2nd INTERNATIONAL OCEAN RESEARCH CONFERENCE

Vertical heterogeneity of plankton distribution in the NW Mediterranean: Density stratification, turbulence, and global warming.

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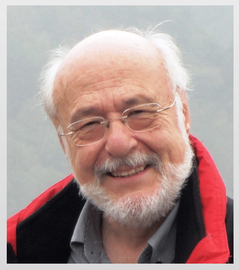

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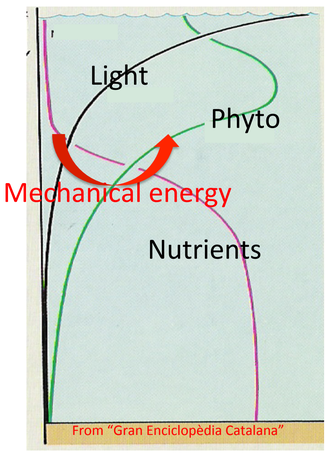
The facts



* Aquatic ecosystems are organized around a vertical axis defined by light and gravity. Nutrients are consumed at surface illuminated layers, whereas are abundant at deep dark layers.

* Mechanical energy (turbulence) returns water rich in nutrients to illuminated layers. But strong density gradients (i.e., summer thermal stratification) prevent the upward transport.

* In oligotrophic seas like the Mediterranean, during the summer stratification, the ecosystem structure and function depend on a deep phytoplankton maximum **(DPM)** that develops in the layer where light and nutrients are sufficient. **(1)**

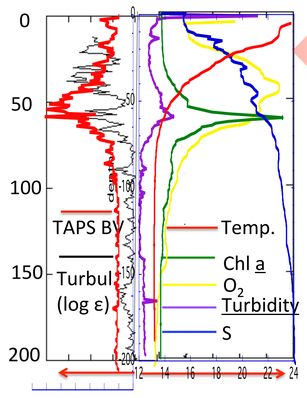
The questions

1) Is there a trophic relation between the **DPM** and the planktonic consumers, like micro- and mesozooplankton?

2) How the expected changes due to the global warming on the physical characteristics and dynamics of the water column could influence the **DPM**, and therefore affect the heterotrophic consumers and the whole pelagic ecosystem?

What we did and how

4-DAY TIME SERIES, SAMPLING EVERY 6 HOUR

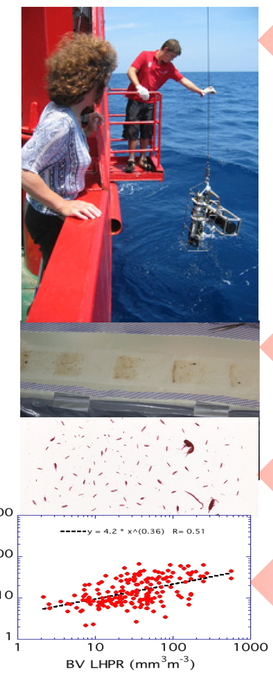


CTD

Temperature, Salinity, O_2, Fluorescence, Turbidity, Turbulence, TAPS (particle volume, resolution 1 m), and mesozooplankton (LHPR, resolution 5-10 m)

MICROTURBULENCE PROFILES

MST- Profiler: Microturbulence, ε (kinetic energy dissipation rate), T, S, Chl*a* fluorescence, temperature and salinity.



PARTICLE NUMBER AND VOLUME PROFILES

TAPS (High Resolution Acoustic Profiler). Plankton biomass: < 200 µm – 1.3 mm ESR, 6 size-classes. Attached to a Sea Bird 25 CTD.
Spatial Resolution: 3 L, Integrated to 1 m.

MESOZOOPLANKTON PROFILES made with LHPR hauls, 15-20 depth strata, 0-200 m, > 200 µm. Spatial resolution 5-10 m.

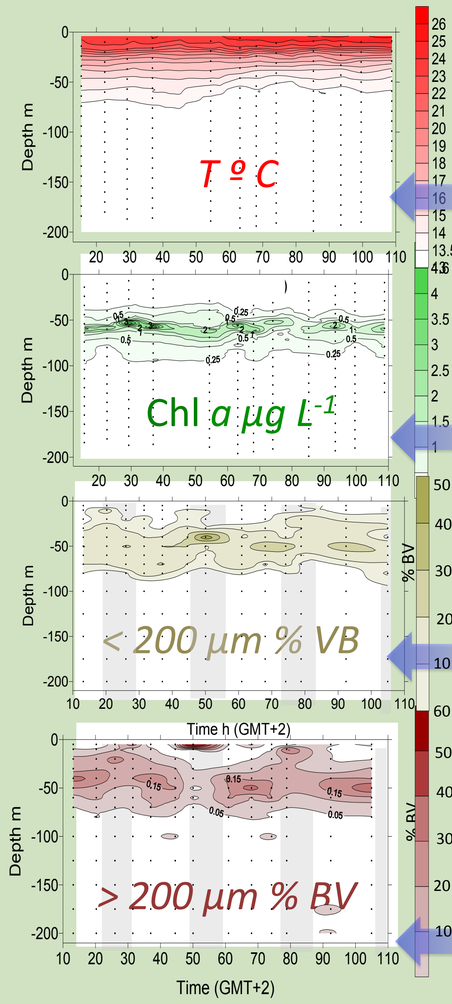
Automatic identification and biomass determination by ZooImage® **(2, 3).**

LHPR-TAPS BV correlation:

r =0.51

Results

Temperature (density) stratification and plankton distribution



Temperature- stratified water column, with the base of the thermocline at around 50 m depth.

Phytoplankton (as Chl *a*) concentrated in a layer (**DPM**) coinciding with the highest temperature gradient.

The deep microplankton (< 200 µm) maximum (**DmM**) coincided with . the **DPM.**

During daylight hours, the mesozooplankton (>200 µm) maximum (**DZM**) coincided with the **DPM** and the **DmM**. Nocturnal migration to the surface (grey bars).

Fig. 1. Time-series of the vertical distribution of temperature (ºC), chlorophyll (µg L^{-1}), micro- and mesozooplankton (% BV, **TAPS**). During the night (grey bars) > 200 µm organisms ascend from the **DZM** to surface waters.

Physical structure, plankton distribution and ecosystem function

The **surface temperature** and the **depth** of the **DPM** and of the **DZM** are related.

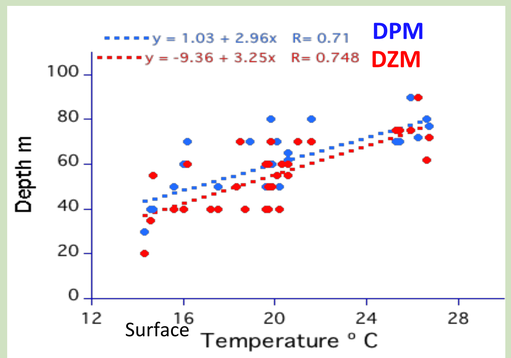
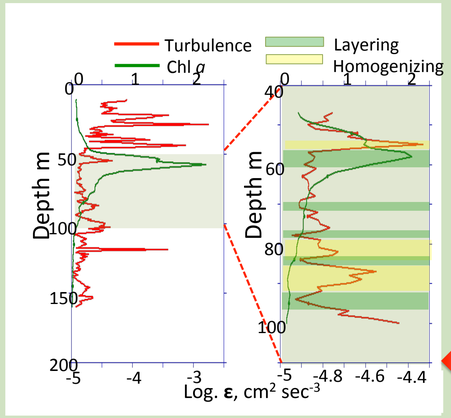


Fig. 2 Relationships between surface temperature and the depth of **DPM** and of the **DZM**. **(4, 5)**



Inverse relation between **turbulence** (ε) and the formation of **phytoplankton layers.**

Fig. 3 Turbulence and the pattern of vertical distribution of phytoplankton

Table I. Correlation coefficients between the depth of the **DPM,** the integrated primary production **IP**, and the quotient production/biomass **P/B** **(IP/-Chl *a*.** (Data from Estrada et al. **(1993) (6)**

	DPM depth
IP	-0.47**
P/B	-0.19

** P < 0.01

Conclusions

1) The **DPM** is a trophic hotspot, acting as concentration layer for micro- and mesoheterotrophs **(Fig. 1)**.

2) The increase of **surface temperature** by **global warming** will result in the deepening of the **DPM**, and simultaneously of the **DmM** and **DZM (Fig. 2)**.

3) Any change in the vertical turbulence field (**ε**) will at turn modify the vertical pattern of the **DPM**, and therefore of the micro- and meso heterotrophs **(Fig. 3)**.

4) With the deepening of the **DPM** there will be a decrease of the integrated primary production **(IP)** and, in a minor scale, of the turnover rate of phytoplankton biomass, represented by the quotient **P/B**, **(Table I)** that will modify the structure and function of the Mediterranean pelagic ecosystem.

References

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