METHODOLOGICAL INVESTIGATIONS ON THE ^{14}C UPTAKE FOR PLANKTONIC PRIMARY PRODUCTIVITY ESTIMATES

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RESUME

En 1982-1983, nous avons entrepris de nouvelles investigations méthodologiques en utilisant le phytoplancton de la mer Noire, afin de déterminer l'importance du moment et de la durée de la période d'exposition pour une meilleure estimation de la productivité primaire.

ZUSAMMENFASSUNG

Neue methodologische Untersuchungen wurden im Zeitraum von 1982-1983 mit Phytoplankton aus dem Schwarzen Meer zur Ermittlung der Rolle des Expositionszeitpunktes und der Expositionsdauer für bessere Primärproduktionsbestimmungen durchgeführt.

Diurnal variation in the photosynthetic capacity of natural phytoplankton communities is the subject of a vast body of literature (e.g. DOTY and OGURI,1957; DOTY,1959; SOURNIA,1974; SAVIDGE,1978; HARDING et al.,1982a,b). Both mid-morning and mid-afternoon maxima of the assimilation ratios have been reported (MALONE,1971), depending upon the size of plankton and the availability of essential nutrients. Methodologically, as previously shown, there still is no general consensus in the use of the ^{14}C method concerning the time and best exposure duration. Even when using about 4 hours exposures, as is now common with marine phytoplankton samples for primary productivity estimates, the extrapolation of these results for calculating diel productivity rates is also not standardized at all. New methodological investigations were performed with Black Sea phytoplankton in order to test the time duration of exposure for improving

primary productivity estimates in this region.

MATERIAL AND METHOD

Phytoplankton samples were collected in the Constantza sector of the Black Sea ($44^{o}10'N$, $28^{o}41'E$) each month, from 0, 5 and 10 m in 1982, and in February, March, June, August, September and October (two times), from 0 m in 1983.

The samples were exposed *in situ* for 4 hours between 1000-1400 (1982), for 4, 8 and 24 h (1982) and for 4 h at different times of the day (1983).

The ^{14}C method (STEEMANN NIELSEN,1952), using liquid scintillator counting, was used. Three light and 1 dark bottle (250 ml) containing phytoplankton were inoculated, each with 25 /uCi (925 kBq) aqueous $NaH^{14}CO_3$ solution. Total inorganic carbon content of sea water was determined by total carbonic alkalinity analysis (cf. Water Quality Control, 1967). The ^{14}C activity was measured with an automatic N.E. spectrometer type 8310/1/2 using following scintillation mixture: 5 ml dioxan (for filter solubilization) + 5 ml Unisolve scintillator. The efficiency of sample measurement was 83%.

The values for the dark (control) bottles were not subtracted from the photosynthetic assimilation values.

Primary productivity rates were computed according to a frequently used formula (VINBERG *et al.*,1960) and expressed in mg C $m^{-3}hour^{-1}$.

RESULTS AND DISCUSSION

The results obtained by means of identical parallel phytoplankton samples differ depending as well on the exposure duration (Table 1) as well as the exposure time within a light-day (Table 2).

During the annual cycle, nearshore (0-10 m depth), i.e. in 1982, the highest primary productivity level occurred in July, August and March (BOLOGA *et al.*,1984); these summer maxima differ from the previous decades on the Romanian coast, when the highest values were typical only in spring and autumn.

Table 1. Primary productivity rates (mg C $m^{-3}h^{-1}$) according to different exposure times in the Constantza sector (Black Sea) in 1982.

Month	Exposure duration (h)			
	1000-1400 (4)	1000-1400 (4)	1000-1800 (8)	1000-1000 (24)
Jan.	2.1			
Feb.	2.6	2.6	1.0	0.1
Mar.	2.7			
Apr.	0.5	0.5	0.5	0.2
May	2.5			
Jun.	0.6	0.6	0.2	0.02
Jul.	9.7			
Aug.	3.1	3.1	1.2	1.3
Sep.	2.1			
Oct.	2.0	2.0	-	0.3
Nov.	0.7			
Dec.	1.9	1.9	-	0.2

Table 2. Primary productivity rates (mg C $m^{-3}h^{-1}$) according to different exposure times in the Constantza sector (Black Sea) in 1983.

Month	Exposure duration (4 h)				
	0800-1200	1000-1400	1200-1600	1400-1800	1600-2000
Feb.	2.6	1.0	0.5	0.6	-
Mar.	4.9	3.5	2.5	3.0	-
Jun.	186.0	102.8	145.5	131.9	71.5
Aug.	1.7	1.9	0.8	0.8	0.7
Sep.	10.2	5.6	9.6	6.7	-
Oct.	1.5	1.1	0.6	-	-
Oct.	0.6	0.6	0.4	-	-

The primary productivity in June, 1983, greatly exceeded the usual values, is due to the presence of an extremely intense bloom of Exuviaella cordata.

As to the exposure duration, higher values were always recorded after a short period (4 h), as compared to longer periods (8, 24 h) (BOLOGA,1984), probably due to the known side-effects after long exposures (the damage of enclosed organisms, the development of benthic bacteria etc.).

As to the exposure time, the highest values generally occurred during the first half of the day-light (0800-1200) in all seasons.

The data show, once again, the importance of the duration and time of ^{14}C exposure for marine primary productivity estimates.

Among these results, the values obtained after 4 h exposures are closer to those previously obtained after half-day exposures, in the same coastal waters, and seem to be more realistic.

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