Influence of an anticyclonic eddy on the distribution and taxonomic composition of the phytoplankton population.

Kees van Lenning, Mikel Iatasa and Marta Estrada,

Institut de Ciències del Mar, CSIC, Barcelona

Introduction

Phytoplankton can be considered as the base of all animal production in the open sea, and the distribution and activity (e.g. carbon fixing rates) of these organisms have to be studied in great detail to understand the basics of marine food webs and the carbon cycles involved. The distribution and quantification of the phytoplankton biomass in natural environments is commonly revealed by chlorophyll *a* (Chl *a*) measurements. This pigment is the principal photosynthetic component of the plant kingdom, and its value as a biomass indicator of oceanic microscopic marine plants has been recognised for over 40 years. However, only quantifying total phytoplankton standing stock is not enough for a complete understanding of marine photosynthetic ecosystems, since particulate organic fluxes not only depend on the production and biomass levels, but also on the taxonomic composition of the autotrophic communities. Larger phytoplankton species, such as diatoms and dinoflagellates, the main contributors to elevated Chl *a* concentrations, are considered to be the main contributors to new production, whereas prokaryotes (cyanobacteria and *Prochlorococcus*) and small sized eukaryotic phytoplankton groups, such as haptophytes, chrysophytes, cryptophytes and prasinophytes, are believed to be most likely involved in oligotrophic systems dominated by regenerated production.

Different techniques like (epifluorescence) microscopy and flow cytometry have been successfully employed to provide taxonomic information. Even so, many of the delicate- and generally abundant picoplankton cells can be damaged beyond recognition (and subsequently underestimated) whereas others lack useful morphological features for microscopic identification. However, many taxonomic considerations are based on the distribution of certain chlorophylls and carotenoids in algal groups. The composition of pigments commonly varies from one taxonomic group to another and some (marker) pigments, can be used to estimate to concentrations of Chl *a* associated to each of the taxonomic classes present. The best way to measure chlorophylls and carotenoids, together with their possible degradation products, in extracts obtained form natural field samples, is to separate the mixture of pigments in its individual components, then identify them all and measure their concentrations. Such chemotaxonomic procedures are commonly performed by High Performance Liquid Chromatography (HPLC).

For the present work we combined three techniques (HPLC, microscopy, flow cytometry) to evaluate the influence of an anticyclonic eddy, located south of Ibiza Island, on the abundance and taxonomic composition of the phytoplankton population.

Methods

Sample collection

Data for this study were collected along three sections crossing the anticyclonic eddy. The first section sampled crossed the central area of the eddy. Two further transects, located left and right of the middle section respectively, covered the border conditions of the structure. On each station, water samples were collected from 12-14 depths per station (5 to 150 meters), using 12 L Niskin bottles attached to a rosette sampler equipped with a fluorometer plus CTD system. Seawater samples (2 L) were filtered through 25 mm glass fiber filters (Whatman GF/F, nominal pore size 0.7 µm), using low vacuum. On each station two 200 ml samples (5 m and DCM) were fixed for microscopic cell counts and on every second station 6 samples we collected, and stored in liquid nitrogen for flow cytometric observations. Only station 2 could not be sampled due to a minor problem with the filtration setup.

Chromatographic procedures

Pigments will be extracted in 5 ml cold (6°C) methanol : 1M ammonium acetate (95:5, v:v), filtered through 25 mm GF/F filters to remove cell debris and filter fragments and injected in the HPLC setup. Chromatographic procedures, using a Lichrospher PAH column (250 x 4 mm i.d. (polymeric C18, 5 µm particle size, 150 Å pore size), are based on procedures previously designed for samples collected in the subtropical Atlantic ocean (Van Lenning *et al.*, 1995). These methods resolve mono- and divinyl forms of chlorophylls *a*, *b* (*Prochlorococcus*) and c_3, Chls c_1, c_2, MgDVP and two nonpolar *c*-like comonents, as well as most carotenoids, under which fucoxanthin (diatoms), 19'-hexanoyloxy-fucoxanthin (haptophytes), 19'-butanoyloxyfucoxanthin (chrysophytes), zeaxanthin, lutein (chlorophytes), alloxanthin (cryptophytes), prasinoxanthin (prasinophytes), neoxanthin, peridinin (dinoflagellates) and an unidentified carotenoid recently mentioned to occur in *Prochlorococcus marinus*.

The HPLC derived pigment signatures will be used to estimate the contribution of the taxonomic groups present to total chlorophyll present according to procedures previously described- and employed by Everitt *et al.* (1990), Letelier *et al.* (1993) and Anderson *et al.* (1996)

Microscopic- and flow cytometric data

Microscopic observations on fixed samples will provide information with respect to the species present within each of the taxonomic groups. This information will improve the taxonomic results expected from HPLC derived pigment signatures, since marker pigment to chlorophyll ratios may vary between species constituting a taxonomic compartment. Cyanobacteria lack specific marker pigments and their cells will be enumerated by flow cytometric techniques. Flow cytometric cell counts will also provide the information necessary to establish the variability of the cellular concentrations of pigments associated to each of the algal groups present in the area. Such variations are a consequence of the photoacclimatation and therewith expected to show vertical profiles.

Literature

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