

# An integrated approach to evaluate the role of the macro-zoobenthos on the dynamics of biophilic elements in a tidal estuary in the Seto Inland Sea

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## Introduction

An integrated and long term monitoring survey of both sedimentary organic matter and benthic macrofauna was started in 1994, within a program which aims to quantify the circulation of C, N and P and to determine the role of the benthic macrofauna, on this processes, on a tidal estuary in the Seto Inland Sea, Japan.

Due to the high flexibility and variability of the tidal estuaries and the often unknown extent of the coupling between chemical and biological processes, the need for a conspicuous set of data, enabling to describe properly the dynamics of biophilic elements, made necessary preliminary objectives: follow the temporal variations of the main physico-chemical parameters both on the intertidal flat (river runoff, intertidal water and sediment) and on the subtidal zone (water column and sediment) and evaluate spatial differences; investigate, contemporary, both on the intertidal flat and on the subtidal zone, the qualitative and quantitative composition of the autochthonous macro-zoobenthos, and determine temporal changes and spatial differences; evaluate short time effects of the tidal cycle on the nutrients balance and the fluxes of organic matter throughout 24 hours coordinated surveys on a river station, on the intertidal flat and on the adjacent subtidal zone; quantify the influence of the macro-zoobenthos on the nutrient regeneration and the circulation of the organic matter, throughout laboratory experiments on excretion and feeding rate.

Final objectives of the present study were: quantify and correlate each others the chemical and biological variations, occurring in time and in space; evaluate the "external" loading from the river and the *in situ* regeneration of nutrients and organic matter, with an estimation of the annual primary production and secondary production; propose a model of the dynamics of biophilic elements, with an inner river box, an intermediate intertidal box and a outer subtidal box.

## Results and Discussion

Results show that both in the water column and in the sediment, physico-chemical parameters and processes (e.g. fluxes of nutrients and organic matter) showed significative temporal variations, as linked to major benthic biological events (e.g. macro-zoobenthic community dynamics, production and decomposition processes), and were considerably higher on the intertidal flat than on the subtidal zone, progressively less affected by the tidal export.

On the intertidal, among the macro-zoobenthos, dominant species were represented by two bivalves (*Ruditapes philippinarum* and *Musculista senhousia*), seasonally well supported by high concentrations of resuspended particles, and two polychaeta (*Nereis sp.* and *Cirriformia tentaculata*). At this site, both density and biomass (Fig. 1a and b, respectively) were higher than that found on the subtidal zone (Fig. 1c and d, respectively).

Short time effects of a tidal cycle on the nutrient dynamics were quantified: river input of silicate and nitrate+nitrite nitrogen was strong while receding the tidal front, both on the tidal flat and the surface water of the subtidal station. Inversely, during the high tide, river nutrient concentrations were lowered by the mixing of fresh water with sea water. As a result, best (inverse) correlations were found at the river station for salinity against silicate ( $y = - 2.90 + 110.68 r^2 = 0.879$ ) (Fig. 2a) and nitrate+nitrite ( $y = - 1.25 + 48.41, r^2 = 0.796$ ).

Differently, ammonium nitrogen concentrations were higher, at intermediate salinities, both on the intertidal flat and on the close subtidal station. Indeed no significant correlation was found between salinity and ammonium nitrogen (Fig. 2b). This fact was also the result of a high benthic biological activity and nitrogen regeneration exercised by the macrobenthos (particularly, the filter feeding bivalves) living on the intertidal flat. The results will enable us to make a final budget on the dynamics of biophilic elements in order to construct a new strategy for the sustainable use of tidal estuaries.

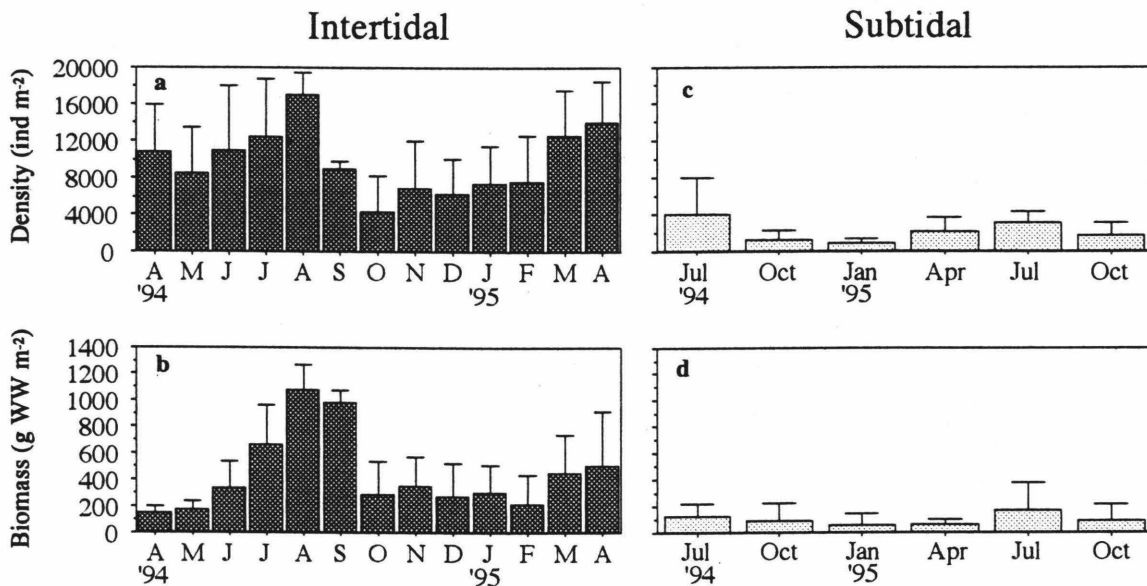


Fig. 1a, b, c, d. Density and biomass of the macro-zoobenthos on the intertidal flat (a and b) and the subtidal zone (c and d)

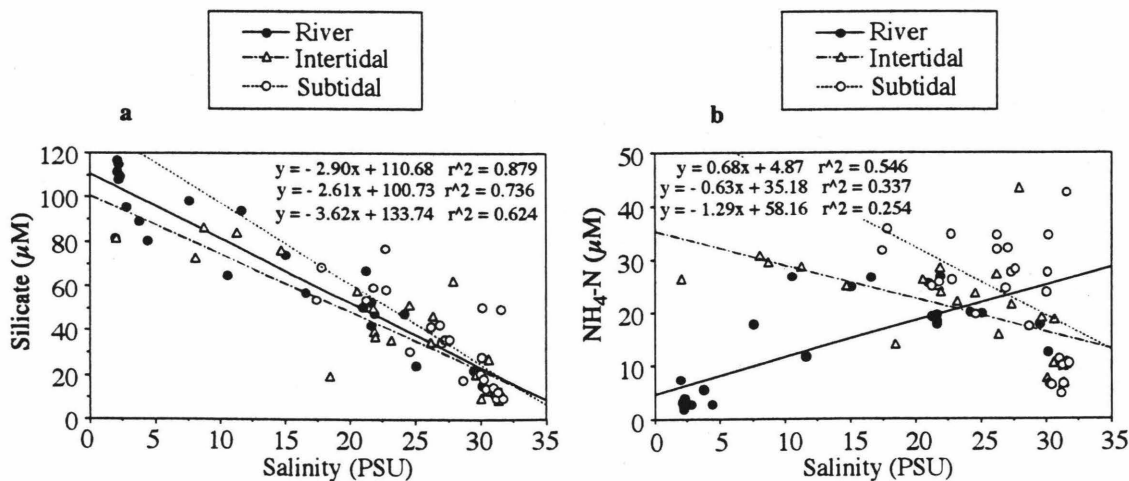


Fig. 2a and b. Silicate/salinity (a) and ammonium nitrogen/salinity (b) plots for individual stations obtained from a 24 hours survey carried out along a transect line of the estuary.