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## CHANGES IN MACROZOOBENTHOS OF THE SOUTHERN BALTIC IN 1979–1988

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The studies concerned the Gdańsk, Gotland, and Bornholm Deeps as well as the Pomeranian Bay, each of the areas housing one station. The most abundant and diverse bottom fauna was found in the shallow Pomeranian Bay. The most impoverished and least diverse bottom fauna inhabited the Gdańsk and Bornholm Deeps. At the Gotland Deep station, no macrobenthos occurred in 1981.

### INTRODUCTION

The paper presents results of qualitative and quantitative studies on bottom fauna carried out by the Institute of Environment Protection, Gdańsk Branch, within the framework of the Baltic Monitoring Programme (BMP) in 1979–1988.

The bottom fauna is one of the best biological indicators of aquatic environment quality. Composition and abundance of benthic assemblages evidence the present-day ecological conditions of the environment studied. Conclusions can also be drawn about the factors which have influenced the bottom community in the past, particularly with respect to such limiting factors as oxygen deficiency, occurrence of  $H_2S$  and toxic substances. The impact of these factors leads to a decreased number of species and even to complete disappearance of the bottom macrofauna. Such is at present the situation in all the southern deep basins in the Baltic the bottom of which was inhabited in the 1950s by several invertebrate species, adult bivalves playing an important role. Due to temporary oxygen deficits and contamination of the near-bottom water by  $H_2S$ , long-lived organisms, i.e. bivalves, have now disappeared. Bottom fauna communities dominated by a single species, be it *Harmothoe sarsi*, *Scoloplos armiger* or *Pontoporeia femorata*, tolerant of the prevailing environmental conditions, appeared in periods of temporary environmental improvement.

## MATERIALS AND METHODS

Benthic animals were collected at 3 deep-water stations located in the central part of the Gdańsk Deep (P-1), the southern part of the Gotland Deep (P-140), and the eastern part of the Bornholm Deep (P-5), and at a shallow-water station located in the Pomeranian Bay (B-12) (Fig. 1).

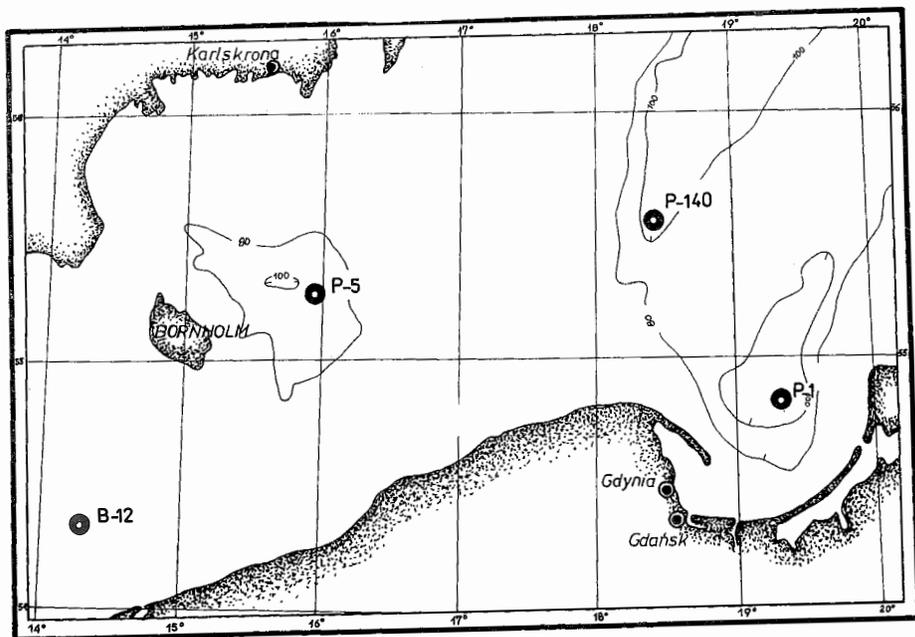


Fig. 1. Location of macrobenthos sampling stations in 1979–1988

Sampling, preservation, and laboratory processing of samples followed the BMP guidelines (Anonymus 1984).

## RESULTS

## Qualitative macrozoobenthos composition

A total of 15 species of macrozoobenthos were found at the 3 deep stations visited. The Crustacea were represented by 5 species, Polychaeta and Bivalvia contributed 4 species each, and the Priapulioidea were represented by 2 species. The latter were found only at P-140. Of all the deep stations, P-140 showed the highest species richness, with 13 taxa found during the 10 years of study. The bottom macrofauna

was, however, absent at the station in 1981. In the Bornholm Deep (P-5), 6 invertebrate species were encountered, but macrofauna was completely absent in 1981, 1983, and 1987-1988.

Only 3 species were observed at P-1 in the Gdańsk Deep, the hemipelagic *Harmothoe sarsi* being the dominant species. The station lacked bottom invertebrates in 1979, 1981-1982, and 1987-1988.

The most diverse benthic fauna was found to inhabit the shallow Pomeranian Bay (B-12), with 20 species recorded altogether and from 10 to 13 species occurring in different years.

### Quantitative macrozoobenthos composition

During the 10 years of studies, abundances of the benthos at the three deep-water stations were similar, varying within 0-640 ind./m<sup>2</sup>. The highest average abundance, reaching 179 ind./m<sup>2</sup>, was recorded in the Gotland Deep (P-140); however, the station showed extensive variations of abundance in 1979-1981, the abundance being reduced to null in 1981 and amounting, on the average, to 163 ind./m<sup>2</sup> (SD =65) in 1982. Contributions of the Priapuloida and Polychaeta decreased with a simultaneous increase in the abundances of crustaceans (Fig. 2). On the average, polychaetes, crustaceans, priapulids and bivalves contributed 75, 19, 4, and 3% to the total abundance, respectively.

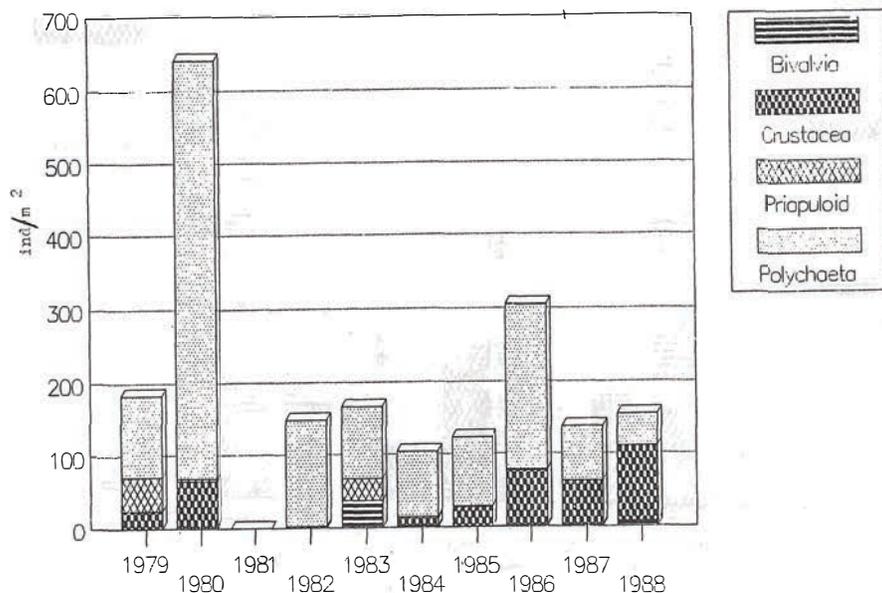


Fig. 2. Changes in bottom macrofauna abundance in the southern part of the Gotland Deep (Station P-140)

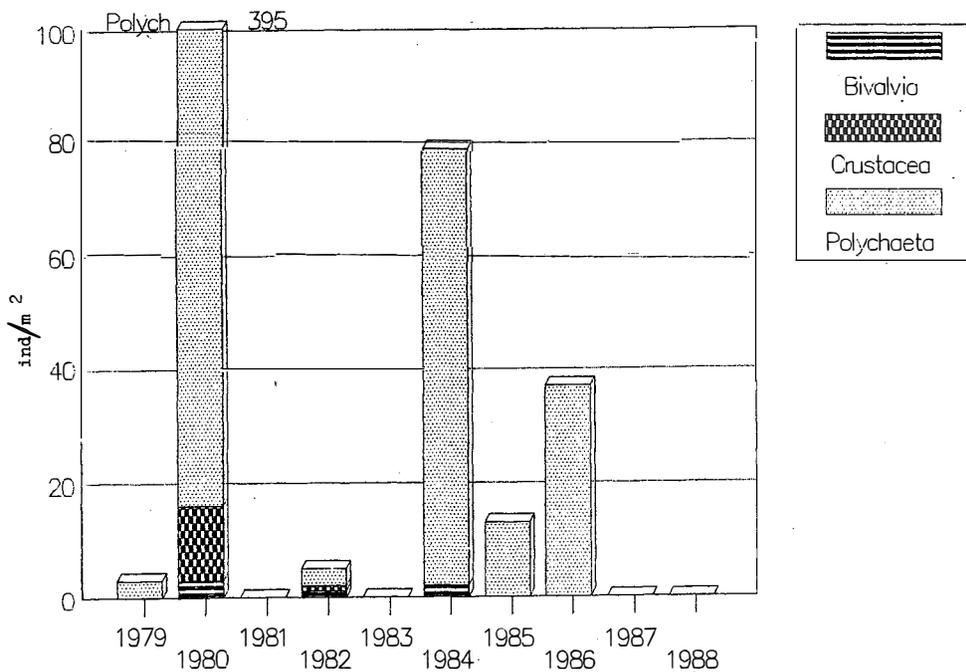


Fig. 3. Changes in bottom macrofauna abundance in the Bornholm Deep (Station P-5)

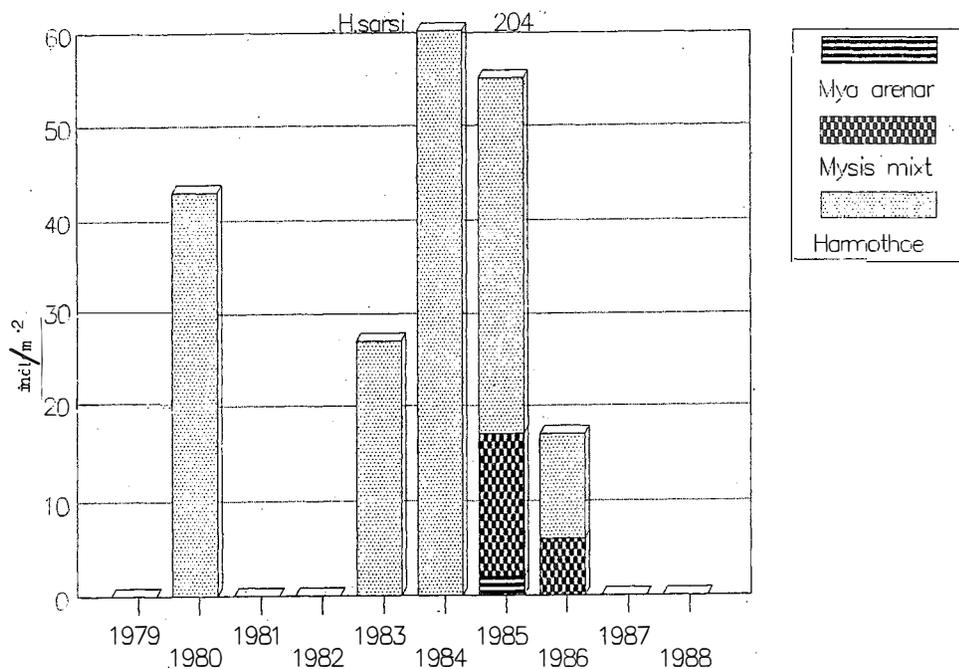


Fig. 4. Changes in bottom macrofauna abundance in the central part of the Gdańsk Deep (Station P-1)

In the Bornholm Deep, the polychaete species, i.e. *Harmothoe sarsi* (0–40 ind./m<sup>2</sup>) and *Scoloplos armiger* (0–355 ind./m<sup>2</sup>) predominated. The two species attained their maximum abundances in 1980. In 1980 and 1982, the crustaceans *Diastylis rathkei* and *Pontoporeia femorata* were also found, their joint abundance reaching 13 ind./m<sup>2</sup> in 1980. Bivalves occurred in 1980, 1982, and 1982, but were represented only by juveniles (shell length less than 5 mm) of *Astarte borealis* and *Macoma balthica*. Their abundance did not exceed 4 ind./m<sup>2</sup> in 1980, 1982, and 1987–1988 (Fig. 3). Polychaetes contributed 96% of the total macrozoobenthos abundance in the Bornholm Deep, whereas the respective contributions of bivalves and crustaceans amounted to 1 and 3%.

The bottom macrofauna of the Gdańsk Deep consisted of 3 species, *Harmothoe sarsi* dominating. Its abundance did not exceed, as a rule, 50 ind./m<sup>2</sup>, except for in 1984 when it attained 204 ind./m<sup>2</sup>. The crustacean *Mysis mixta* was observed here in 1985–1986 and the bivalve *Mya arenaria* in 1986, but their abundances never exceeded 20 ind./m<sup>2</sup> (Fig. 4).

The most abundant macrofauna (600–26.000 ind./m<sup>2</sup>) was observed in the Pomeranian Bay. During the period of study, bivalves and gastropods contributed 62 and 32% to the total abundance, respectively, average contributions of other groups not exceeding 4% (Fig. 5).

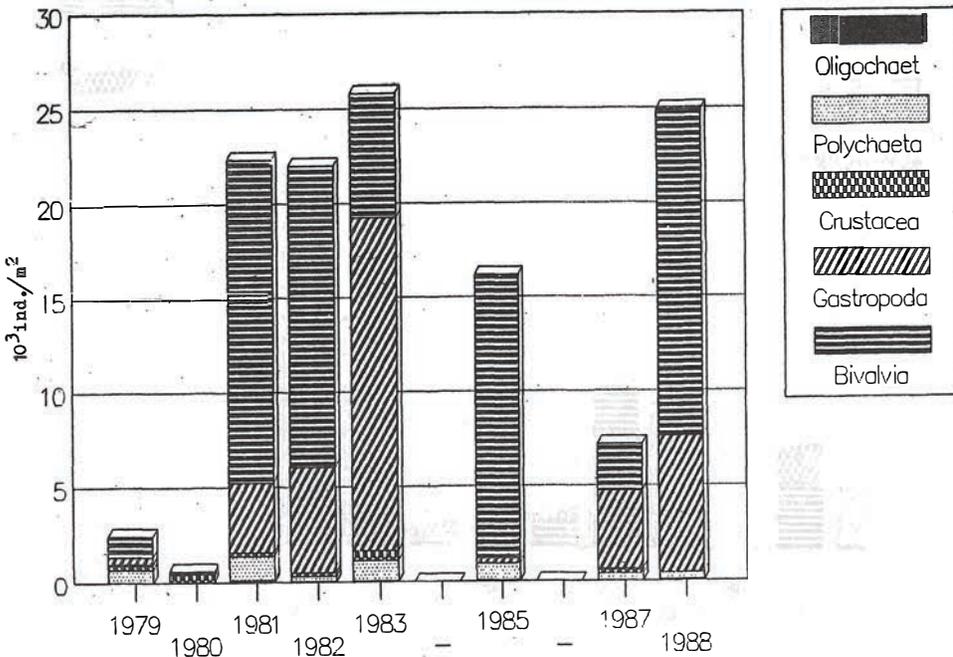


Fig. 5. Changes in bottom macrofauna abundance in the Pomeranian Bay (Station B-12)

## Biomass

The macrobenthos biomass in the Gotland Deep was higher than that at other deep stations in the Southern Baltic. An average biomass amounted to  $3.7 \text{ g/m}^2$  in 1979–1988, which was 4 times as large as that in the Bornholm and Gdańsk Deeps (Fig. 6). The lowest macrobenthic biomass was recorded in the Bornholm Deep where it did not exceed  $0.9 \text{ g/m}^2$  on the average, except for 1980 when the polychaete biomass was 10 times higher than the average. In the Bornholm Deep, *Pontoporeia femorata* ( $0.43 \text{ g/m}^2$ ) and *Diastylis rathkei* ( $0.13 \text{ g/m}^2$ ) occurred only in 1980 (Fig. 7). In the Gdańsk Deep, the macrobenthic biomass did not exceed  $2.5 \text{ g/m}^2$ , the polychaete *Harmothoe sarsi* being its most important component. In 1985 and 1986, the crustacean *Mysis mixta* ( $0.12 \text{ g/m}^2$ ) appeared temporarily and the bivalve *Mya arenaria* ( $0.03 \text{ g/m}^2$ ) was observed in 1986 (Fig. 8).

Over the 10-year period of study, polychaetes contributed 66% of the macrozoobenthos biomass in the Gotland Deep, their respective contributions in the Bornholm and Gdańsk Deeps being 91 and 98%; bivalves and crustaceans contributed 16 and 13% of the biomass, respectively.

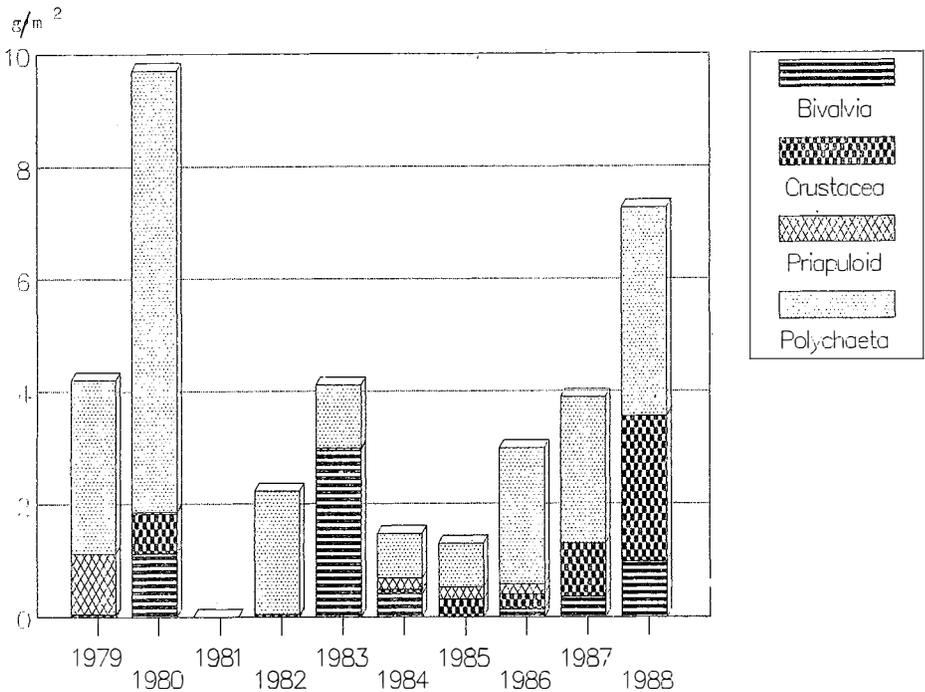


Fig. 6. Changes in macrobenthos biomass in the southern part of the Gotland Deep (Station P-140)

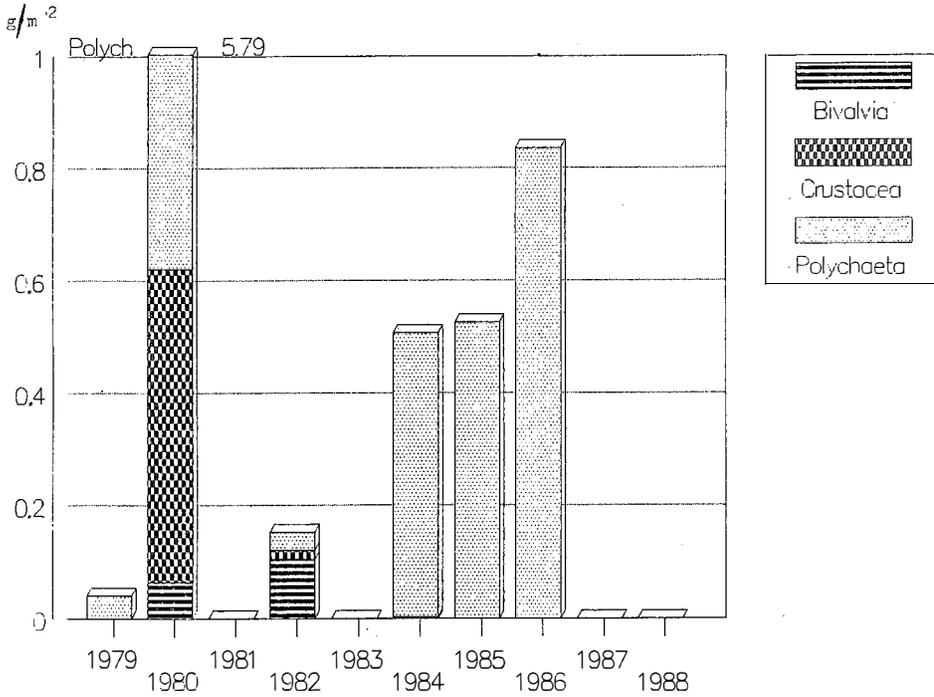


Fig. 7. Changes in macrobenthos biomass in the Bornholm Deep (Station P-5)

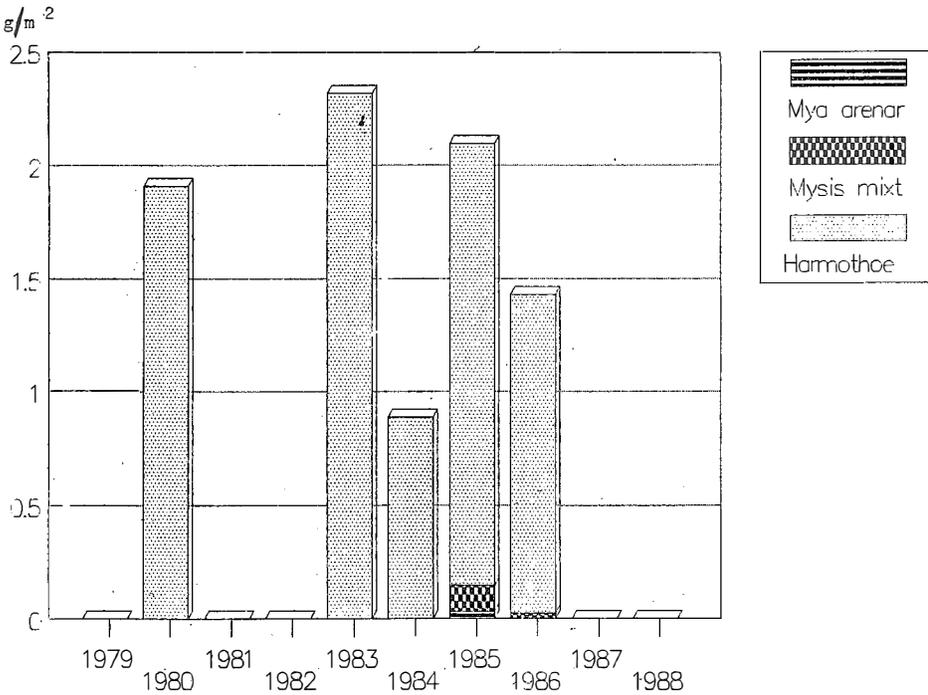


Fig. 8. Changes in macrobenthos biomass in the central part of the Gdańsk Deep (Station P-1)

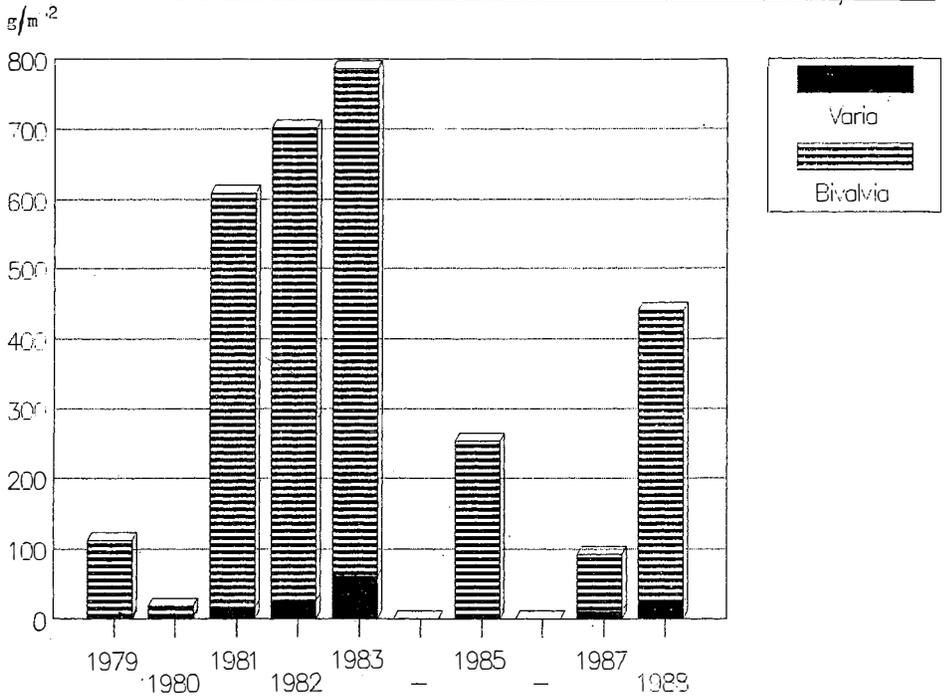


Fig. 9. Changes in total macrobenthos biomass in the Pomeranian Bay (Station B-12)

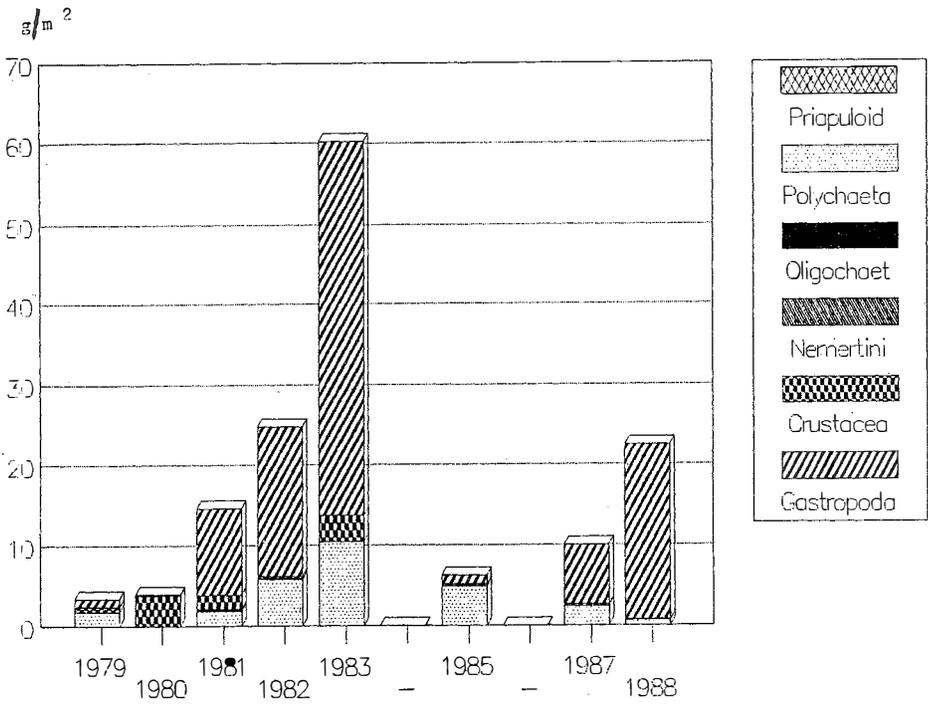


Fig. 10. Changes in macrobenthos biomass (without Bivalvia) in the Pomeranian Bay (Station B-12)

The highest macrobenthic biomass was recorded in the Pomeranian Bay (B-12) with an average of 379 g/m<sup>2</sup> (maximum of 784 g/m<sup>2</sup>) (Fig. 9). Bivalves contributed 95% of the average biomass, their biomasses ranging within 13.8–724 g/m<sup>2</sup>. Bivalves at B-12 included 4 species: *Mya arenaria*, *Cardium glaucum*, *Macoma balthica*, and *Mytilus edulis*. The remaining 5% of the biomass were contributed by 6 taxa, among which the Gastropoda and Polychaeta dominated. Only in 1980 did crustaceans dominate as their biomass increased to over 3 times the 10-year average, with a simultaneous drastic biomass reduction of the remaining taxa (Fig.10).

## DISCUSSION

The history of studies on the Baltic bottom fauna dates back to the 1870s. The whole bottom, including the Southern Baltic deeps, was then inhabited by a diverse fauna, adult bivalves being a constant component of which (Moebius 1873; Demel and Mulicki 1954). From the beginning of the 1950s, macrobenthos in the central parts of the deeps began to disappear temporarily (Tulkki 1965; Żmudziński 1968; Żmudziński et al. 1987). Adult bivalves were the first to disappear from the deep-bottom communities. Of the 14 sampling occasions in the Bornholm and Gdańsk Deep during the 10 years of study, macrobenthos was absent in 7 cases. In the remaining years, the polychaete *Harmothoe sarsi* was often the only species found in the deep-bottom areas. Slightly better ecological conditions were found at the Gotland Deep station where juvenile *Macoma balthica* and *Mytilus edulis* were observed.

The most abundant and diverse fauna inhabited the shallow bottom of the Pomeranian Bay, with bivalves predominating in terms of abundance and biomass.

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