Preliminary phytoplankton investigations in Western Saronicos gulf, and an assessment of log-normal diversity during late autumn 1972

by

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Abstract

Samples were collected from two stations in the western Saronicos Gulf, Aegean sea, during late autumn 1972. Station P was under the influence of the sewage outfall derived from Athens, while station A was located at a distance where eutrophication effects were weakened. Station P had greater phytoplankton standing crop and net specific daily production rate than A, and there were also marked differences in the dominant species. However, the results of fitting a log-normal model of species abundances distribution indicated that there were no significant diversity differences between stations, suggesting that the pollution has had no clear effect on the phytoplankton community so far.

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Introduction

This paper describes the results of short investigation of phytoplankton productivity and its diversity in the western Saronicos Gulf during late November and early December 1972. This region is subjected to a substantial input of sewage from Athens and its vicinity, and it is apparent that the effect of pollution on the phytoplankton communities of this area is of great interest for research.

Materials and Methods

Stations are situated in the western Saronicos Gulf. Station P is in the vicinity (3 km away) of the sewage outfall, whereas station A is further to the south (30 km) where the effects of pollution are considerably weakened. Water samples were collected from 5 and 10 m depths with a 5 l opaque plastic bottle. Aliquots of the samples were used for the estimation of the ^{14}C fixation rates in both 125 ml glass bottles [BECACOS-KONTOS, 1968] and 300 ml clear PVC bottles (WOOD, TETT & EDWARDS, 1973]. Pigment determinations [UNESCO, 1966] and phytoplankton enumerations [TETT, 1973] were carried out for each sampling depth.

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Log-normal statistics and estimates of their errors, were calculated by computer, using the methods of HALD [1949] and COHEN & WOODWARD [1953] for truncated log-normal distributions.

Results and Discussion

Phytoplankton standing crop carbon was estimated both from summations of the estimated biomasses of individual species and from chlorophyll estimates (Tabl. 1). Measured carbon fixation rates (Table 1) were converted into instantaneous hourly rates by allowing both for 5 % loss of fixed ^{14}C in respiration and also for increase in standing crop during incubation. Assuming a 10 hour day, and some reduction in photosynthesis in the early morning and late afternoon, the gross specific photosynthetic carbon fixation rates given in Table 1 were calculated from the formula :

10.ln[1+0.8 (instantaneous hourly fixation rate/standing crop)] day^{-1}. Respiration over 24 hours was assumed to be at a rate of 0.12 day^{-1}, and so the net specific production rates given in the last column of Table 1 were calculated. At the time in question, station P was clearly more productive than station A, both in respect of specific net production rate and also of standing crop.

Complete tables of numbers and biomasses of phytoplankton are too lengthy for inclusion here, but copies may be obtained from either author. In general, the list of species observed at P and A was in good agreement with those recorded in the eastern Saronicos Gulf [IGNATIADES, 1969] for November and December. In addition to differences in total biomass, the species composition at P differed from that at A in several important respects. Chief amongst these were the dominance at P of the dinoflagellate *Ceratium furca* and the occurrence only here of *Prorocentrum* spp. while at A the diatom *Dactyliosolen mediterraneus* and its epiphytic or parasitic flagellate *Solenicola setigera* were dominant.

Table 2 lists the sample parameters and estimated log-normal statistics for the phytoplankton at the two stations. For detailed account of the use of log-normal models of species abundances distribution, refer to TETT [1973]. The results in table 3 (s, $\hat{\sigma}$ and $\hat{S}^*$) do not indicate any significant diversity differences between stations. The $\hat{a}_{\bar{R}}$ values confirm that the biomass differences were a feature of all the species making up the phytoplankton, not just of the dominant species. In all cases the log-normal distribution proved to be a good fit to the data.

Table 1 : Standing crop and production rate data.

Station	Date	Standing crop (mgCm^{-3})			Instantaneous hourly fixation rate (mgCm^{-3} hr^{-3}	Specific production rate (day^{-1})	
		Based on chlorophyll	Based on biomass	Mean		gross	net
Psittalia (P)	28/11/72	26	59	37	2.0	0.43	0.31
	4/12/72	79	94	87	5.0	0.45	0.33
Aegina (A)	30/11/72	20	6.5	13	0.54	0.32	0.20

Note : Values are means for 5 and 10 m samples.

The results obtained indicate that station P is richer in standing crop and primary production than A, and it seems likely that this is due to eutrophication conditions caused by the sewage outflow at station P (Ignatiades in preparation). The similar diversity indices at these stations suggest that pollution has not had any clear effect on phytoplankton community so far. The differences in the species composition at the two stations are probably simply indicative of the differences between coastal and more open water environment.

Table 2 : Values of log-normal statistics calculated from biomass abundances.

Station	Date	Sample parameters A	s	Fitted log-normal statistics $\hat{a}_{\bar{R}}$ ($\pm$ s.e.)	$\hat{\sigma}$ ($\pm$ s.e.)	$\hat{S}$*
Psittalia	28/11/72	5.7	51	2.9 (0.13)	0.84 (0.10)	52
	4/12/72	5.9	59	2.9 (0.12)	0.88 (0.09)	59
Aegina	30/11/72	4.7	61	2.2 (0.11)	0.87 (0.09)	61
	4/12/72	5.1	53	2.6 (0.12)	0.82 (0.09)	54

Note : All values are the results of combining observations on 5 and 10 m samples. The units of A, $\hat{a}_{\bar{R}}$ and σ are $\log_{10}$ $\mu g\ m^{-3}$.

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