Phytoplankton production in the North Adriatic (1967-1970)

by

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In winter 1964 we started a long term study on primary phytoplankton productivity in the North Adriatic, which area is considered to be one of the richest resources of fishing in the Adriatic Sea and some results of these investigations have already been submitted to press [KVEDER & KEČKEŠ, 1969; KEČKEŠ *et al.*, 1969; LOVAŠEN, 1969; REVELANTE & KVEDER, 1969].

In the present communication the data on phytoplankton productivity, chlorophyll and seston at three fixed hydrographic stations for the period from June 1967 to June 1970 will be presented.

Methods

The hydrographic stations were located 1 (A_1), 11 (A_{11}) and 20 (A_{20}) nautical miles off the west Istrian coast. In the 3-year period station A_1 was visited at approximately forthnight intervals, the other two once a month, all at about the same time of the day (8-9 a.m.).

Sea-water samples were taken with plastic samplers from five depths (surface, 5 m., 15 m., 20 m. and 30 m.). The rates of phytoplankton productivity were estimated in the samples from each particular depth by the slightly modified STEEMANN-NIELSEN radiocarbon method [KVEDER *et al.*, 1967]. The sea water samples, inoculated with ^{14}C, were incubated for about three hours either at the place from which the samples had been collected (" in situ " productivity) or in an illuminating incubator under constant light (2400 lux) and temperature (20°C) conditions (SLT-productivity). The results were arithmetically integrated for the whole water column. Phytoplankton abundance [UTERMÖHL, 1958], chlorophyll [STRICKLAND & PARSONS, 1968] ans seston [KREY, 1964] were measured in representative samples obtained by mixing equal amounts of sea-water from each particular depth.

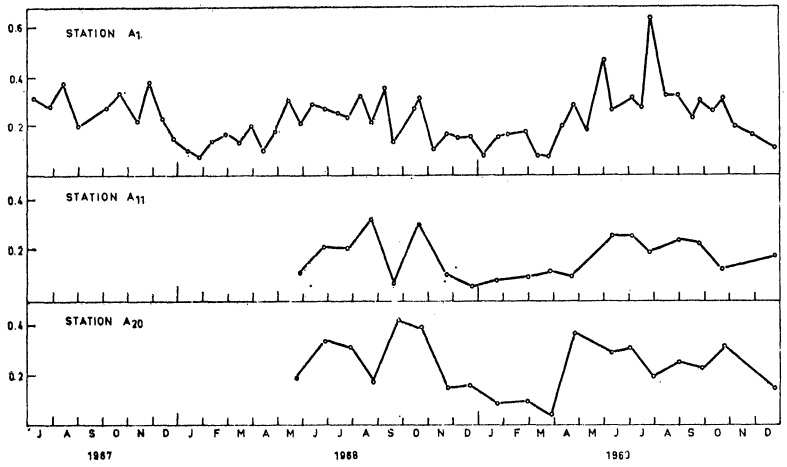

FIG. 1. — Daily primary production (g C/m²/day) at three hydrographic stations in the North Adriatic.

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Results and discussion

An intense winter phytoplankton bloom which usually takes place from November to February or March is characteristic of the investigated area. This bloom is expressed through considerable increases of SLT-productivity rates as well as of the concentration of chlorophyll $a + c$. These two parameters are generally in good mutual correlation ($r = 0.97$, $P < 0.01$) and the registered variations of the amounts of assimilated carbon per unit of chlorophyll were more likely due to the seasonal variations of the assimilation index [CURL & SMALL, 1965] than to experimental errors. The maximum values of the assimilation index coincided with the winter phytoplankton bloom while the minimal ones were registered in summer periods.

The phytoplankton organisms observed under the microscope were mostly diatoms (more than 95 %) and the participation of peridineae in phytoplankton population was considerable only when the number of total organisms was small. However, the number of phytoplankton organisms was generally in poor correlation with either SLT - productivity rates or the amount of chlorophyll. In some experiments, where the sea-water sample was subjected to fractional filtration, up to 80 % of total chlorophyll was found in the fraction that had passed a 20 μ sieve. This indicates that by microscope analysis a considerable number of phytoplankton organisms has escaped the estimation being desstroyed during the fixation of the sample or being to small to be identified and counted. The role of these " lost " organisms in the primary production is yet to be elucidated.

The *in situ* productivity rates were, in general, lower than the ones measured under SLT-conditions and they did not show large variations throughout the seasons. However, when the " in situ " rates, based on 3-hour incubations, were multiplied by hours of the daylight — to obtain a rough estimation of the daily productions — the annual cycle of the production and its relation with the light conditions became obvious (Fig. 1). During winter phytoplankton bloom, in spite of relatively large phytoplankton standing crop with a high assimilation index, the adverse field conditions limit the total production; on the contrary, during summer and autumn the intensity and the duration of the daylight enable a poor phytoplankton standing crop to be fairly productive.

The amounts of seston varied considerably even in short time intervals. In general, smaller amounts of seston were found in winter during phytoplankton bloom indicating that phytoplankton constitutes a minor part of the total seston. The largest amounts of seston were found in summer and autumn coinciding fairly well with the period of high daily productions.

The dotal annual productions as well as the annual means of chlorophyll and seston in periods from June to May of the next year are presented in Table I. The productions at the near-shore station (A_1) and the farthest one (A_{20}) were fairly equal, while the production at the station in between (A_{11}) was considerably lower.

During the period of investigations the amount of chlorophyll, at all three stations, was diminishing from year to year while the amount of seston was increasing. Unfortunatelly the complementary data on zooplankton standing cropp, or at least of the organic fraction of seston, are lacking making impossible the right explantation of these findings.

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TABLE I

Annual production and annual means of chlorophyll and seston at three hydrographic stations in the North Adriatic in periods from June to May of the next year.

	Production ($gC/m^2/year$)	Chlorophyll (a/c, mg/m^3)	Seston (g/m^3)
Station A_1			
1967/68	87	0.58/0.41	4.6
1968/69	77	0.43/0.36	7.0
1969/70	(52)	0.28/0.25	8.9
Station A_{11}			
1968/69	56	0.50/0.49	8.6
1969/70	(36)	0.30/0.27	9.9
Station A_{20}			
1968/69	85	0.55/0.47	8.4
1969/70	(44)	0.47/0.42	8.8

The values in parentheses refer only to period from June to December 1969.

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Discussion

Plusieurs questions de méthodologie sont posées concernant la nature des filtres et les dimensions des cuves du spectrophotomètre, la durée d'incubation pour les mesures de productivité, les évaluations du seston (D. BLASCO et M. DURAN).

S. Kveder, qui a présenté la communication, donne les renseignements nécessaires dont une partie figure du reste dans le texte complet de la note.

M.-L. Furnestin souligne l'intérêt de résultats fournis par deux méthodes de mesure de productivité utilisées conjointement (mesures « in situ » et en incubateur). Elle remarque combien les valeurs indiquées sont élevées et une discussion s'ouvre sur les résultats obtenus dans différentes régions méditerranéennes.

Mme Bernard, intéressée par l'étude parallèle qui a été faite du seston et de la production phytoplanctonique demande si les auteurs peuvent expliquer les corrélations observées entre l'abondance du seston et celle du phytoplanton.