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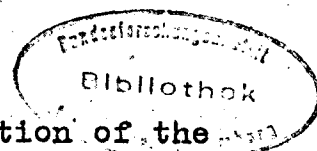
International Council for the
 Exploration of the Sea

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 Plankton Committee

Phytoplankton primary production of the
Baltic Sea

by

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In 1973 the measurements of primary production of the Southern Baltic continued /see: Renk, 1972; Renk et al 1973/. The investigation was carried out at three routine stations /Table 1/. Primary production was measured with the radiocarbon method /Steemann Nielsen, 1952/ at the depths of 0.5, 1, 2, 3, 4, 5, 7, 5, 10, 15 and 20 metres. The incubation was carried out in situ from sunrise until true noon, sometimes even twice a day, additionally from true noon until sunset. The activity of filters was determined with GM counter, barium carbonate being used as the standard. Inorganic carbon dissolved in water was determined with the method of Anderson and Robinson /1946/ modified by Torbicki and Renk /1972/. The details concerning the methods used are described in other papers /Renk 1973; Renk, Torbicki 1972/.

The investigation of primary production was accompanied by chlorophyll measurements. These studies were described in another paper /Renk et al, 1973, 1974/.

Table 1. Stations at which measurements of primary production were taken in 1973

Station	Region	Position	Depth to bottom /m/
A ₁	Arkona Deep	14°01'E 55°02'N	50
B ₁	Bornholm Deep	15°45'E 55°20'N	98
G ₂	Gdańsk Deep	19°20'E 54°50'N	116

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The results of the phytoplankton production measurements are presented in Figures 1-2 by means of diagrams illustrating vertical distributions of primary production in different seasons of 1973. From this figures can be seen that the thickness of the euphotic layer in the southern Baltic amounts to 18-20 m. The primary production under 1 m^2 of the sea surface was calculated by graphical intergrating the curves within the whole water column of the euphotic zone. The integrated values are presented in form of points in Fig. 3. The broken lines in the figure illustrate the mean values of primary production for particular months. There values are obtained as arithmetic means from all the measurements taken in the corresponding months of the years 1966-1973.

As can be seen from Fig. 3 the primary production in 1973 was below the mean value for the years. 1966-1973, i.e., all the results of measurements indicate lower primary production except those from May in the Bornholm Basin /stations A_1 , B_1 /. However the energy efficiency in primary production in the Arkona Deep and in the Bornholm Deep in May 1973 was approximatby 0.4 like in the same month of previons years. The energy efficiency in primary production of the Gdańsk Deep /Station G_2 / in May 1973 was lower than in the same season of the preceding years.

The primary productions calculated for particular quarters of the years and the annual primary production of the Gdańsk Deep are given in Table 2. The mean annual value of primary production for the Gdańsk Deep calculated on the basis of observations carried out for several years /since 1967/ amounts to $85,8 \frac{\text{gC}}{\text{m}^2 \cdot \text{year}}$. From the figures presented in Table 2 follows that the annual primary production decreased during successive years, and in the last one it was approximately by 30% lower than the mean annual primary production. The observations on phytoplankton biomass

Table 2. Annual primary production of the Gdańsk Deep in 1970-1973

Year	Primary production in particular quarters				Annual primary production $\frac{gC}{m^2 \cdot year}$
	I	II	III	IV	
1970	5.8	37.2	67.1	7.4	117.5
1971	5.0	30.4	24.4	13.1	72.9
1972	2.5	12.4	40.5	11.4	68.8
1973	5.8	15.4	25.2	13.3	59.7
mean for the period 1967-1973	3.7	25.1	44.2	12.8	85.8

distribution in the Baltic /Renk et al 1973/ indicate that the chlorophyll concentrations of the southern Baltic waters in 1973 were on the average lower than in 1971 and 1972, the same as the primary productions was.

To demonstrate the differences in primary production of different parts of the Baltic; the mean values of primary production from the period 1966-1973 as they had been evaluated after Polish investigation /Renk 1973, Renk et al 1973/ as well, as the annual primary production taken from some other papers, are presented in Table 3. From the many-year observations the mean value of annual primary production for the southern Baltic was estimated at $82 \frac{gC}{m^2 \cdot year}$. It follows that the primary production of the Gdańsk Deep is greater than that of the Bornholm Basin. The Gdańsk Deep is also peculiar because of its greater primary production as compared with the whole of the Baltic proper and of some other areas belonging to this sea.

Assuming the values of primary production determined at different stations to be representative for the whole of the surrounding areas, we tried to determine the approximate value of annual primary production of particular regions of the Baltic Sea. In Table 4 there are the values of total

Table 3. Primary production per year

Area	Year or period	Annual, or mean annual primary production $\frac{\text{gC}}{\text{m}^2}$	Author
Gdańsk Deep	1967-1973	85.8	Renk 1973, Renk et al 1973, 1974
Bornholm Deep	1966-1973	66	"
Bornholm Sea	1969-1970	63.2	Schulz, Kaiser 1973; Kaiser, Schulz 1973
Arkona Deep	1966-1973	64	Renk 1973, Renk et al 1973, 1974
Arkona Sea	1969-1970	65	Schulz, Kaiser 1973; Kaiser Schulz 1973
Gotland Sea /Baltic proper/	1969, 1970 1969 - 1970	37.9÷69.4 29.4÷30.6	Schulz Kaiser 1973 Sen Gupta, 1972
"	1963 - 1967	78	Fonselius, 1971
Gulf of Finland	1969-1970	45	Schulz Kaiser 1973, Kaiser Schulz 1973
"	1966-1969	15÷192	Bagge, Lehmusluoto 1971, Lehmusluoto 1971, Lehmusluoto Pesonen 1973
"	1967-1969	30÷40	Bagge, Niemi, 1971
"	1969-1971	29.4÷30.6	Sen Gupta 1972
Gulf of Bothnia	1961-1968	56.6	Fonselius, 1971
Transition Area	1953-1960	55÷82	Steemann Nielsen 1965

annual primary production for the southern Baltic as well, as those for the Baltic proper, the Gulf of Finland and the Gulf of Bothnia. For the areas where no measurements had

Table 4. Total annual primary production of the Baltic Sea

Region	Annual primary production $\frac{\text{gC}}{\text{m}^2 \cdot \text{year}}$	Area /km ² /	Total annual production /million ton of carbon/
Southern Baltic	74	84,800	6.27
Baltic proper	56	151,000	8.45
Gulf of Finland	40	31,200	1.25
Gulf of Bothnia	57	118,000	6.74
Baltic Sea		385,000	22.71

been performed, the following mean annual values of primary production per 1 m² of the sea surface were adopted: for the Baltic proper - 56 $\frac{\text{gC}}{\text{m}^2 \cdot \text{year}}$ - the mean value from Table 3, for the Gulf of Finland - 40 $\frac{\text{gC}}{\text{m}^2 \cdot \text{year}}$, and for the Gulf of Bothnia - 57 $\frac{\text{gC}}{\text{m}^2 \cdot \text{year}}$. As results from our calculations the total annual primary production for the whole southern Baltic amounts to about 6.3 million ton of organic carbon, and for the whole of the Baltic area it amounts to 22.7 million ton of carbon.

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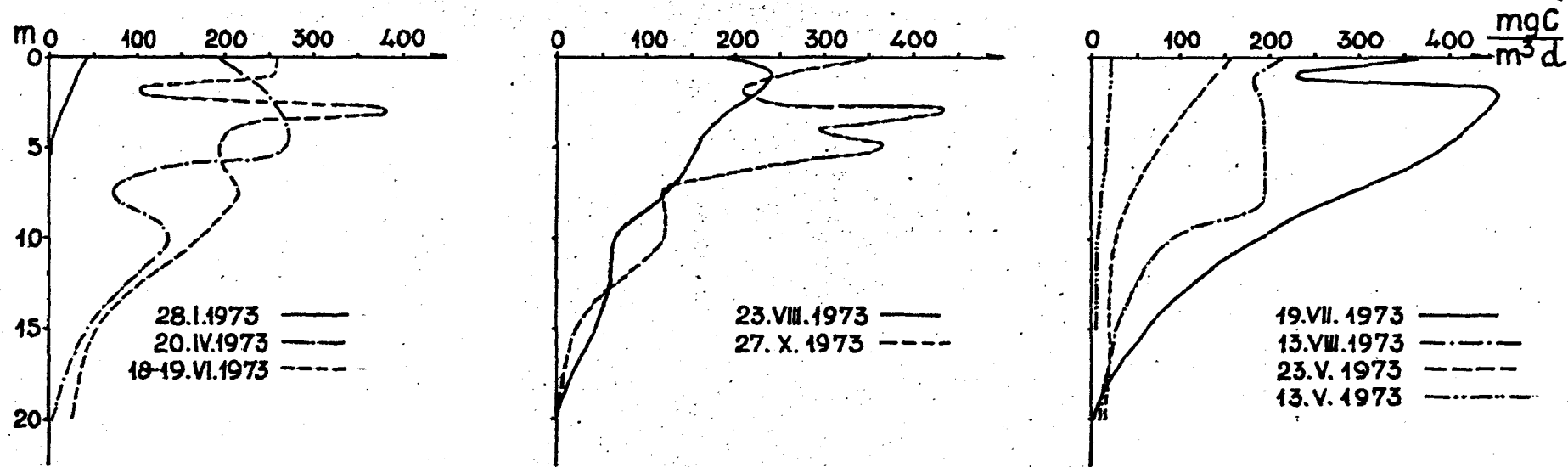


Figure 1. Vertical distribution of primary production at Station G₂.

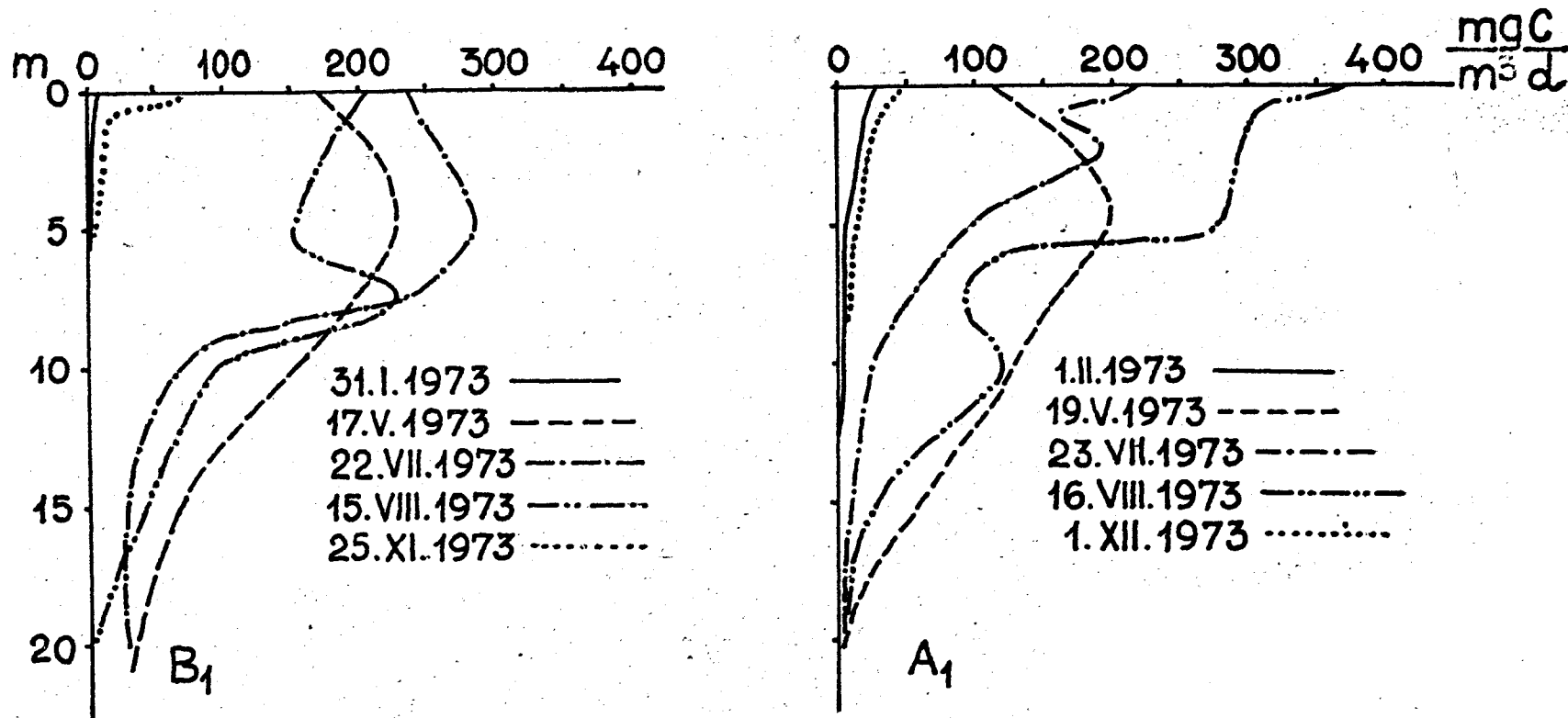


Figure 2. Vertical distribution of primary production at Stations A₁ and B₁.

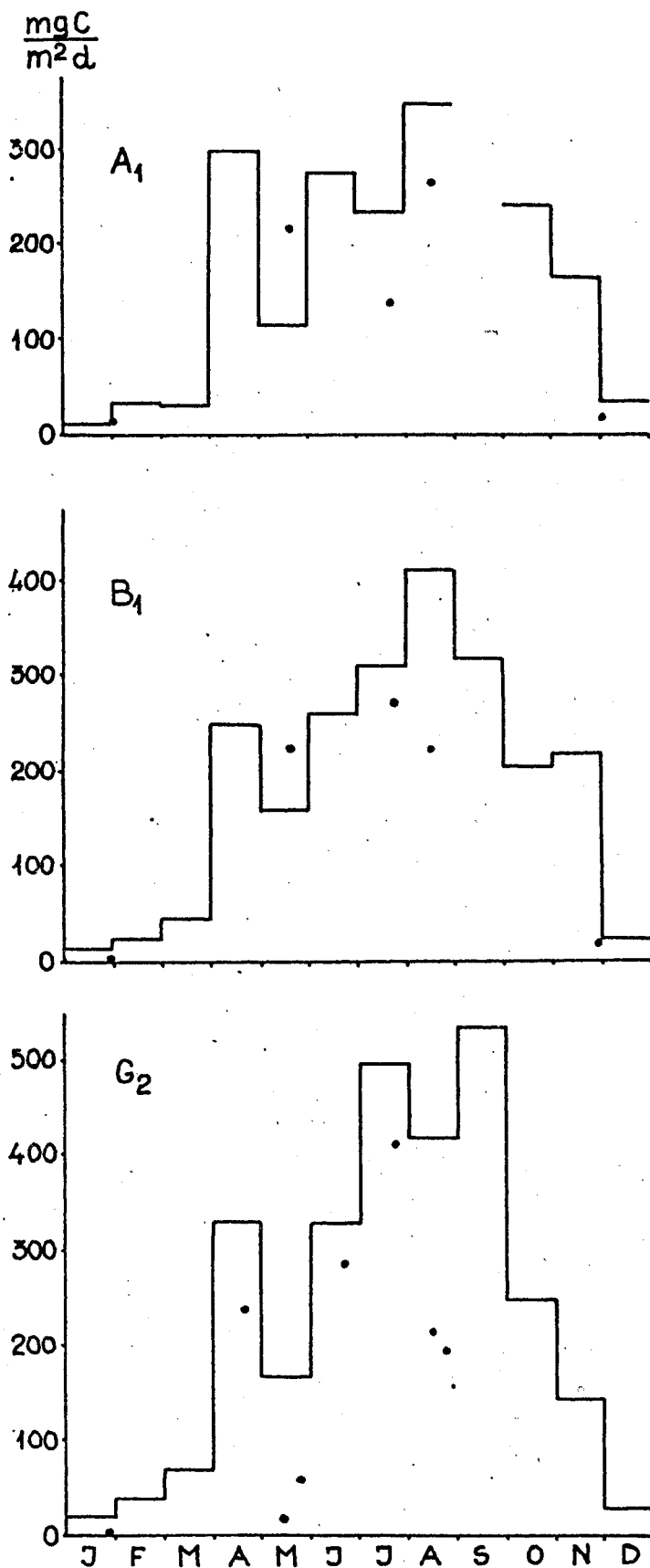


Figure 3. Primary production under 1 m² at Stations A₁, B₁ and G₂. Mean values in various month of the period 1966-1973. Points indicate the results of measurements in 1973.