

SUMMER STRUCTURE AND CIRCULATION PATTERNS IN THE NORTH ADRIATIC SEA:
THEIR INFLUENCE ON THE BENTHIC BIOCENOSES

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Abstract

A general description of the circulation in the northern Adriatic Sea is provided, with indication of its consequences on the local benthic biocenoses. In particular the conditions of summer 1977 are discussed, and an explanation is suggested for the dramatic death of most of the local benthic life in the fall of the same year.

Résumé

On présente une description générale de la circulation de la mer Adriatique septentrionale, remarquant ses conséquences sur la biocénose benthique. Notamment on analyse les conditions de l'été du 1977 et on suggère une explication pour la mort de la plupart de la vie benthique, qui se passa dans l'automne de la même année.

The northern Adriatic Sea (Fig. 1) presents two distinct circulation patterns for winter and summer months. The latter corresponds to the injection of the Po River freshwaters in the surface layer, yet stabilized by the seasonal surface thermal input, with strong effects on the vertical structure of the water column, and on the circulation in the basin.

The Po River plume, and the related dilution zone, extends towards the eastern coast, and seems to create a counterclockwise circulation in the part of the basin northward of the Po Delta (Franco, 1970); the dilution of the upper part of the water column generates a very sharp stratification, with strong pycnoclines between layers of different

thermohaline features.

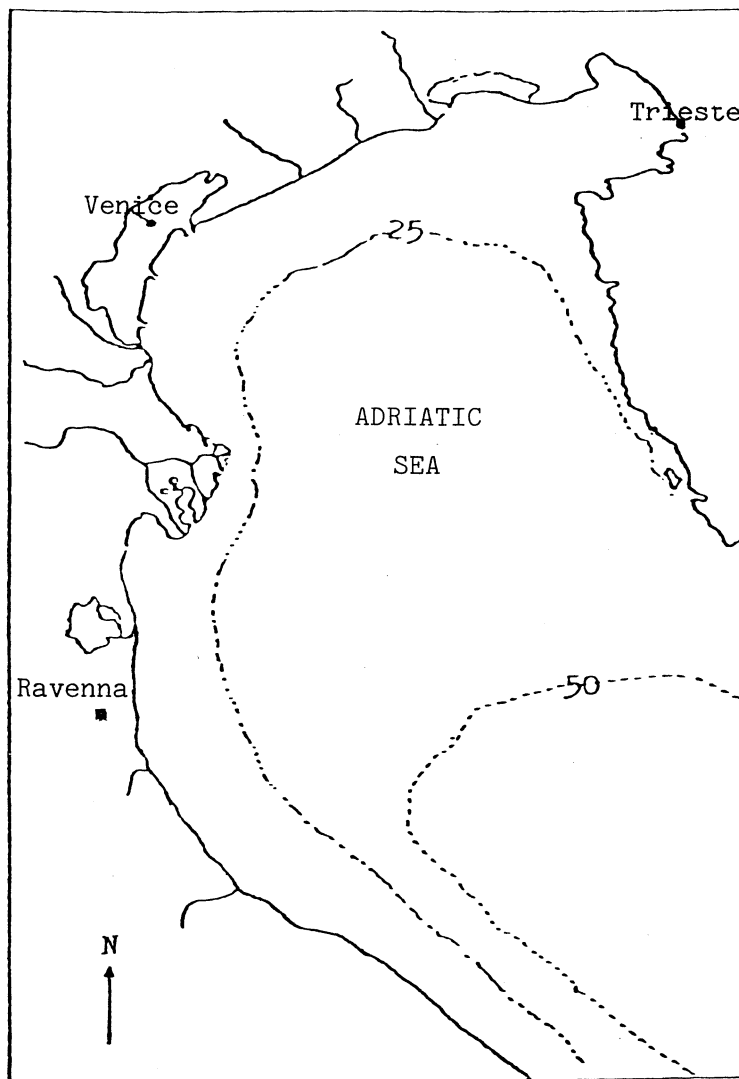


FIGURE 1

This results in a retentive circulation in the deeper layer, and in a sharp reduction of the vertical turbulent diffusion of properties across the pycnoclines, with a definite seasonal trend in the distribution of the non conservative ones.

An extreme fluctuation of the annual cyclic modification of the characters of the denser waters in the column (as oxyty, pH, nutrients con-

centration, irradiance levels: see Franco, 1982) happened in 1977, with important consequences of the benthic biocenoses.

During the spring, summer and autumn of this year the Po River, owing to an unusual climatological regime, had an exceptional large outflow, with an overall discharge, from April till November, of about 60 km^3 of freshwater, which produced in the northern basin of the Adriatic a strongly diluted surface layer (salinity lower than $30 \cdot 10^{-3}$), separated from the underlying saline water by an extremely sharp pycnocline ($\Delta \sigma_t$ up to $5-7 \text{ m}^{-1}$).

The circulation of the denser water masses below the pycnocline was quite faint, with slow and erratic current regimes (Accerboni et al., 1979) and consequently with scarce advective processes.

The surface layer was moreover very turbid, because of both suspended solids of riverine origin and biogenic particulate, and the penetration of the radiant energy below the pycnocline was accordingly very scarce, with depression of planktonic photosynthetic activity in the deeper layers.

Owing to the reduction of the vertical turbulent transport and to the lack of advective renewal of waters, the unbalance of the oxygen budget due to respiratory processes led to a progressive depletion of the oxygen stock in the denser masses, down to concentrations approximating to zero.

The impact of dense water masses with anoxic conditions and the presence of hydrogen sulphide on the underlying benthic biocenoses was obviously dramatic, and the decomposition of organic matter from the dead organisms worsened the situation.

The fine weather condition, and the extreme vertical stability of the water column, maintained this structural pattern up to December. During this month the strong superficial cooling and the wind driven mechanical mixing led to a progressive entrainment of the sub-pycnocline waters and finally to a complete mixing of column, and the resupply of oxygen, through the superficial reaeration and the vertical diffusive transport.

The oxygen stock in the column, as other non conservative properties (nutrients, pH) were in the normal range during the subsequent annual cycle (Franco, 1979). Large areas of the northern Adriatic Sea bed, devoided of benthic organisms by the overlying anoxic water masses, were successively recolonized by different associations (see Stefanon and Boldrin, 1981).

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