Dissertations

Marine photosynthetic primary production bio-optical models *(collection of scientific papers)*

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Bogdan Woźniak
Institute of Oceanology,
Polish Academy of Sciences,
Sopot

Thesis for a 2nd doctor's degree in oceanology supervised by Prof. Danuta Frąckowiak, Prof. Henryk Renk, Asst. Prof. Jerzy Olszewski.

This thesis tackles the crucial problem of marine primary production and the environmental factors controlling it. Thus, it deals with the most critical stage in the natural carbon cycle and with biomass regulation in the sea. The thesis comprises eight extensive chapters previously published in English as separate articles in 'Oceanologia' and the PAS Bulletin, as well as a comprehensive discussion and summary in Polish.

The results and theoretical deliberations are based on experimental data amassed by the author (and colleagues from other domestic and foreign centres) during research cruises to different parts of the World Ocean (including the Atlantic, Pacific and Indian Oceans).

The author's objectives were twofold:

- To define precisely the relationships between the various quantities and properties of the marine environment controlling photosynthesis in the sea.
- To use these mathematical relationships to examine diagnostic models for determining marine primary production on the basis of optical measurements, including remote sensing and satellite data.

These objectives were achieved and yielded two mathematical models of primary production.

The first of these is a semi-empirical model of marine photosynthesis for local application (*e.g.* in the Baltic), enabling integral primary production to be computed from optical measurements made from on board ship.

The great advantage of this method over the usual means of measuring primary production is that it does not require long-term incubation; primary production is calculated from less time-consuming optical measurements and from estimations of chlorophyll. A considerable increase in the density of the measurement grid is thus possible. This method could be implemented in the Baltic Monitoring Programme.

The second model, also diagnostic, is universally applicable and involves a series of mathematical relations and statistical regularities describing the interrelationships of the main factors controlling primary production in the sea, *i.e.* chlorophyll concentration, irradiance, absorption spectra of seawater components, temperature, nutrient concentrations, and others. It is a complex model employing a variety of input data for calculating the integral magnitudes and vertical distributions of the primary production in different areas of the World Ocean from direct and remote (satellite) optical sensing.

This complex model can be used in the rational management of the sea's living resources, in the protection of the marine environment, and in programming and estimating the long-term changes and forecasts of primary production and oxygen release from the World Ocean.

Both methods described here can also contribute to the study and assessment of the greenhouse effect. The results of this work can therefore be employed in crucial areas of present-day oceanography.

Henryk Renk