Benthic diatom response to changing environmental conditions

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Preliminary remarks

- The Gulf of Trieste (northern Adriatic Sea, Italy) is a semi-enclosed water basin with a maximum depth of 25 m and therefore the response to any kind of environmental variation should be rapid and easy to detect.

- The gulf conditions have changed in the last years: from 1991 to 2003 temperature has shown a positive trend up to 0.23 °C year\(^{-1}\) in summer and up to 0.10 °C year\(^{-1}\) in winter at 10 m depth (Malačič et al. 2006), i.e. about one order of magnitude higher than the Intergovernmental Panel on Climate Change (IPCC) estimates (IPCC 2001).

- Salinity showed a most pronounced positive trend up to 0.34 year\(^{-1}\) at 10 m depth (Malačič et al. 2006).
Aims of the study

Following the variations of temperature, salinity, freshwater inflow and nutrient concentrations that occurred in the last two decades in the Gulf of Trieste, we expected to detect a change also in the benthic diatom community.

• The main goal of this survey was to study benthic diatom assemblages with respect to physical parameters (temperature and salinity).

• We made predictions of possible variations that may occur within the benthic diatom community in the future.
Study site

Gulf of Trieste

Legend
- Station
- Bathymetry
  Depth (m)
  -1.0 - 0
  -9.9 - -5
  -14.9 - -10
  -24.9 - -15
  -34.8 - -25
  -41.9 - -34.9

Scale: 0 1.5 3 6 9 12 Km

[Map showing the Gulf of Trieste with stations marked C1 and AA1]
Sampling by KC HAPS bottom corer (I.D. 13.3 cm)

Benthic diatom abundance (cells cm\(^{-3}\)) estimated by an inverted light microscope (Utermöhl, 1958) using a 32X objective
Statistical analyses

• The abundance of diatom genera was reduced performing a ranking of the genera according to their decreasing specific variance (%SV) (Orloci 1978).

• Since the environmental noise markedly affected the measurements, a bin-average analysis was used to obtain a more precise picture of the actual relation between temperature or salinity and abundance. Both temperature and salinity measurements were gathered into equally-spaced bins, with a bin interval of 2°C for temperature and 0.2 for salinity; then, bin-averaged temperature or salinity data were put into correlation with the corresponding averages of abundance data.
Bin-averaged temperature vs. abundance

St. AA1

Navicula

$y = 740.88x + 9696.7$

$R^2 = 0.12$

St. C1

Navicula

$y = 901.05x + 2337.50$

$R^2 = 0.76$

$p < 0.01$
Bin-averaged temperature vs abundance

**St. AA1**

\[ y = 536.39x + 318.05 \]

\[ R^2 = 0.66 \]

\[ p < 0.05 \]

**St. C1**

\[ y = 668.85x + 4277 \]

\[ R^2 = 0.59 \]

\[ p < 0.05 \]
Bin-averaged temperature vs abundance

Abundance (cell cm\(^{-3}\))

**Pleurosigma**

St. AA1

\[ y = -144.38x + 4083.60 \]

\[ R^2 = 0.50 \]

\[ p < 0.05 \]

**Diploneis**

St. AA1

\[ y = -137.55x + 6069.70 \]

\[ R^2 = 0.24 \]
Bin-averaged salinity vs abundance

Pleurosigma

y = 1972.6x - 72379

$R^2 = 0.65$

p < 0.01

St. AA1
Conclusions (1)

• Although our observational period covers only seven years, we found that the benthic diatom community has already shown some variations in its composition, responding to the modified abiotic conditions.

• According to the increasing trend of temperature and salinity observed by Malačič et al. (2006) in the Gulf and to the scenarios predicted by IPCC (2001), it is likely that a marked increase of temperature and salinity will occur in the next future. We infer that in this future scenario also the benthic diatom community will shift.

• As temperature rises in the future, the abundance of genera is expected to shift according to their thermal tolerance and ability to adapt (Harley et al. 2006).
Conclusions (2)

• *Diploneis* could disappear from the community and be replaced by *Gyrosigma*.
• *Navicula* and *Nitzschia* could markedly increase becoming the dominant genera.
• In highly saline conditions we could expect a rise of *Pleurosigma* abundances and frequent *Cylindrotheca* blooms.
• All these changes in the specific composition of the benthic diatom community are likely to be reflected also in benthic primary production variations.
• Since the Gulf of Trieste could be considered a natural megacosm due to its geomorphologic characteristics, the benthic diatoms response to changing environmental conditions observed in this site could be extended beyond the geographical limits of this particular ecosystem. In the next future similar changes in the benthic diatom community are likely to occur also in deeper basins.
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Thanks for your attention!