A comparative study of phytoplankton in S. Aegean, Levantine and Ionian Seas during March-April 1986

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Abstract.

The present investigation represents an attempt to study and compare phytoplankton populations from S. Aegean, Levantine and Ionian seas.

Sampling in the above mentioned areas (13 stations) was performed during March - April 1986. Water samples were collected from the upper 200m of the water column, preserved with Lugol solution and counted in an inverted microscope.

The dominant phytoplankton species from the examined areas are presented in table 1, while dominance indices for each sample (table 2) were calculated according to McNaughton formula (1967). Also phytoplankton species abundances were analysed by the truncated log - normal distribution (Cohen, 1959; Cassie, 1962; Bliss; 1967) which provided a reasonable fit to the data as indicated by the X^2 distribution (table 3). Finally a diversity index based on the log - normal parameters (table 3) was estimated (Edden, 1971).

Low values for phytoplankton abundances (from 1400 cells/l.st.76,200m to 23720 cells/l. st.58,0m both in the Levantine sea) and dominance indices (table 2) were recorded in all areas defining their oligotrophic character. Another interesting feature is that diatoms predominated in S. Aegean, dinoflagellates in Ionian and coccolithophores in Levantine sea.

High values of phytoplankton populations' diversities were estimated for all samples, while higher values of σ (table 3) that have been recorded at the upper layers of stations 13 (Aegean sea), 58 (Levantine sea) and 86 (N. Ionian sea) might be attributed to fluctuating conditions of the environment (Georgopoulos et al. 1986; Theocharis et al. 1986a,b, 1987).

TABLE 1. Dominant species in Aegean, Ionian and Levantine Sea (in alphabetical order)

1.Bacteriastrum delicatulum
3.Chaetoceros affinis
3.Chaetoceros decipiens
4.Chaetoceros sp.
5.Chilomonas marina
6.Coccolithus fragilis
7.Coccolithus leptoporus
8.Coccolithus pelagicus
9.Coccolithus sp.
10.Cryptomonas sp.
11.Cyclotella sp.
12.Emiliania huxleyi
13.Exuviaella baltica
14.Gymnodinium pygmeum
15.Gymnodinium sp.
16.Gymnodinium variabile
17.Gyrodinium pingue
18.Nitzschia closterium
19.Nitzschia seriata
20.Oxytoxum variabile
21.Peridinium sp.
22.Rhizosolenia delicatula
23.Scrippsiella trochoidea
24.Synedra sp.
25.Syracosphaera mediterranea
26.Thalassiothrix frauenfeldii

TABLE 2. Dominant species (as indicated in table 1) and doninance index (δ) in Aegean, Levantine and Ionian Sea.

AEGEAN SEA				LEVANTINE SEA			
St.	Depth (m)	Dom.sp.	δ	St.	Depth (m)	Dom.sp.	δ
	0	18, 3	43		0	24,26	65
13	50	18,19	62		5	26,24	39
	200	22, 7	28	58	10	26,21	49
					20	19,26	33
50	0	26,25	50		50	24,26	37
52	0	26, 8	42		0	12, 9	31
				56	50	12, 8	34
	10	5, 6	47				
68	50	2,18	33		0	15,12	31
	75	4,18	40		50	15,12	34
				76	100	17,12	22
72	0	13,26	42		200	12, 1	25

IONIAN SEA			
St.	Depth (m)	Dom.sp.	δ
	0	23,12	19
86	50	10,14	40
	200	11,10	37
85	0	10,16	38
	0	9,14	59
83	50	14,20	31
84	0	10,14	25
82	0	12,23	25

TABLE 3.Lognormal distribution parameters of phytoplankton species concentration in Aegean, Levantine and Ionian seas.

AEGEAN SEA

St.	Depth (m)	N	μ	σ	$\hat{N}$	σ^2	D"	df	X^2
	0	25	1.7	0.7	42	0.5	5.2	5	0.8
13	50	24	1.1	0.9	85	0.8	6.2	4	5.4
	200	29	1.8	0.5	42	0.5	5.2	2	4.5
50	0	21	2.1	0.6	26	0.4	4.6	4	5.5
52	0	26	2.0	0.6	32	0.5	4.9	4	9.1
	10	21	2.1	0.5	25	0.3	4.5	5	3.8
68	50	17	2.2	0.4	18	0.1	4.1	2	2.5
	75	14	2.5	0.5	15	0.2	3.9	2	5.7
72	0	15	2.0	0.6	18	0.4	4.0	4	5.5

IONIAN SEA

St.	Depth (m)	N	μ	σ	$\hat{N}$	σ^2	D"	df	X^2
	0	33	2.3	0.6	37	0.3	5.1	6	20.6
	5	28	2.1	0.6	36	0.4	5.0	5	0.3
58	10	21	2.1	0.5	25	0.3	4.5	5	7.0
	20	27	2.4	0.4	28	0.2	4.7	5	5.8
	50	27	2.3	0.5	28	0.3	4.7	4	9.0
	0	15	2.3	0.4	15	0.1	5.9	10	10.5
56	50	22	2.1	0.3	22	0.1	4.5	5	7.4
	0	26	2.1	0.6	37	0.3	5.1	5	2.3
	50	37	1.9	0.7	45	0.5	5.6	7	10.5
76	100	24	2.1	0.4	69	0.2	4.7	4	8.5
	200	11	2.0	0.3	12	0.1	3.5	2	1.9

IONIAN SEA

St.	Depth (m)	N	μ	σ	$\hat{N}$	σ^2	D"	df	X^2
	0	23	2.2	0.5	27	0.3	4.6	4	11.3
86	50	32	1.8	0.9	51	0.8	5.4	5	9.6
	200	15	1.8	0.5	20	0.3	4.2	2	1.0
85	0	18	1.9	0.5	25	0.3	4.6	5	5.0
	0	15	1.1	0.7	60	0.5	5.7	2	1.7
83	50	25	1.9	0.5	55	0.2	5.1	2	2.1
84	0	26	2.3	0.4	27	0.2	4.7	5	6.9
82	0	19	1.9	0.4	33	0.2	5.0	2	5.3

N=total number of observed species, μ = log mean abundances, σ = log standard deviation, $\hat{N}$= total number of expected species, σ^2= variance, D" = log $\hat{N}$ - 0.3466 $*\sigma^2$(diversity), df = degrees of freedom.

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Sewage nutrient enrichment and phytoplankton ecology in the Pagassitikos Gulf (Greece)

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The abundance, species composition and taxonomic diversities of phytoplankton has been studied in relation to sewage pollution in the north Pagassitikos Gulf, Greece (Fig. 1). Surface water samples were collected from a series of stations in July 1987. Samples were preserved, concentrated by settling, and the concentration of each species of phytoplankton enumerated in an inverted microscope. Water samples from the vicinity of the major sewer outfalls (Stations 1, 2 and 3) showed very high concentrations of nutrients, greater total concentration of phytoplankton, and a lower taxonomic diversity than samples remote from outfalls (Tables 1, 2 & 3).

Table 1: Surface salinity(‰) and nutrients (μg-at/l).

St.	S	PO_4^{-3}	SiO_4^{-4}	NH_4^+	NO_2^-	NO_3^-
1.	34,6	0.91	14.65	0.98	0.24	5.87
2.	30.7	0.42	27.20	1.15	0.08	13.81
3.	22.2	0.49	34.35	1.30	0.07	17.86
4.	37.2	0.12	1.18	1.25	0.08	1.18
5.	36.6	0.10	4.74	0.74	0.07	2.18
6.	36.9	0.13	3.16	1.70	0.08	6.67
7.	36.1	0.10	7.20	0.76	0.08	3.47
8.	37.1	0.11	5.53	0.44	0.08	2.56
9.	37.0	0.13	2.69	0.58	0.07	1.26
10.	36.8	0.11	2.70	0.48	0.08	0.96
11.	37.0	0.13	2.98	0.41	0.08	1.06

Phytoplankton abundance and taxonomic diversity depend upon the supply of nutrients in natural waters, where abundance increases and diversity decreases with increasing nutrient concentrations (Table 4) in the Pagassitikos Gulf. A considerable variation in the occurrence of species and dominance occurred along the nutrients gradients (Table 3). Dinoflagellates were dominant in polluted waters, while diatoms dominated in cleaner waters (Table 2). From the dominance and relative distribution of the taxa along the nutrients gradient certain species of Gymnodinium emerge as indicator species of red tide pollution. These changes correspond to a typical degradation of a complex community to a less mature state by the inflow of nutrient-rich sewage (eutrophication) in the north Pagassitikos Gulf.

Table 2: Taxonomic groups (cells x 10^3/l). Numbers in parentheses are the % ratios.

Taxonomic group. / St.	1	2	3	4	5	6	7	8	9	10	11
Diatons	282 (2.2)	48.4 (13.2)	13.8 (17.8)	16.3 (12.9)	19.5 (31.6)	11.2 (67.4)	23.2 (36.7)	22 (31.7)	10.6 (43.6)	31 (50.5)	12.9 (65.4)
Dinoflagellates	12145 (97.7)	316 (86.5)	57.4 (74)	106 (84)	41.1 (66)	3.9 (23.4)	39.4 (62.3)	44.3 (63.6)	12.4 (51)	27.2 (44)	5.6 (28.4)
Coccolithophores	- -	0.8 (0.2)	3.2 (4.3)	4 (3.1)	1.1 (1.7)	1.5 (9)	0.6 (0.9)	3.3 (4.7)	1.3 (5.3)	3.1 (5)	1.2 (6)
Silicoflagellates	-	-	-	-	-	-	-	-	-	4 (0.6)	-
Total microplankton	12427	365	74.4	126	61.7	16.6	63.2	69.6	24.3	61.3	19.7
μ flagellates	2184	38.2	113	113	199	124	24	37.5	110	42.1	31.4

Table 3: Dominant species, dominance (δ, McNaughton, 1967) and diversity (D, Margalef, 1967) indiees.

St.	Dominant species	δ	D
1	Gymnodinium sp. Cachonina niei	94.1	0.49
2	Gymnodinium sp. Cachonina niei	83.4	1.37
3	Cachonina niei Gymnodinium sp.	68.1	1.93
4	Cachonina niei Gymnodinium sp.	73.4	1.87
5	Gymnodinium sp. Cachonina niei	60.2	1.77
6	Chaetoceros affinis Nitzschia closterium	28.9	2.77
7	Gymnodinium sp. Cachonina niei	55.5	1.89
8	Cachonina niei Gymnodinium sp.	51.2	2.28
9	Chaetoceros socialis Gymnodinium sp.	41.1	2.72
10	Gymnodinium sp. Chaetoceros socialis	31.9	2.69
11	Chaetoceros socialis Skeletonema costatum	32.4	2.81

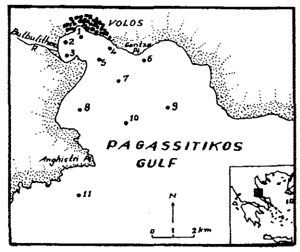

Fig. 1. Sampling locations

Table 4: Significant linear correlation between biological and chemical parameters.

Phytoplankton density correlated with :	Regression equation	Correlation coefficient
Phosphate	log Y = 2.70X+4.30	0.87* (n=9)
Nitrite	log Y =14.25X+3.66	0.88* (n=9)
Diversity of phytoplankton correlated with :	**Regression equation**	**Correlation coefficient**
Phosphate	D = - 2.20X+2.60	-0.80* (n=9)
Nitrite	D = -10.37X+3.01	-0.72**(n=9)

* Significant at the 99% level ** significant at the 95% level.

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