A model of competition between primary producers in Coastal Lagoons

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Mediterranean coastal lagoons show many types of salinity-temperature relationship. Because of climate conditions, the increase in salinity during the summer is a common feature under non-perturbed conditions. However, human influences can alter the hydrology of the lagoons, which can result in striking changes in the biological community living in the lagoons.

The coastal lagoons in the delta of the Ebro River have been affected by human agricultural practices for over a century. The consequence was a change in the hydrological regime: decreasing salinity (35-1 ppt) during May-October due to the discharge of freshwater from irrigated ricefields and increasing salinity (1-35 ppt) during November-April due to water exchanges with the sea (COMIN, 1984). Biological populations adapted to these seasonally fluctuating conditions include submerged rooted macrophytes (*Potamogeton pectinatus* and *Ruppia cirrhosa* which developed every year in the lagoons according to these salinity-temperature fluctuations (MENENDEZ & COMIN, 1989). In highly eutrophic lagoons, submerged rooted macrophytes disappeared after the water column became very turbid, because of phytoplankton blooming (COMIN *et al.*, 1990). These results obtained comparing different coastal lagoons in the Ebro Delta were used to propose a simple model of competition between primary producers (phytoplankton *versus* submerged rooted macrophytes). Light and nutrients were the key factors for the result of the competition. Cultural eutrophication, increasing freshwater discharges to the lagoons containing huge amounts of nutrients, favoured phytoplankton proliferation, which in turn increased light extinction in the water column and prevented submerged rooted macrophyte development. No data are available on the influence of other factors, such as biocides used intensively for agriculture and changes in the characteristics of the sediments.

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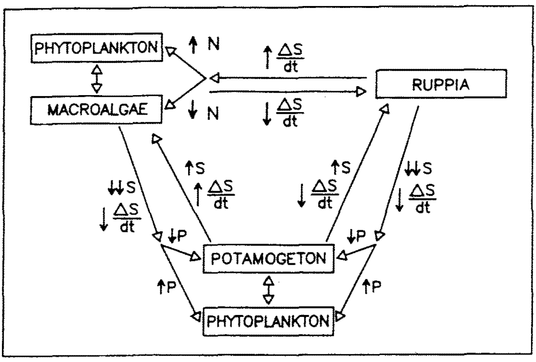
However, this model is too simple considering the variety of plants which can contribute to primary production in coastal lagoons and the range of environmental conditions affecting the same coastal lagoon through time. Floating macroalgae developed a huge population in a coastal lagoon in the Ebro Delta (Tancada) in two years (1990-91) after water management practices prevented freshwater inputs to the lagoon. The water of the lagoon became hypersaline during summer (conductivity 65 mS cm^{-1}, while it had ranged between 50 and 5 mS cm^{-1} in previous summers). At the same time, the nitrogen concentration in the water changed from relatively low nitrate (1-8 µg-at l^{-1}) and high ammonium (1-50 µg-at l^{-1}) before 1990 to relatively high nitrate (1-30 µg-at l^{-1}) and low ammonium (0-1 µg-at l^{-1}) during 1990. Again, relatively low nitrate and high ammonium concentrations were observed during 1991. No significant changes were observed in the phosphorus concentrations. During these two years, phytoplankton biomass did not increase significantly and both the area covered by *Ruppia cirrhosa* and its biomass per area decreased compared to previous years. As floating macroalgae (*Ulva rigida, Chaetomorpha linum, Cladophora* sp.) did not develop large populations in previous years, a more realistic model of competition between primary producers in coastal lagoons is proposed here (Fig. 1).

Fig. 1.- Schematic representation of the model of competition between primary producers in coastal lagoons. Arrows between boxes indicate the changes of populations dominating the primary production. (N-Nitrogen, P-Phosphorus, S-Salinity, delta S/dt-rate of salinity change. Upward arrows: increase, downward arrows: decrease).



The substantial proposal of this new model is the contrast between the nutrients through which the control of competition between primary producers is exerted. Phosphorus at low salinity and nitrogen at high salinity would be the key nutrients. In both cases, phytoplankton would take the lead at high nutrient concentration while macroalgae having a high affinity for nitrogen would decrease nitrogen concentration in the water, as in 1990, and would proliferate. In any case, phytoplankton and macroalgae can bloom rapidly because of their high growth rates, accumulating huge biomasses in the water column and limiting available light available for submersed rooted macrophytes.

REFERENCES

COMIN F.A., 1984.- Caracteristicas fisicas, quimicas y fitoplancton de las lagunas costeras Encanyissada, Tancada y Buda (Delta del Ebro). *Oecologia Aquatica* 7:79-161.

COMIN F.A., M. MENENDEZ & LUCENA J.R., 1990.- Proposals for macrophyte restoration in eutrophic coastal lagoons. *Hydrobiologia* 200/201:427-436.

MENENDEZ M. & COMIN F.A., 1989.- Seasonal patterns of biomass variation of *Ruppia cirrhosa* (Petagna) Grande and *Potamogeton pectinatus L.* in a coastal lagoon. *Scient. Mar.* 53(2-3):633-638.