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# Seasonal and spatial alterations in macrofaunal communities and in *Nephtys cirrosa* (Polychaeta) oxidative stress under a salinity gradient: A comparative field monitoring approach

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ABSTRACT

Sustainability of estuaries and lagoons is vital for coastal regions both in ecological and economic terms. These ecosystems are highly vulnerable to both natural and anthropogenic disturbances, with environmental risk assessment becoming increasingly challenging, and requiring the application of more adequate and accurate approaches that allow to distinguish between the effects induced by anthropogenic factors from those related to organisms characteristics and/or ecosystem's natural features. In this context and as a case study, the present study compared the responses to different salinities analyzed through macrobenthic community composition (namely, species richness, abundance, *alpha* diversity, margalef richness and rarefaction index) inhabiting the Ria de Aveiro and on *Nephtys cirrosa* (polychaete species present in the studied community) oxidative stress markers (including, protein content, antioxidant enzymes activity and cellular damage). Overall, results confirmed that macrofauna's descriptors of community composition are highly suitable to assess the effects of environmental salinity at both spatial and seasonal levels. Comparatively, biomarkers provided valuable information on the effects of environmental changes at the sub-cellular level in *N. cirrosa*, despite showed to be less specific to spatial and seasonal salinity variation, being influenced by a multitude of different abiotic factors. The present study emphasizes the importance of identifying the potential interfering factors and their impacts on the biomarker signals observed in wild populations and reinforce that in biomonitoring programs, biomarkers should be used as complementary tools.

## 1. Introduction

Coastal ecosystems, such as lagoons and estuaries, are complex systems with high productivity (McLusky, 1999). They play a vital role in providing several ecosystem services mainly associated to the sustenance of vast biological resources (Lillebø et al., 2015). However, these ecosystems are also highly vulnerable to both natural (e.g. Govender et al., 2011) and anthropogenic (e.g. Langston et al., 2010) disturbances. As additional concerns arise, such as emergent contaminants or climate change related factors, the environmental risk assessment becomes more challenging, requiring the application of increasingly accurate approaches. Classical assessment through water chemical analysis has been losing importance and attention has been turned to effects on biota (WFD, 2000/60/EC). In its turn, biota studies facilitate the detection of negative consequences of chemical exposure before becoming significant in terms of conservation or ecological impacts (Picado et al., 2007). In particular, ecosystem biomonitoring approaches have been based on the effects induced in benthic organisms, by the assessment of alterations at the community level (benthic community parameters), and more recently, on individual and cellular levels (physiological and biochemical markers), not only to assess the impacts of pollutants but also to investigate alterations derived from climate change, namely salinity shifts. Benthic community parameters such as abundance, biomass and species richness have been widely applied, especially in soft-bottom communities (e.g. Brenchley, 1981; Borja et al., 2000; Bergamino et al., 2009; Martins et al., 2013a,b) mainly due to their response to anthropogenic and natural stressors. Recently, Wu et al. (2016) evaluated the effects of long-term metal contamination on benthic community structure and demonstrated that few organisms were present in impacted sites (with extreme metal contamination). Also, Van Diggelen and Montagna (2016) studied the effect of two different salinity regimes (two estuarine ecosystems) on

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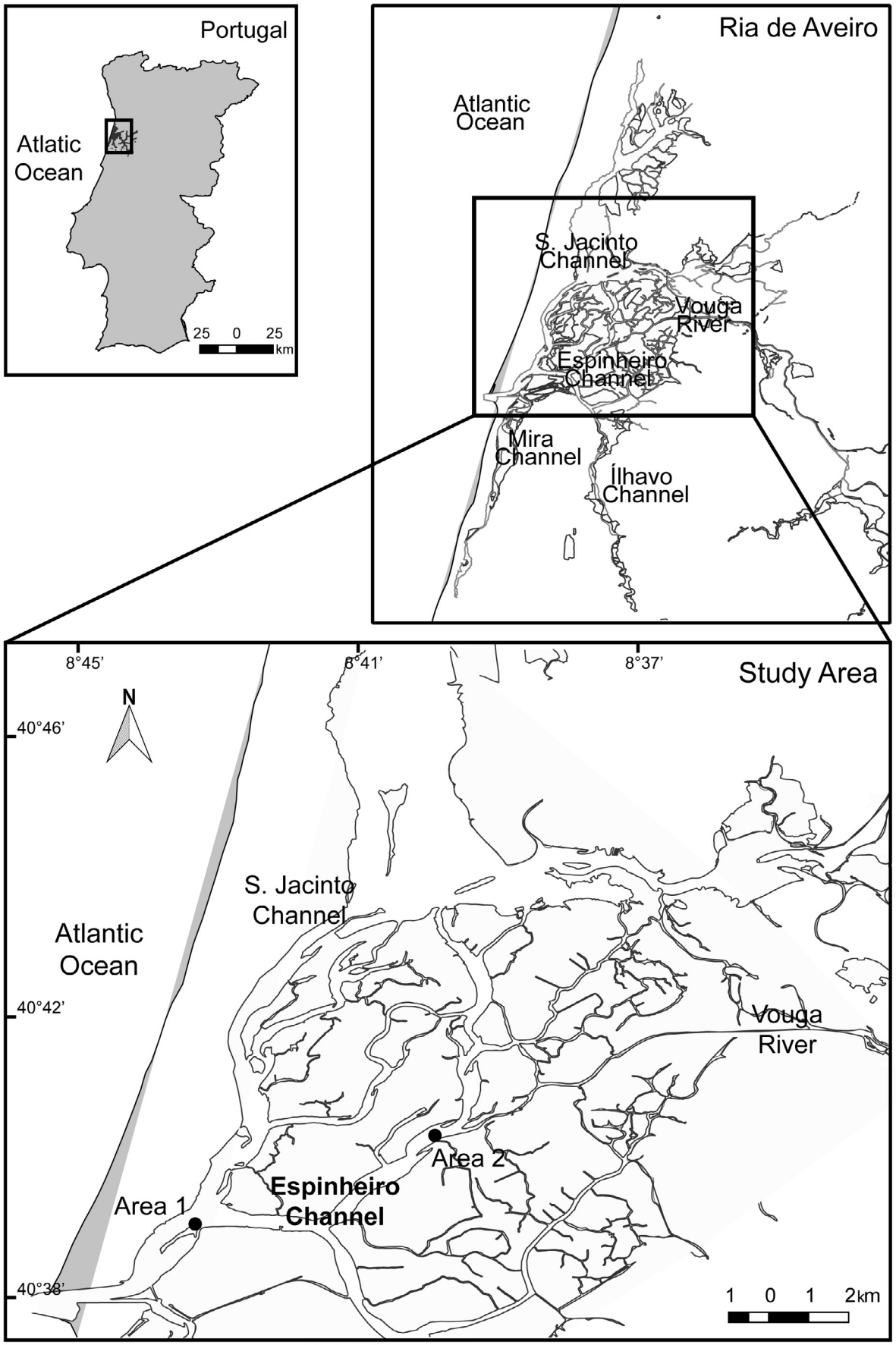


**Fig. 1.** The Ria de Aveiro (Northwest of Portugal) map showing the study areas (Area 1 and Area 2).