Dissertations

The absorption of yellow substance in the Baltic Sea

OCEANOLOGIA, 44 (2), 2002.
pp. 287–288.

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Ph. D. thesis in marine physics supervised by Asst. Prof. Jerzy Olszewski.

The dissertation presents and summarises the results of an eight-year investigation into the absorption properties of yellow substance in the Baltic Sea. The work aimed to:

- Find the statistical characteristics of yellow substance absorption in the Baltic Sea and determine the macroscale differentiation of water masses based on yellow substance absorption characteristics.
- Establish the range of variability of the yellow substance absorption coefficient $a_y(\lambda)$, and of the coefficient (S) of the slope of the half-logarithmic absorption spectrum.
- Describe the seasonal variability pattern of $a_y(\lambda)$ and S in the surface waters of the Pomeranian Bight, the Gulf of Gdańsk, the coastal zone and the open sea.
- Establish empirical relationships between yellow substance absorption characteristics and the inherent and apparent optical properties of Baltic Sea water.
- Calculate the relative proportion of yellow substance absorption in the total absorption of light by Baltic Sea waters.

All the above aims were pursued with consistency. The results are set out consecutively and in an orderly manner. Their presentation is preceded by a comprehensive environmental characterisation of the Baltic Sea in the light of the extensive current bibliography. The work is remarkable for the fact that it is the first scientific description world-wide of the large-scale temporal and spatial characteristics of yellow substance absorption in any region. The mean values of some of the characteristics may serve as very

useful input data for any complex bio-optical model of the environment. The variability of certain natural cycles is discussed in relation to the rhythm of hydrologic and hydrodynamic processes in the Baltic. The relationships between the absorptive properties of yellow substance and other optical properties opens up new methodological opportunities for investigations.

The results of the work can be summarised as follows:

- Yellow substance absorption in the Baltic Sea is characterised by significant seasonal variations. The absorption maximum is observed in spring, the minimum in autumn-winter.
- The coefficient (S) of the slope of the absorption half-logarithmic spectrum is subject to minor seasonal variation. The mean value of $S = 0.019$ nm^{-1} is similar in all the regions investigated.
- Under certain environmental conditions statistically significant relationships exist between $a_y(400)$ and each of salinity, chlorophyll a concentration and slope coefficient S.
- The calculated mean relative proportions of yellow substance absorption in the total absorption in blue (74%) and green (28%) light are very high and confirm the dominant part played by yellow substance in light absorption in the Baltic Sea.
- The relationships established between $a_y(400)$ and selected apparent optical properties of Baltic Sea water permit yellow substance absorption to be approximated by irradiance measurements or by remote sensing methods.

Some of the above are merely confirmation of several well-known findings, but this time they are backed up by a very extensive and original experimental data set. Nevertheless, some of them are out of the ordinary, for instance, that the spectra display much steeper mean slopes than expected for the Baltic. Finally, the finding that a large proportion of the total absorption of light in Baltic waters is due to yellow substance appears to be very significant.

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