Saltmarshes are important constituents of transitional environments, where they provide several services to the ecosystem and are essential to the sedimentary budget (Pethybridge, 1984). On the other hand, they are subject to the effects of increasing human pressures, especially where anthropogenic activities occur. As a consequence, the accumulation of contaminated sediments (e.g., heavy metals) may affect these fragile environments (Casador et al., 1996). Plants living in saltmarshes often show their ability to accumulate heavy metals both in roots and shoots, thus providing a natural metal-extraction pathway useful for remediation activities.

The aim of this study was to evaluate the content of some heavy metals (As, Cd, Cr, Cu, Hg, Ni and Pb) of ecotoxicological importance (WFD/2000/60/EC) in sediments, rhizo-sediments and in plants (roots, shoots and leaves) from two selected saltmarshes located in the Marano and Grado Lagoon. Enrichment Factors (EF) and metal translocation from the belowground to the aboveground biomass were also considered.

The Marano and Grado Lagoon (Northern Adriatic Sea) is the second largest lagoon area of the Adriatic after Venice. The Lagoon is generally considered a well-preserved area where conservation of the natural environment must coexist with several human activities such as fishing, shipping and industries. The main source of contamination in the Lagoon is represented by the inflow from the Ausa-Corno river system which is impacted by industrial discharges from several industries and is connected to the open sea by a navigable channel. Another source of contamination is given by the Ionian River, the largest contributor of mercury into the northern Adriatic Sea since the 16th century, due to its transport of cinnabar (HgS) rich tailings from the Idrijca (Slovenia) mining district (Covelli et al., 2012).

Sampling operations took place in July 2011. Two saltmarshes were selected: MSB in the Marano Lagoon and BARB in the Grado Lagoon. The saltmarshes differ for morphology and heavy metal contents and are representative of a highly impacted area (Marano Lagoon) and a moderately (except for high Hg contents) contaminated area (Grado Lagoon). In both saltmarshes, individuals of Sarcocornia fruticosa and Limonium Vulgare, two of the most abundant halophytes in this environment, were considered.

The heavy metal content in the sediments was quite high at both saltmarshes. MSB was the most contaminated site, showing higher concentrations especially for As, Cd, and Pb (Table 1). On the other hand, Hg was highest in BARB. Such results reflect the different contamination history of the two areas: MSB is directly influenced by the industrial area that consists in the Marano basin, while BARB was affected by Hg contamination due to Hg-rich particulate matter inflowing from the Ionian River.

The results show that in both areas Mn, Pb and Zn are the metals that reached higher concentrations with values above the threshold limits set by WFD/2000/60/EC. In the MSB saltmarsh, Ni was also among the metals with higher concentrations, while in BARB Cr was the metal with the highest concentration. The highest values of Mn, Pb and Zn were measured in the shoots of S. fruticosa, while the highest values of Ni were measured in the shoots of L. Vulgare.

To evaluate metal accumulation in the plants, the Enrichment Factors (EF = [metal/roots]/[metal/sediment]) were calculated (Table 3). In both saltmarshes, the halophyte vegetation showed accumulation (EF>1) of As and Cd, but not of Ni. S. fruticosa showed the greater bioaccumulation while MSB seemed to be a more favorable site for such processes, probably due to redox conditions in the sediment that enhance metal mobility. The translocation of metals from the halophytes’ roots to their shoots and leaves was evident at both saltmarshes. Notably, at BARB, Cr in the shoot of S. fruticosa was particularly high (181 mg kg⁻¹) compared to its content in the roots (69 mg kg⁻¹) and rhizosphere (86 mg kg⁻¹). In L. vulgare, the Zn content in the leaves was almost double that of in the shoots and about half of that in the roots. Zn is an essential element for plant physiology, playing a key role as enzymatic co-factor and, thus, its presence in the leaves is not surprising. No translocation was observed for Cd and Hg, and they appeared to be immobilized in the halophytes’ roots.

**Fig. 1** – The Marano and Grado Lagoon study area. Saltmarshes core sampling sites are indicated.

**Fig. 2** – Vertical concentration profiles for As, Cd, Cr, Hg and Ni in rhizosphere and roots of the halophytes S. fruticosa and L. vulgare in the Marano and Grado Lagoon saltmarshes (sites MSB and BARB).

**References**
