THE UNDERESTIMATION OF SEAGRASS BIOLOGICAL CYCLE IN THE BIOMONITORING OF COASTAL TRACE ELEMENT POLLUTION

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Introduction

The seagrass *Posidonia oceanica* (L.) Delile forms monospecific meadows along Mediterranean coasts from the surface to depths of about 40 m (Fig.1). It has been largely used for the biomonitoring of pollutions in Cr, Ni, Cu, Zn, Cd, Pb and/or Fe. In contrast, other trace elements (TEs) like As, V, Ag, Be, Al, Mn, Co, Se, Mo, Sn, Sb or Bi have been subject to nearly no ecotoxicological survey with that species. Moreover, the understanding of the seasonal variation of TE levels according to the seagrass biological cycle, a prerequisite to the intercomparison of sites sampled at different times of the year, has been little investigated.

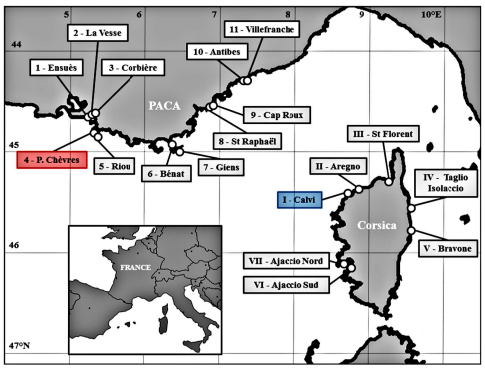


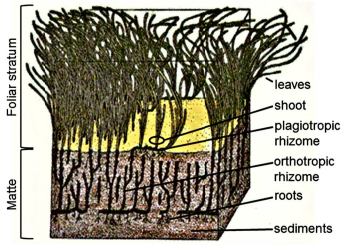
Fig.2. 18 sites along Provence-Alpes-Côte d'Azur (PACA; 1-11) and Corsican (I-VII) coasts (France, NW Mediterranean) sampled in April 2007 for *P. oceanica*. Colored Calvi and P. Chèvres sites were further monitored for 3 years (2008-2010).

Material and methods

- TE levels were biomonitored in April 2007 along the French Mediterranean littoral (Fig.2).
- TE bioaccumulation was seasonally studied (March, June and November) for 3 years (2008-2010) in *P. oceanica* sampled in the pristine Calvi Bay site and in the impacted Plateau des Chèvres site located near the Cortiou outlet discharging wastewaters from Marseille city (Fig.2).
- *P. oceanica* biometry was measured according to the method of Giraud.
- TEs were analysed by DRC-ICP-MS.

Results and discussion

French Mediterranean coasts are submitted to local, diffuse and/or chronic contaminations both by TEs broadly or little biomonitored with *P. oceanica* (Fig.3, left). High TE levels could be linked to specific anthropic activities: agriculture (Mo), mining (Cr, Sb, Zn), industries (As), storage and refinement of oil products (V, Pb), presence of major ports and urban centres (Sn, Bi, Ag). In *P. oceanica* from the pristine Calvi Bay site, TE concentrations further evolved seasonally according to the ecophysiological cycle of that perennial, deciduous plant (Fig.3, middle). In the impacted Plateau des Chèvres site, this seasonal evolution could be disrupted (Fig.3, right).



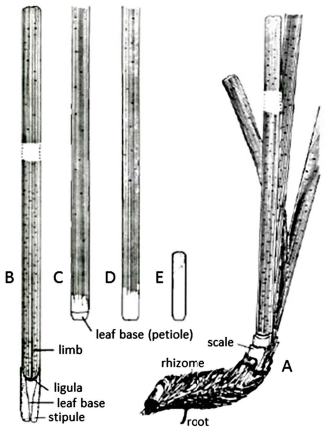


Fig.1. Above - 3D schematic view of a portion of a *P. oceanica* meadow, drawing of (A) a shoot of leaves fixed on a plagiotropic rhizome, and detailed drawings of (B, C) adult, (D) intermediate and (E) juvenile leaves. Left - Pictures of a *P. oceanica* meadow (above), of the matte (middle) and of an accumulation of dead leaves hosting the litter monster (below).

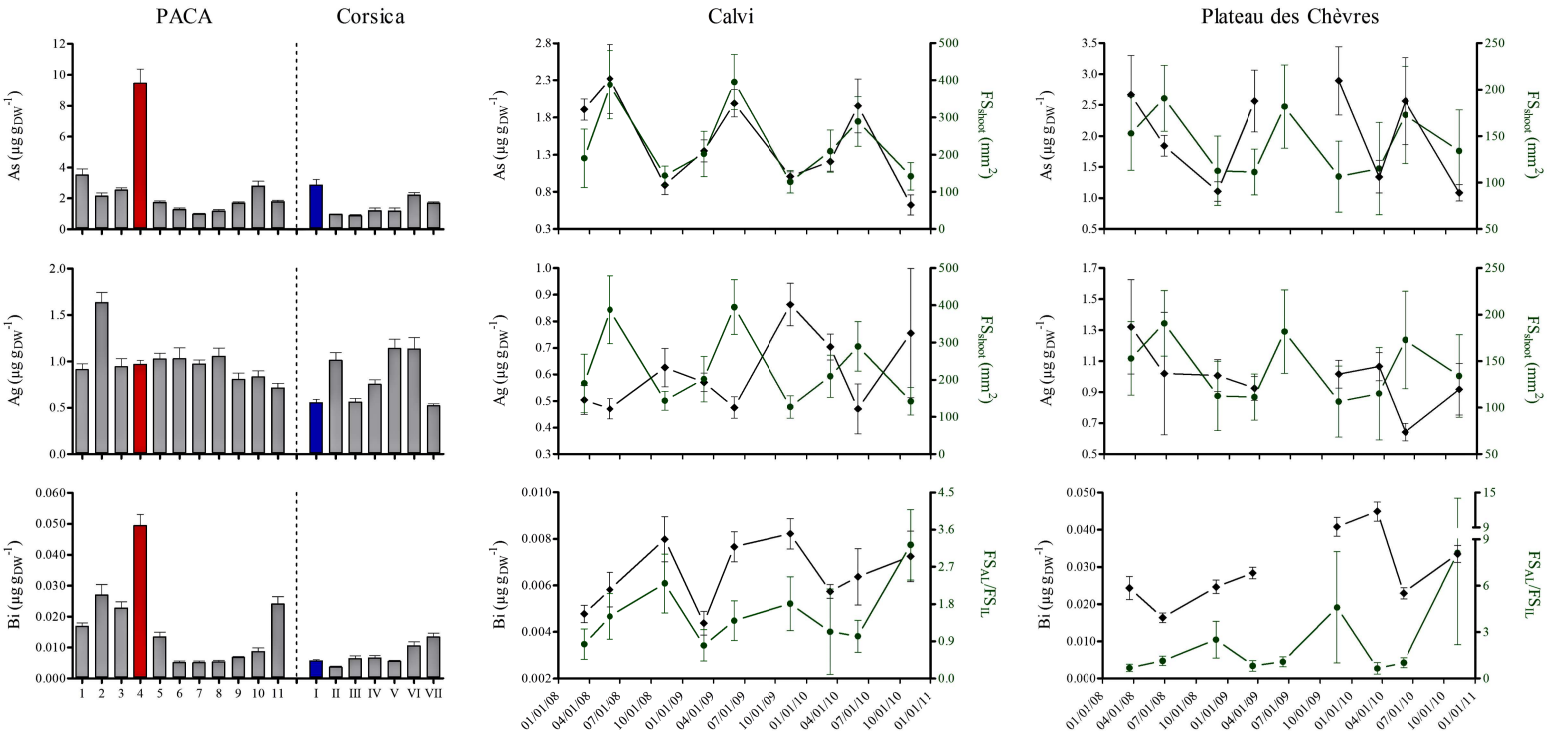


Fig.3. Spatial variations of As, Ag and Bi concentrations (µg g_{DW}^{-1}) in *P. oceanica* sampled in April 2007 in 18 sites along Provence-Alpes-Côte d'Azur (PACA; 1-11) and Corsican (I-VII) coasts (France, NW Mediterranean; left graphs; Calvi site colored in blue, Plateau des Chèvres site colored in red) and temporal variations of As, Ag and Bi concentrations (µg g_{DW}^{-1}) in *P. oceanica* seasonally sampled for 3 years (2008-2010) in the pristine Calvi Bay site (middle graphs) and in the impacted Plateau des Chèvres site (right graphs). The foliar surface of shoots (FS_{Shoot}; mean ± SD, in mm^2) is an indicator of the cyclic growth of leaves; the ratio between the foliar surface of adult leaves and the foliar surface of intermediate leaves (FS_{AL}/FS_{IL}; mean ± SD) is an indicator of the seasonal aging of shoots.

Conclusion

These complementary studies allowed highlighting that roles played by both the seagrass biological cycle and its environment are of the same order of magnitude in the bioaccumulation process of TEs in *P. oceanica*. The natural cyclic evolution of seagrass TE concentrations should therefore be systematically quantified in regional reference sites in order to properly intercompare results from biomonitoring surveys conducted at different times of the year.

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