RIVER INPUTS TO SOUTHERN EUROPEAN SEAS: MAJOR DRIVERS FOR ECOSYSTEM CHANGES DURING PAST AND FUTURE DECADES?

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Abstract
The purpose of this paper is to highlight the changes that characterize the river discharges of water and nutrients of Mediterranean and Black Sea rivers during recent decades, giving them an important role in the control of the productivity and distribution of the marine ecosystems that depend upon these inputs. In particular the fluxes of inorganic nitrogen and phosphorous species evolved very differently, and the nutrient availability in the coastal zones may have been altered significantly, not only quantitatively, but also qualitatively.
Keywords : Eastern Mediterranean, Western Mediterranean, Black Sea, River Input.

The influence of river basins on the coastal zone and even on the open part of enclosed seas as the Mediterranean has been recognized since the early 1970s as a key driver in sediment, water, nutrients and pollutants budgets when UNEP launched a series of Regional Seas Programmes on the Caribbean, Gulf of Guinea and Mediterranean, among others. These first studies pointed out the great heterogeneity of Mediterranean and Black Sea rivers in terms of water runoff, sediment discharge, and associated nitrogen and phosphorus fluxes, mainly due to the great climatic variability in this region and the related differences of land use and socio-economic practices in the corresponding drainage basins.

Also at temporal scales, the evolution of the river inputs is characterized by great differences. Several reasons can be cited for this. First of all, the river inputs directly translate the effect of climate change on the Mediterranean and Black Sea regions. A first state of the art evaluation [1] indicates that freshwater inputs by rivers might have considerably changed during the last century, at least for the Mediterranean Sea. Precipitation rather increased in the high latitudes, whereas it tended to decrease in the lower latitudes. This should have strengthened the contrast between the water inputs from the north and from the south.

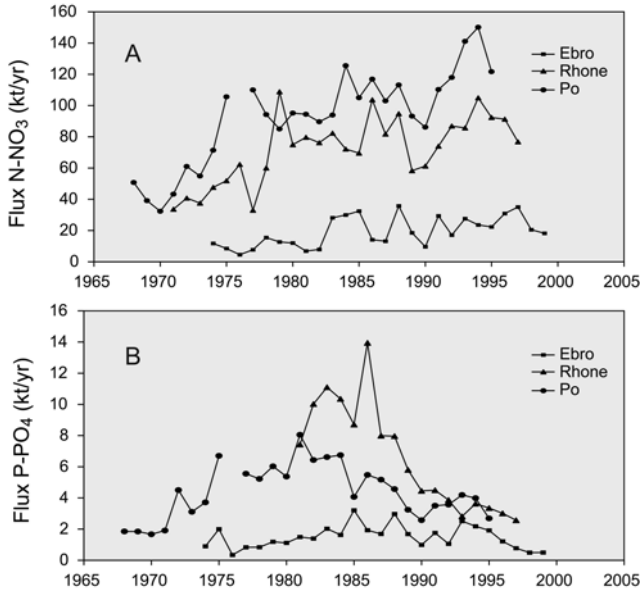

Fig. 1. Evolution of the annual fluxes of nitrate (A) and phosphate (B) in three major Mediterranean rivers [1]

Moreover, the river inputs directly reflect the intensification of human activities in the corresponding drainage basins. Certain nutrient fluxes, such as the fluxes of dissolved inorganic nitrogen (DIN), are closely linked to anthropogenic controlling factors like population densities and/ or fertilizer spreads. As a consequence, DIN fluxes in the great Mediterranean rivers, such as the Po and Rhone rivers, increased since the '70s at least by a factor of two or three, mainly because agricultural practices changed (Fig. 1A). But nutrient levels in rivers are also sensitive to policy changes and other changes that affect societal behaviour, and not all human released nutrients followed this increase. An illustrative example for this is the riverine flux of dissolved inorganic phosphorous (DIP), which, as DIN, also strongly increased from the '70s on, but then decreased drastically during the eighties or nineties because of the banning of phosphate detergents and the improvement of wastewater purification in the drainage basins (Fig. 1B).

Finally, the river inputs are strongly affected by dam constructions. Since the second half of the last century, dam constructions rapidly increased in the Mediterranean and Black Sea countries, which had a considerable impact on the rivers. On the one hand, water extraction for irrigation and drinking water could be intensified, which also contributed to the decrease of the freshwater inputs especially by the southern rivers. On the other hand, dams strongly reduced the riverine transfer of particulate and dissolved nutrients (e.g. silica) to the sea.

Up to now, the forcing of the marine ecosystems through rivers has not been evaluated on the scale of the Mediterranean and Black Sea on the whole. This issue was the focus of a recent CIESM Workshop [2] and it is one of the objectives of the EU project SESAME (Southern European Seas: Assessing and Modelling Ecosystem changes). Reconstructions and modelling data for the riverine nutrient fluxes will be combined with a variety of biological models in order to test whether the river discharges can explain the major changes in productivity and compositions of marine biota that were observed during the last decades, and, together with climate and anthropogenic change scenarios for the future, whether they may affect the ability of the marine ecosystems to provide goods and services in the near future.

References

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