Hydrographic and biotical conditions in North Adriatic. XI. Some relations between phytoplankton abundance, primary productivity and plant pigments in Rovinj area

by

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In the winter of 1964 a study of the primary phytoplankton productivity in North Adriatic was initiated. The results of a two year investigation of hydrographic and biotical conditions on three fixed hydrographic stations off the west Istrian coast are summarized in papers of ŠKRIVANIĆ [1969], ŠKRIVANIĆ *et al.* [1969], LOVAŠEN [1969], KVEDER & KEČKEŠ [1969], and KEČKEŠ *et al.* [1969].

These complex investigations have been continued at single hydrographic station — Station No. 1 — which, although situated only one nautical mile from the coast, is considerably influenced by the open see through local currents. The sonic depth at this station is 32 m, the water is well mixed, and the station represents well the conditions of Rovinj area.

In the present communication the cycles of phytoplankton abundance, plant pigments, rates of phytoplankton productivity « in situ » and in an illuminating incubator, and seston as recorded in period from May 1967 to June 1968 will be described.

Methods

In the 14-month period the Station No. 1 was visited at approximately fortnightly intervals at about the same time of day (8-9 a.m.).

See water samples were taken from five depths (surface, 5 m, 15 m, 20 m, and 30 m) with all glass or plastic samplers. Phytoplankton abundance and productivity rates were measured in samples from each particular depth and the results arithmetically integrated for the whole water column. Phytoplankton pigments and seston were estimated in representative samples obtained by mixing equal amounts of sea-water from each particular depth.

Phytoplankton organisms were counted under an inverted microscope after fixation with Lugol's acetic acid solution and sedimentation for 24 hours.

Phytoplankton pigments were estimated by the trichromatic method of RICHARDS with THOMSON [1952] as modified by CREITZ & RICHARDS [1955] using Millipore AA (pore size 0.80 μ) filters. The absorbances were converted to mg-weights of chlorophylls using the formulas of PARSONS & STRICKLAND [1965].

The rates of primary productivity were measured with ^{14}C-method of STEEMANN-NIELSEN [1952] as modified by KVEDER *et al.* [1966] to meet the local needs. For each depth two light and one opaque bottle were inoculated with 4 μc ^{14}C and the samples incubated for about three hours either at the place from which the water samples had been collected (« in situ » productivity) or in a constant temperature (20° C) and illumination (2400 lux) incubator (« incubator » productivity). The photosynthesis was stopped by adding the formaldehyde solution, the samples were filtered on Millipore HA (pore size 0.45 μ) filters, and the radioactivity of filters measured with a thin mica-window GM tube.

Dry seston was obtained by filtering 3-5 lit of sea water through preweighed Millipore HA filters; the filters with contents were dried in a dessicator with silica to constant weight.

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Light conditions during *in situ* determinations of primary productivity were estimated by measuring, in frequent intervals, the incident light by the aid of a luxmeter (C. ZEISS, Type LMI).

Results and discussion

North Adriatic is a shallow basin strongly disturbed by winds, currents and upwelling and therefore poor regularities were found in the investigated area regarding the vertical distribution of the meesured parameters. However, when the whole water column was taken into consideration the seasonal cycles became obvious.

In Fig. 1. the seasonal cycles from May 1967 to June 1968 of phytoplankton abundance, concentration of chlorophyll *a* and *c*, productivity rates, and seston are presented. The results refer either to the water column below 1 m^2 and 30 m deep (productivity rates) or to average m^3 (other measured parameters).

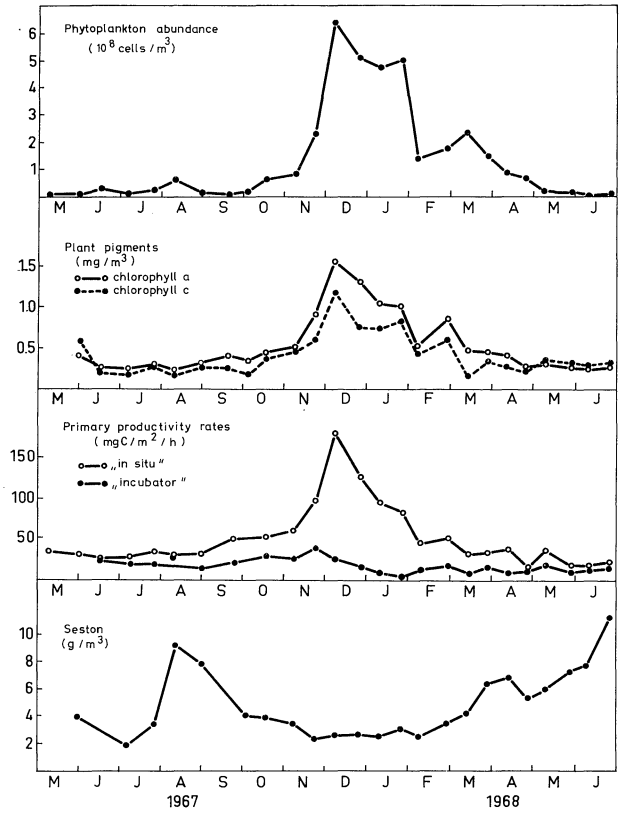

Fig. 1

A conspicuous feature of the investigated period is an intense phytoplankton bloom in winter. This bloom is expressed through a rapid and considerable increase of the number of phytoplankton organisms (maximum 6.5×10^8 cells/m^3), of the concentration of chlorophyll *a* and *c* (maximum 1.57 and 1.18 mg/m^3 respectively) as well as through the increased rate of « incubator » productivity (maximum 179 mg C/m^2/h). The corresponding rise of the rate of « in situ » productivity was not registered probably because of the adverse light and temperature conditions. This winter bloom lasted until January 1968 and was followed by a moderate increase (2.3×10^8 cells/m^3) of phytoplankton numbers in mid-March. The remainder of the investigated period was poor in the phytoplankton standing crop regardless of whether it was expressed as the number of organisms or the concentration of chlorophyll or the rate of productivity under standard conditions.

The phytoplankton standing crop does not seem to be the main causer of the seasonal variations of seston, since small amounts of seston were found just during the winter phytoplankton bloom and large amounts in time beyond it. We have the feeling that in the spring of 1968 zooplankton formed the bulk of seston and it may be that the excessive zooplankton grazing masked the spring phytoplankton flowering.

The phytoplankton organisms registered were largely diatoms. They represented almost 96 per cent of the total phytoplankton population, except in July of 1967 when they decreased to 30 per cent in favour of peridineae. During the winter flowering two species, Nitzschia seriata and Thalassiotrix mediterranea, predominated to such an extent that they could mask the bloom of other species. The remainder of investigated period, despite of the low number of cells, is characterized by a great variety of species belonging to genera Chaetoceros, Coscinodiscus, Rhisosolenia, Thalassiotrix and Nitzschia.

Chlorophyll *a* and *c* are the main algal pigments and they were found always in almost equal amounts except during the phytoplankton flowering when the concentration of chlorophyll *c* was considerably lower than that of chlorophyll *a*.

The productivity rates measured *in situ* were in general lower than those measured in illuminating incubator and they did not show large variations throughout the investigated period. The maximum value « in situ » was recorded at the end of November 1967 — 40 mg/Cm^2/h — and the minimum at the end of January 1968 — 7 mg C/m^2/h. Throughout the remainder of the period investigated « in situ » producti vity rates oscillated between 12 and 15 mg C/m^2/h.

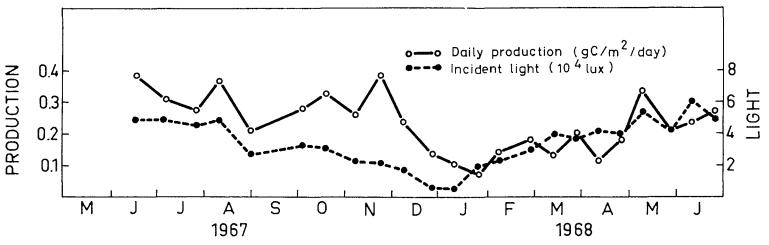

Fig. 2

Fig. 2 shows the « in situ » productivity rates based on 3-hour incubations multiplied by the hours of daylight to obtain a rough estimation of the daily production.

The annual cycle of production showed a close relationship with the light conditions except in late autumn 1967; on onset of winter phytoplankton bloom the production of phytoplankton crop grew despite of the worsening of the light conditions. However, this lasted only a short time and soon the light conditions became the main limiting factor of the production. The area under the production curve corresponds to some 85 g C/m^2/year (or to about 75 g C/m^2/year after the correction for the night respiration). This figure, although slightly lower than that obtained in 1965, places the North Adriatic in the rank of fairly rich seas regarding the primary productivity.

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