# Taxonomic composition and pigments of phytoplankton in the Northern Levantine Basin

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**Abstract-** Between December 2001 and June 2002 monthly sampling was carried out at two stations (one coastal and one open) in the NE Levantine basin to study the relationship between phytoplankton distributions as evaluated by taxonomic pigments. The 0 to 150m chlorophyll-a concentration averaged 0.9 µg\L with highest values restricted to winter period. The vertical pattern of chlorophyll-a in winter showed a general trend of high concentration at the surface. Chlorophyll-a concentrations sharply decreased below 25 m depth. A deep chlorophyll maxima was observed during summer. Microscopic analyses revealed that diatoms and coccolithophores were the two dominant groups during the sampling period. Maximum biomass and abundance were found in January in coastal (780 µg\L and 246,15 cell\L) and in open surface waters (443µg\L and 303,462 cell\L) in the studied area. *Cerataulina bergonii, Skeletonema costatum, Guinardia flaccida, Rhizosolenia alata* and *Rhizosolenia stolterfothii* were the species having the highest biomass while *Skeletonema costatum, Emiliana huxleyi, Chaetoceros socialis,* and *Nitzschia delicatula* had the greatest abundance. Pigment data reflecting phytoplankton assemblages dominated by diatoms and coccolithophores. Fucoxanthin and 19'hexanoyloxyfucoxanthin (19'hex) were the main accessory pigments in all samples. Significant relationships were found between the marker pigment concentrations and cell numbers ($p<0.0001$-$0.0005$). Chlorophyll-a: marker pigment (fucoxanthin and 19'hex) ratios were calculated by linear regression analyses ($p<0.0001$). Ratios of 1.64 chlorophyll a:fucoxanthin and 2.86 chlorophyll a: 19'hex were obtained.

**Keywords-** Phytoplankton, marker pigments, Northern Levantine Basin.

## Introduction

The eastern Mediterranean is known as one of the oligotrophic seas over the world, due to limited nutrient input to its surface waters from external and internal sources (Bethoux, 1981; Dugdale and Wilkerson, 1988). Chlorophyll concentrations previously recorded in the Levantine basin were low, not exceeding 1 µ g/L even in coastal waters (Berman et al., 1984; Dowidar, 1984: Azov, 1986; Abdel-Moati, 1990: Salihoğlu et al., 1990; Yilmaz et al. 1994). However, phytoplankton composition is quite diverse (minimum 70 spp.). Microscopic analysis of phytoplankton composition is a tedious and necessitates well-trained taxonomist. Unfortunately, there are almost no studies on the pigment characterization of phytoplankton in the Northern Levantine basin. The main aim of this research was to evaluate the utility of pigment analysis for detecting phytoplankton composition in the area. A specific objective was to establish whether pigment ratios could be used to characterize particular phytoplankton populations.

## Methods

The relationship between phytoplankton pigments and composition was studied at two stations from the Northern Levantine basin during December 2001 and June 2002. Water samples were collected from the stations shown in Fig. 1 using 5 l Niskin bottles. A portion was preserved with formaldehyde for microscopic analysis. Between 1 and 4 l samples were filtered through 25 mm Whatman GF\F filters and immediately frozen by storage in liquid nitrogen until HPLC analysis. In the laboratory, the frozen filters were extracted in 5ml 90 % HPLC-grade acetone, ultrasonicated for 30 seconds and centrifuged to remove cellular debris. The method chosen in this study (Barlow *et al.,* 1993) is a modification of the reverse-phase method described in Mantoura and Llewelyn (1983). The HPLC system was calibrated for each pigment with commercial standards (chlorophyll *a, b*: Sigma Chemicals; carotenoids and chlorophyll *c*: VKI Water Quality Institute, Denmark ). Pigments were identified by injecting samples of phytoplankton reference cultures whose pigment composition has been documented in the literature (Mantoura and Llewelyn, 1983, Barlow *et al.,* 1993, Jeffrey *et al.*, 1997).


Fig. 1. Location of sampling stations.

## Results and Discussion

The highest surface chlorophyll a concentrations were recorded in January at both open (1.19 µg\L) and coastal water (7.46 µg\L) (Fig. 2). The deep chlorophyll-a maximum, a common feature of the Mediterranean has clearly been observed in the area during summer and was well coincident with the relative fluorescence intensities (Fig. 3). The vertical pattern of chlorophyll-a in winter showed a general trend of high concentration at the surface and chlorophyll-a concentrations sharply decreased below 25 m depth (Fig. 3).



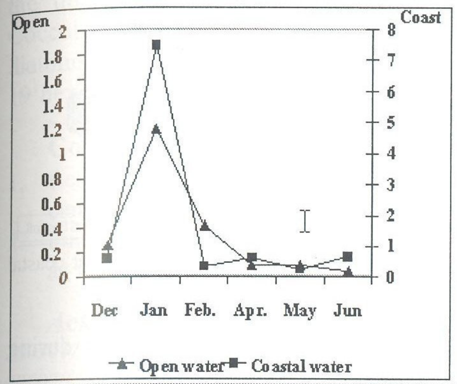


Fig. 2. Surface Chl-a concentrations at open and coastal stations.

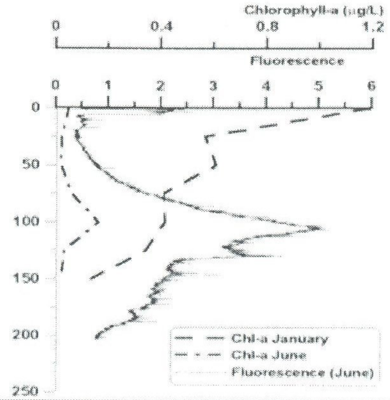


Fig. 3. Chl-a and in-situ fluorescence profiles at open stations

Microscopic analyses revealed that diatoms and coccolithophores were the two dominant groups during the sampling period in surface waters. Maximum biomass and abundance values were obtained in January both in coastal (780 µg\L and 246,15 cell\L) and in open stations (443 µg\L and 303,462 cell\L) in the studied area. *Cerataulina bergonii, Skeletonema costatum, Guinardia flaccida, Rhizosolenia alata* and *Rhizosolenia stolterfothii* were the species having the highest biomass while *Skeletonema costatum, Emiliana huxleyi, Chaetoceros socialis,* and *Nitzschia delicatula* had the greatest abundance. The contribution of the Diatom and Coccolithophore to total biomass was between (50-98%) and (1-14%), respectively, throughout the sampling period. An examples of January and February surface biomass and abundance data were shown in Fig. 4A-C and 5A-C, respectively.

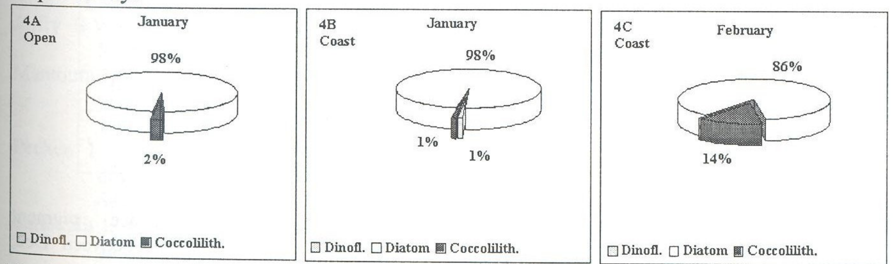


Fig. 4. % of surface phytoplankton biomass at open and coastal water in January and at coastal water in February.

Maximum surface pigment concentrations were obtained in January both at open and coastal station (Fig. 6 and 7). Fucoxanthin concentration was close to 0.35 µg\L at open station and its concentration reached to nearly 5 µg/L at coastal station in January. The highest surface 19'hex concentration (0.21µg\L) was observed in February and second maximum was recorded in May at coastal station

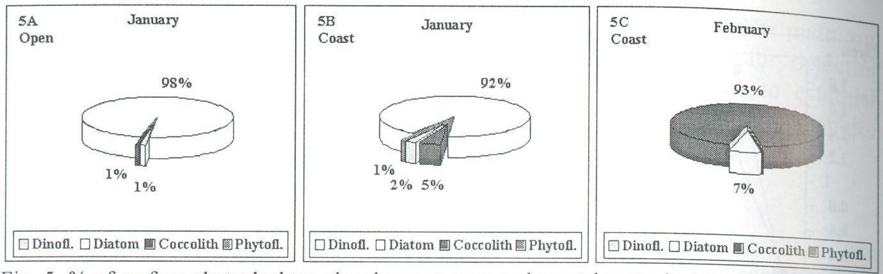


Fig. 5. % of surface phytoplankton abundance at open and coastal water in January and at coastal water in February.

(Fig. 7). 19'hex concentrations were below 0.05 µg/L at open stations during sampling period (Fig. 6).

Chlorophyll-a:dominant accessory pigment (fucoxanthin) ratio was calculated by linear regression analyses as 1.64 and the chlorophyll a:19'hex. as 2.86 ($r^2$: 0.91; $p<0.0001$). As shown in Table 1 these ratios (1.64 and 2.86) were within the range of 1.08-2.3 reported for diatoms and 0.7-3.2 reported for Coccolithophores *in situ* in comparable areas (Tester *et al.*, 1995; Peeken, 1997).

Table 1. Chlrophyll-a and accessory pigment ratios.

| Chl-a:Fuc | Chl-a:19'hex |
|---|---|
| 1.64 (Present Study) | 2.86 (Present Study) |
| 1.1-1.95 (Tester et al., 1995) | 0.7-3.2 (Peeken, I., 1997) |

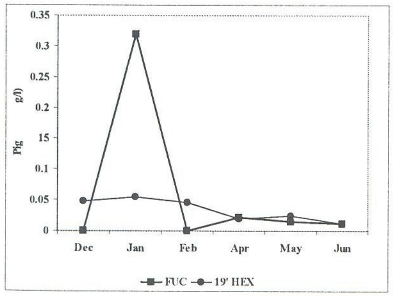


Fig. 6. Variations in surface pigment concentrations at open stations between Dec. 2001 and June 2002.

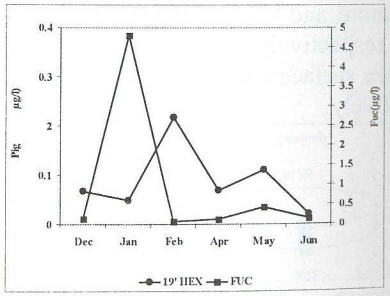


Fig. 7. Variations in surface pigment concentrations at coastal stations between Dec. 2001 and June 2002.

Significant relationships were found not only between the chlorophyll a and marker pigmet (i.e. fucoxanthin and 19'hex) but also between cell biomass and these pigments ($r^2$: 0.86 ($p<0.0001$) for diatoms, ($r^2$: 0.65 $p<0.0005$) for coccolithophores.Pigment data reflecting phytoplankton assemblages show the domination of diatoms and coccolithophores in the area. In both stations diatoms were usually observed to be dominant from microscopic analysis. Fucoxanthin is



the dominant biomarker for diatom. The second most dominant group was Coccolithophores. 19'hex is biomarker for this group. This would confirm that diatoms and coccolithophores are the most important carrier of fucoxanthin and 19'hex in the sample from studied area.

## Concluding remarks

1. Results presented here have shown that a diatom and coccolithophores group can be distinguished through simple pigment ratios in the studied area.
2. Further research is still needed to prove the presence of the other algal groups as well as genus or species-specific pigments.

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