

# Long-term changes in Wadden Sea macrozoobenthos

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During 40 years the bottom fauna is monitored at several sites in the Wadden Sea. The total biomass of the fauna increased during these years, as a result of eutrofication. Several immigrant species entered the area successfully. Actions to reduce nutrient levels in fresh and coastal waters so far did not result in decreasing macrozoobenthos levels.

In the Wadden Sea, research on macrozoobenthos, i.e. bottom-dwelling invertebrates, started at regular time intervals in 1967. At Balgzand, a tidal flat area in the westernmost part of the Wadden Sea, a sampling programme was started to study seasonal variability of macrozoobenthos, and in particular the densities and biomass of intertidal bivalves. In the framework of the International Biological Program (IBP), the objective of this study was to provide an estimate of bivalve production in the intertidal areas of the Wadden Sea. The year around sampling programme with sampling intervals of ~1.5 months was started on 3 permanent plots at Balgzand (Fig 1). In 1969 an additional set of 12 transects was added, scattered over Balgzand (Fig. 1), to identify distribution, densities and biomass of macrozoobenthos at the moments of highest (end of summer) and lowest (end of winter) individual body mass. In late winter the populations of adults that would participate in the coming reproduction in spring and early summer could be identified, in summer the results of that reproduction could be estimated. From 1969 onwards, sampling

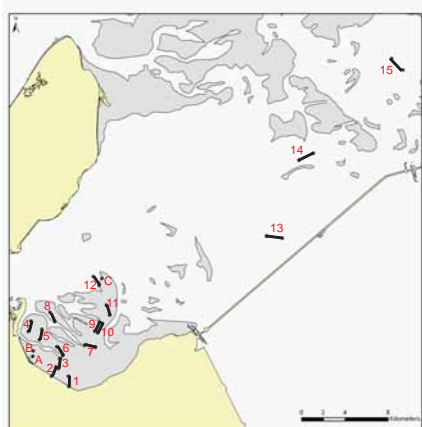


Fig. 1. Map of the Wadden Sea, indicating sampling positions.



Fig.2. Hand operated core sampling in intertidal areas

on these 15 study sites was carried out twice annually in an almost unaltered way.

Between 1968 and 1978, similar sampling programmes were initiated by the Ministry of Transport and Public works in other areas of the Dutch Wadden Sea. In the years 1981-1982 a survey on the macrozoobenthos in the subtidal parts of the western Wadden Sea was carried out. The characteristics of the subtidal fauna was hitherto poorly known. As a follow-up of this survey, in 1990 a programme on macrozoobenthos dynamics in the subtidal was started in the relatively shallow and sheltered inner part of the western Dutch Wadden Sea (Fig. 1). In the intertidal areas sampling was carried out on foot with hand operated corers (Fig. 2), in the subtidal areas samples were taken with a Reineck boxcorer operated from a shallow draught research vessel (Fig. 3).



Fig. 3. Box corer for sampling in subtidal areas (photo A.G. Brinkman)

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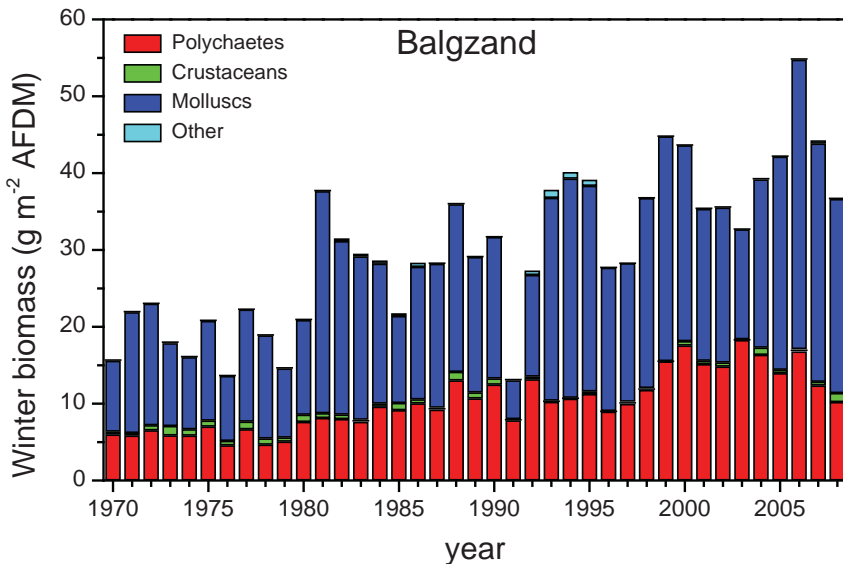


Fig. 4. Total biomass of the macrozoobenthos at Balgzand during winter, subdivided in taxonomic groups

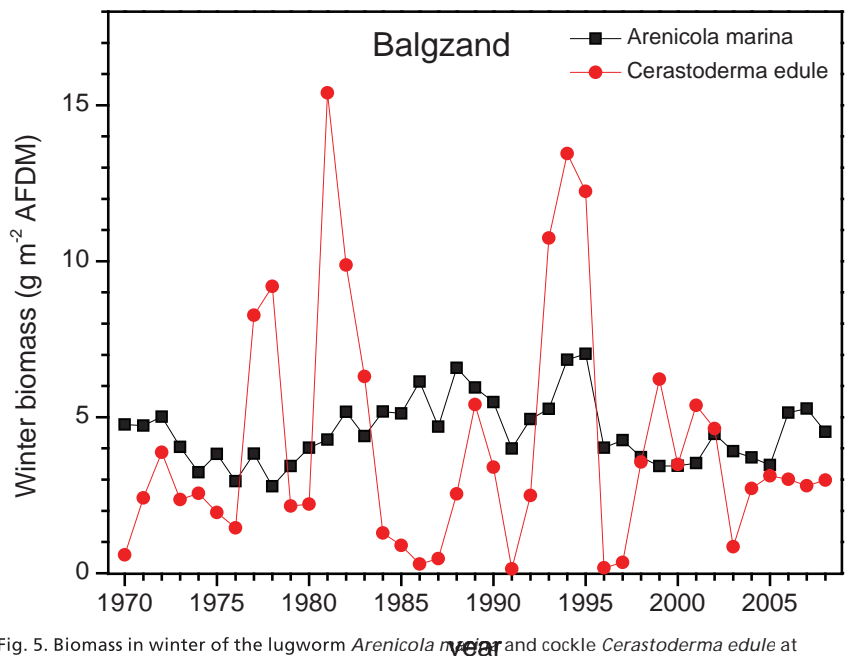


Fig. 5. Biomass in winter of the lugworm *Arenicola marina* and cockle *Cerastoderma edule* at Balgzand.

In terms of biomass (ash free dry mass) the benthic fauna at Balgzand showed an increasing trend from the beginning of the research period up to recent years (Fig. 4). During the first ten years the total biomass in winter had a relatively constant value of ~ 15 g.m<sup>-2</sup> AFDM, in the second decade this value roughly doubled. The total benthos collapsed in 1991, mainly caused by failing recruitment in bivalves during three of the preceding years, intensive shellfish fisheries and high predation pressure by birds. After 1991 the benthic macrofauna recovered rapidly and showed an

increasing trend up to now. At the species level large differences were observed. The lugworm *Arenicola marina*, a deep-living worm, is a very stable component of the macrozoobenthos at Balgzand. On the other hand, the cockle *Cerastoderma edule*, a bivalve living close to the sediment surface, shows strong fluctuations in biomass as a result of strong variations in recruitment and high mortality in cold winters (Fig. 5). The increasing trend in macrobenthic biomass is partly caused by the increase in total biomass of the sand gaper *Mya arenaria*, a deep living filter feeding

mollusc. Examples of common species that show both increases and decreases are the deep-living worm *Heteromastus filiformis* and the Baltic tellin *Macoma balthica* (Fig. 6), a small mollusc that is dealt with separately in another chapter. New immigrants appeared in the Wadden Sea during last decades: most prominent in terms of biomass are the American jackknife clam *Ensis americanus*, the Pacific oyster *Crassostrea gigas* and the spionid worm *Marenzelleria viridis*. *Marenzelleria* prefers brackish water, and was first recorded in the Dollard in 1983. In the western Wadden

Sea the species appeared later, around 1989. In both areas the populations increased rapidly around 1995, but collapsed to lower levels after about 10 years (Fig. 7). At present, *Marenzelleria viridis* can be considered as an established component of the macrozoobenthos in the Wadden Sea, concentrated in the brackish parts. During the last decades, government policy was to reduce nutrient levels (mainly phosphates) in fresh waters, and hence to reduce nutrient influx in coastal waters. This should reduce primary production. The total macrobenthic biomass did not respond to this reduction so far.

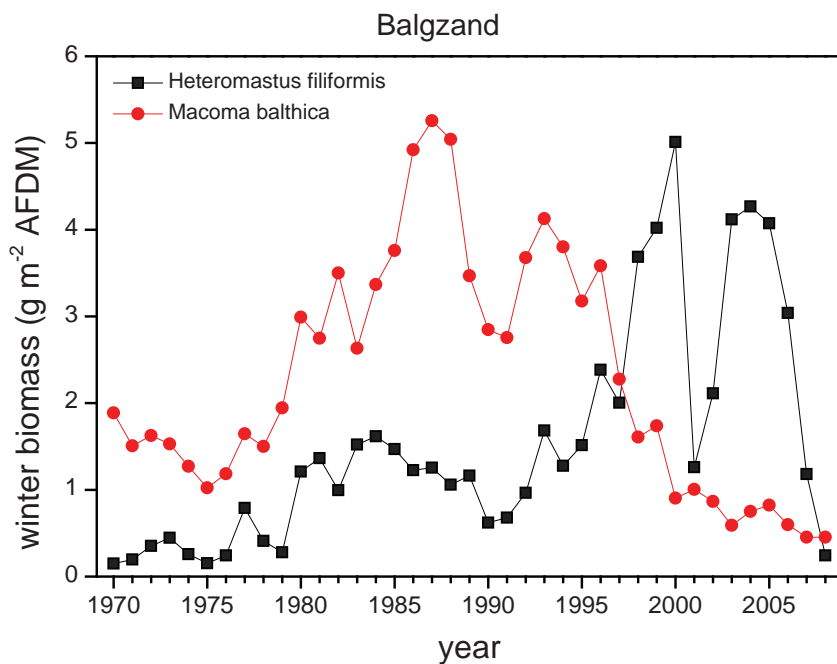


Fig. 6. Biomass in winter of the polychaete worm *Heteromastus filiformis* and Baltic tellin *Macoma balthica* at Balgzand.

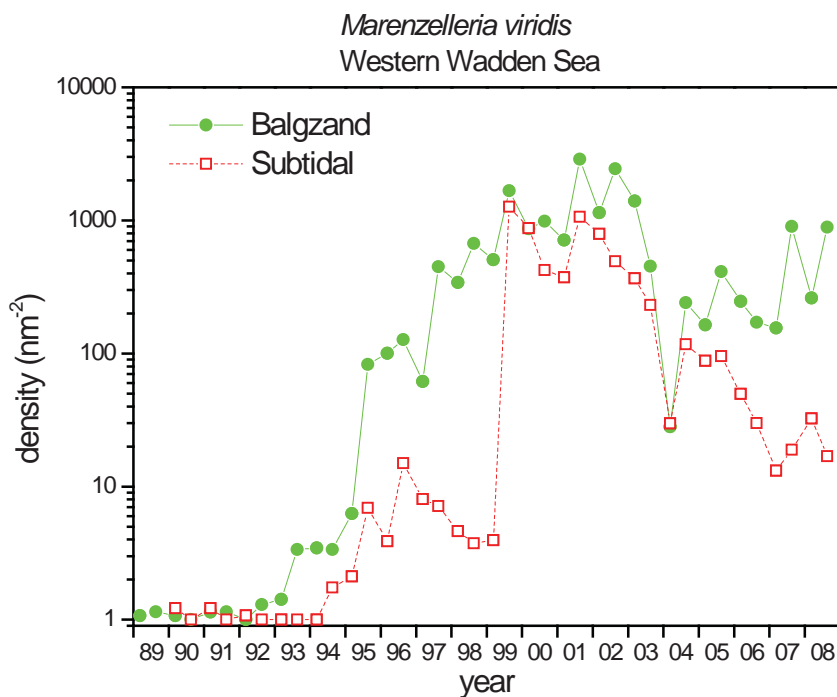


Fig. 7. Development of the densities of the polychaete worm *Marenzelleria viridis*, immigrant from the west Atlantic, in the western Dutch Wadden Sea (intertidal Balgzand and subtidal).