E-III3

Nutrient dynamics and dystrophy in a Brackish Coastal Lagoon (St. Andre, SW Portugal)

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St. Andre (150 ha, ca. 1.5m average depth, SW Portugal) is a land-locked lagoon isolated from the sea except during a short period in Spring (1/2 - 1 1/2 months) when a man-made channel is opened through the sand barrier. Such feature makes it an ideal system for the study of lagoonar metabolism.

Chemical parameters variation from March 84 to March 86 (Fig. 1) shows low nutrient concentrations except for two types of periods: 1)late Autumn-Winter and 2)Summer.

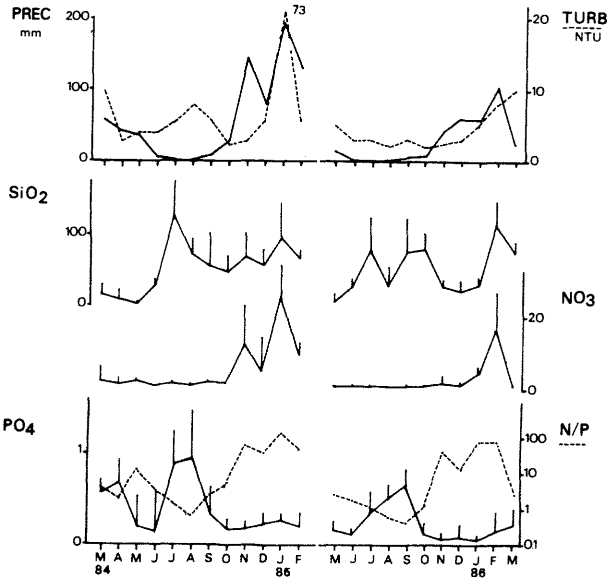

Fig.1. St.Andre lagoon - parameters variation during a two years survey. No values for March and April 85 when the lagoon was connecting with the sea. Chemical values expressed in µgat/l.

1. Late Autumn-Winter - Nutrient Income

During the raining period high concentrations of Silicate (SiO_2) and Nitrate (NO_3) coming from the watershed are observed. The highest concentrations of NO_3 in the lagoon water are observed after intense rainfall periods - Jan.85 and Feb.86 - and a strong correlation ($p<0.001$) exists between NO_3 and precipitation. No raising of phosphate (PO_4 - dissolved reactive phosphorus) is observed for this period. However it is well known that predominant form of incoming phosphorus is not dissolved but particulate (particularly sorbed to clay). During the reported period, precipitation correlates ($p<0.01$) with turbidity which is caused by particulate (silt+clay) material. The only other turbidity peak value is observed in Aug.84 when a high phytoplanktonic biomass was recorded (CANCELA DA FONSECA *et al.*, *in press*).

2. Summer - Nutrient Sediment Release

For Summer months high concentration of PO_4 and SiO_2 were detected. As no loading of SiO_2 from the watershed is developing during the dry months, these peak values must be explained as the result of internal recycling.

Sediment has a high organic content (12-15% monthly average and 48% maximum values) and, as temperature raises, intense oxidative processes develop. The high macrophytic biomass develops intense photosyntesis during the day but contributes to the nocturnal oxygen consumption and prevents adequate mixing of the whole water column causing some diurnal low bottom dissolved oxygen values. Under oxidative conditions of sediment-water interface no nutrient release from the anoxic layers to the water occurs. When anoxic conditions prevail phosphorus trapped in the sediment (eg. in iron compounds) passes rapidly into the water above at a rate as much as 1000 times faster than releases from oxygenated sediments (GOLDMAN & HORNE, 1983). Oxygen also plays a role in the control of SiO_2 which is also released in reduced conditions (VANDERBORGHT *et al.*,1977).

According to CHASSANY DE CASABIANCA (1979) the evolution of N/P ratio makes possible the prediction of dystrophic phenomena. The behaviour of N/P in Fig.1 compared with PO_4 and SiO_2 clearly traces the sediment anoxic-reduced conditions. The lower values of the ratio were recorded in Jul.-Aug.84 when large fish mortalities and a set of environmental conditions usually refered to as "dystrophic crisis" occured (BERNARDO *et al.*, *in press*). In Sep.85 fish mortalities were detected by local fisherman corresponding again to a low N/P value.

Low values of N/P ratio agree with high water phosphate and silicate concentrations. A whitish water layer attributable to iron compounds was observed indicating the release of these compounds from the sediments when anoxic conditions occur. Fish mortalities can also be related with iron hidroxid precipitation which could recover its gills and asphixiate them (MACHADO CRUZ,1969). The fact that this precipitation occurs in the presence of O_2, could explain the mortalities observed at noon (BERNARDO *et al.*, *in press*). So, low N/P values could be better explained by a sudden raise of phosphate concentration (normally low in these productive environments where dissolved phosphate is rapidly transfered to the vegetal biomass) than by a great decrease of nitrate. The high sediment release of SiO_2 under the reduced conditions of the dystrophies gives to this compound a real interest in the prediction of this phenomena.

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E-III4

Occurence of a bloom of Gymnodinium catenatum Graham in a Tyrrhenian Coastal Lagoon

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Gymnodinium catenatum Graham (Dinophyceae, Pyrrophyta) is an unarmoured, chain-forming dinoflagellate. The chains can be formed by a few (2-4), or up to more than 30 individuals 24-35µm long and 30-41µm wide. This species is known to have caused paralytic shellfish poisonings (PSP) in humans in Mexico, Spain and Australia (Campos et al., 1982). Extensive information concerning the toxicological properties of this species is given by Mee et al., 1986.

Gymnodinium catenatum has a wide geographic distribution (Pacific coast of America, Japan, Australia, and the Atlantic coast of Spain), but its ecological characteristics are as yet insufficiently known (Hallegraeff & Sumner, 1986; Hallegraeff et al., 1987; Campos et al., 1982).

In early September 1987 a bloom of Gymnodinium catenatum was observed at Fusaro lagoon, located on the Southern Tyrrhenian coast of Italy. Fusaro is a euhaline coastal lagoon, showing low spatial and temporal variations in salinity, due to both a good connection with the sea and a scarce inflow of fresh water. In recent years, the lagoon has undergone heavy domestic pollution and extensive dredging that have drastically modified its morphological and ecological characteristics. As a consequence, anoxic conditions are often observed, particularly in the area subject to dredging, where the present bottom reaches down to more than three times (13m) the average depth of the basin (4m).

Since this is the first report of a bloom of Gymnodinium catenatum for the Mediterranean Sea and for a coastal lagoon, we believe that its presence may be considered interesting from both an ecological and an applied point of view (shellfish farming), considering that Gymnodinium catenatum exerts toxic effects at concentrations of 10^3 cells/l (Estrada et al. 1984).

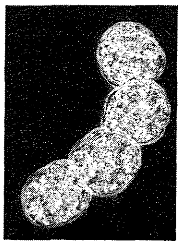

FIGURE 1.

Figure 1 shows a chain of Gymnodinium catenatum collected on September 9th and preserved in 4% neutralized formol. It is worth noting that preservation techniques have a strong influence on the variability of some morphological features of this species (Graham, 1943; Balech, 1964).

When the bloom occurred, Gymnodinium catenatum reached total densities of $1.7 \cdot 10^6$ cells/l (46% the entire population). The remaining phytoplankton population consisted of about 30% phytoflagellates and 18% diatoms. Some physico-chemical parameters, measured at three stations along the main axis of the basin during the occurrence of the bloom are given in Table I.

Previous observations in the same lagoon (1985, unpublished data) indicate the presence of this species from June through September. In these samples Gymnodinium catenatum, which at times occurred at higher concentrations ($\approx 6 \times 10^6$ cell/l) than in September 1987, accounted for no more than 42% of the entire population. The remaining part was composed by diatoms (38%-78%), and phytoflagellates (17%-34%).
The considerations of Bravo (1986), who suggests that the blooms observed in the Ria de Vigo may originate from cysts present in the bottom sediments, may represent an appropriate basis for hypothesizing that the Fusaro blooms are a possible consequence of the continuous resuspension of the lagoon sediments, and hence of the cysts, by dredging.

Despite the lack of information regarding the toxicity of its population, the presence of Gymnodinium catenatum in the Fusaro lagoon may represent a possible complication for the reclamation programs aimed at restoring in the lagoon ecological conditions compatible with its century-long tradition in shellfish farming.

TABLE I

ST. #	h	Temp. °C	Sal. PSU	O_2 ml/l	O_2 %sat	N-NO_2 µM	N-NO_3 µM	N-NH_4 µM	P-PO_4 µM	SiO_4 µM	Chla µg/l	Phaeoa µg/l
17	15.30	28.44	38.19	6.41	146.1	0	0.52	1.06	0.45	9.91	20.68	3.73
24	16.03	28.45	38.18	5.99	136.7	0.10	0.10	1.07	0.49	16.43	21.50	11.53
29	16.23	28.61	38.15	5.58	127.6	0	0.63	1.30	0.26	12.03	22.06	8.76

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