CAROTENOID / CHLOROPHYLL a RATIO IN RELATION TO NUTRIENT DISTRIBUTIONS

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Abstract

The seasonal changes of carotenoids to chlorophyll a ratio were studied in the coastal waters of Saronicos Gulf, Agean Sea. The ratio showed a maximum in May and June and a statistically significant dependence on nitrate concentrations. The relationship of the pigment ratio to phytoplankton biomass was also investigated and discussed.

Introduction

The reliability of Chl a measurments as estimates of phytoplankton biomass is controversial since various authors maintained that chl a can vary indepenently of biomass in response to nutrient availability (Yentsch and Vaccaro 1958) or species composition (Mullin et al 1966). Furthermore, carotenoid pigments being less stressful than chl a to environmental factors may be better predictors of phytoplankton biomass (Lehman 1981). In the present work the dependence of pigments on nutrient distribution is examined and an evaluation of pigments as biomass predictors is attempted.

Materials and Methods

Surface samples were collected every month during 1981 from stations S1 and S3 in Saronicos Gulf, Greece. Both stations were located along a nutrient environmental gradient, S1 characterised by eutrophic and S3 by oligotrophic conditions. Pigment, P-PO4, N-NO3, N-NO2, Si-SiO2 (Strickland and Parsons 1972)

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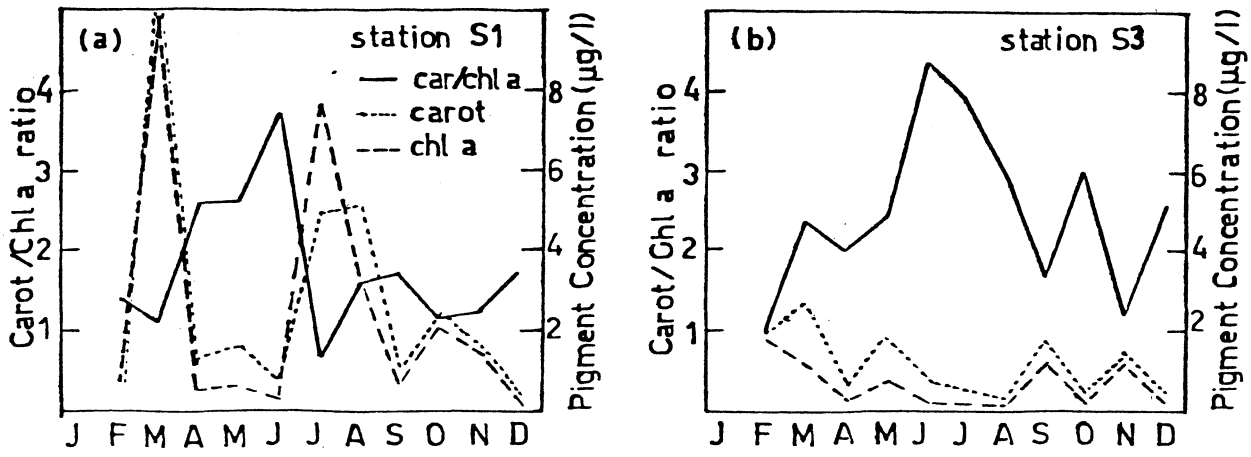

Fig. 1. Seasonal variations in Chl a, Carotenoids and Car./chl a ratio in Saronicos Gulf, during 1981.

and N-NH3 (Liddicoat et al 1976) determinations were performed.

Results and Discussion

The seasonal variations of pigments are shown in Fig. 1. In the eutrophic station S1, chl a showed a maximum in March and a second peak in July (Fig. 1a) whereas, carotenoids followed the fluctuations of chl a. In station S3(Fig. 1b) the seasonal cycle of chl a and carotenoids were similar and both showed weak seasonal quantitative fluctuations. It is interesting that in both stations the seasonal cycle of the carotenoid / chl a ratio showed an inverse relationship with the corresponding cycles of carotenoid and chl a concentrations.

The possible relationspips between pigments, cell concentrations, nutrient concentrations and the diatom/flagellate (D/F) ratio were examined (Table 1). High positive correlation was recorded between chl a and carotenoids as well as between chl a and the carotenoid / chl a ratio (negative correlation) in both stations. However, at station S1 an additional relationship was recorded : positive correlation between chl a and nitrate concentrations. Cell number abundance, species composition (D/F ratio) phosphate and ammonia did not seem

Table 1. Correlations between pigments and some environmental variables for Saronicos Gulf, in 1981;(df-10, r(.o5)- .57 (x) and r(.01)- .71 (xx). Upper triangle : station S1, Lower triangle : station S3.

	CHL a	CAROT.	CAR./CHL a	D/F	PHYT.	P-PO4	N-NO3	N-NH3
chl a		.94^{xx}	-.56^{x}	.47	.29	.28	.26	.20
carot.	.85^{xx}		-.43	.16	.19	.36	.41	.11
car./chl a	-.78^{xx}	-.52		-.49	-.37	-.23	-.24	-.20
D/F	.27	.09	-.36		.39	.09	-.24	.52
phyt.	.34	.26	-.55	.12		.50	-.13	.46
P-PO4	.50	.39	-.49	-.36	.41		.57^{x}	.76^{xx}
N-NO3	.68^{xx}	.51	-.34	-.19	-.04	.64^{x}		.32
N-NH3	.31	.46	-.02	-.34	.17	.58^{x}	.66^{x}	

to be significantly associated with pigment variations in both stations.

The reslts suggest that:

1. The high correlation between chl a and carotenoid pigment shows that they can both be equally used as biomass predictors.

2. The absence of relatioship between pigments and cell concentration or D/F ratio suggests that each of these parameters has its own specificity and cannot be replaced by any other in ecological studies.

3. Pigment dependence on nutrients (nitrate in this case) might be associated with oligotrophic conditions. In eutrophic environments (station S1 in this case) where phytoplankton and nutrients occur at saturation level, there is no direct relatioship between these parameters.

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