence of some key species

The occurrence, mean density and biomass of the most dominant species in the marine and brackish zone of both estuaries is given in Table 1 and 2.
Species like *Macoma balthica*, *Nereis diversicolor*, *Heteromastus filiformis* and *Corophium spec.* are very common species in both estuaries. However, differences in mean density and biomass exist both within each estuary (marine versus brackish) and between the estuaries (Schelde versus Ems). For other species like *Cerastoderma edule* and *Mya arenaria* the data show important differences between the two estuaries. *C. edule* is a very common species in the marine zone of the Schelde estuary; it contributes here for > 50 % to the total biomass. On the other hand, in the Ems estuary *C. edule* is a rare species which only appears in low densities and biomasses. *M. arenaria* shows the opposite: common in the Ems estuary, rather rare in the Schelde estuary. In the marine zone of the Ems estuary *M. arenaria* contributes for ± 65 % to the total biomass, in the brackish zone for 26 %.
Pygospio elegans is one of the most common polychaetes in the Schelde estuary and reaches very high densities whereas in the Ems estuary it is hardly found, and only in low densities.

Benthic (trophic) community structure

The community structure within and between the two estuaries shows beside similarities also some structural differences.
The diversity is in both estuaries much higher in the marine zone as compared to the brackish zone.
In both estuaries, densities in the marine zone as well as in the brackish zone are dominated by deposit feeders (Fig. 4). Mean densities are higher in the Schelde estuary as compared to the Ems estuary.
In terms of biomass, a different pattern is observed between the marine and brackish zone of both estuaries. The marine zone in both estuaries is mainly dominated by filter feeders (*C. edule* in the Schelde estuary and *M. arenaria* in the Ems estuary) (Fig. 5). In the brackish zone of the Schelde estuary deposit feeders (*P. elegans*, *H. filiformis* and *Corophium spec.*) are dominating the community. In the brackish zone of the Ems estuary deposit feeders, omnivors (*N. diversicolor*) and filter feeders (*M. arenaria*) are

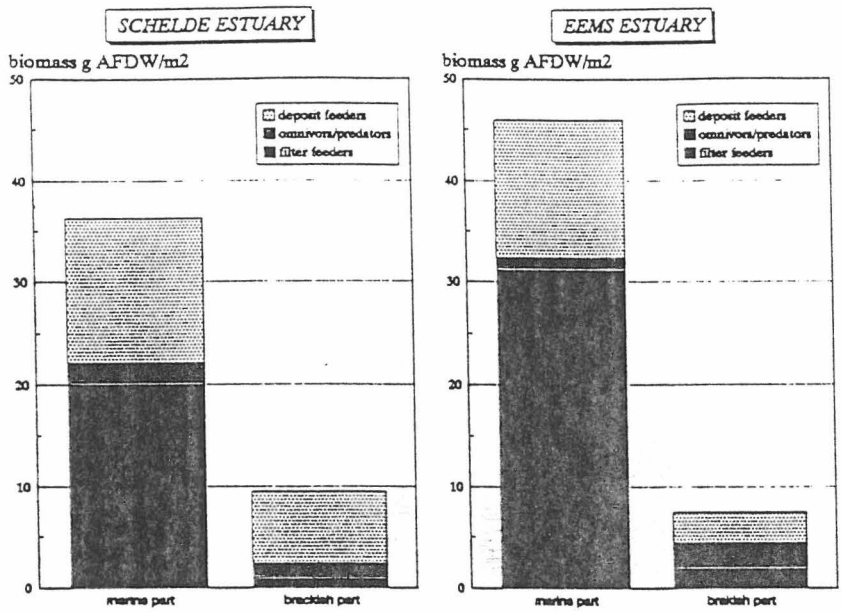

Fig. 5 Trophic structure (in terms of biomass) of the benthic community in the marine and brackish zone of the Schelde and Ems estuary.

equally present.

Conclusions

Species composition is similar between both estuaries and is comparable with other european estuaries. It is however difficult to make good interpretations due to methodological differences. Therefore, standardisation of sampling and analysis procedures is needed in the future.

Despite some similarities, the marine and brackish zone of both estuaries show structural differences, related not only to salinity, but probably also to food availability and hydrodynamics. Primary production of phytoplankton is relatively high in the marine zone and serves as food for the filter feeders (*C. edule* in the Schelde estuary and *M. arenaria* in the Ems estuary). In the brackish zone, concentrations of organic matter are very high which can explain the dominance of deposit feeders here. Hydrodynamics and sediment dynamics will however in the first place determine whether or not a species can settle or survive at a certain location. Especially in the very dynamic brackish zone of the Schelde estuary this can play an important role in determining the distribution and occurrence of benthic organisms. The role of these hydrodynamics is at present studied in more detail.

Acknowledgements

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