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Polycyclic aromatic hydrocarbons (PAHs) in transplanted Manila clams (*Tapes philippinarum*) from the Lagoon of Venice as assessed by PAHs/shell weight index: A preliminary study

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Abstract

Variation of polycyclic aromatic hydrocarbons (PAHs) levels was assessed in *Tapes philippinarum* from the Lagoon of Venice. Clams were transplanted from a polluted area next to Porto Marghera to two rearing areas of the Southern Lagoon. Analyses of PAHs were made in sediments and clams by GC/MS at first sampling and after 30, 60 and 180 days. Principal component analysis was performed to elucidate bioaccumulation and depuration pattern and input sources. Biota-Sediment-Accumulation-Factor (BSAF) was applied to evaluate the PAHs input sources from sediment. Condition index was calculated to compare the seasonal variation of clam tissue to PAHs levels. To propose results not affected by seasonal changes in flesh weight of clams, the approach based on the calculation of PAHs/SW index was applied. From the results, it was concluded that PAHs/SW index is more recommendable to asses temporal variation of PAHs levels in Manila clams.

Keywords: *Tapes philippinarum*; Polycyclic aromatic hydrocarbons; PAHs/shell weight index; Biota-Sediment-Accumulation-Factor; Sediments; Lagoon of Venice

1. Introduction

Among the ubiquitous organic xenobiotics in estuarine and marine environments are compounds termed polycyclic aromatic hydrocarbons (PAHs), which have become increasingly important because of their potential carcinogenicity, mutagenicity and teratogenicity to aquatic organisms and man. PAHs are a group of compounds consisting of hydrogen and carbon arranged in the form of two or more fused aromatic (benzene) rings in linear, angular or cluster arrangements with unsubstituted groups possibly attached to one or more rings (Kennish, 1997). Most PAHs released into the environment are due to both anthropogenic and natural source. Among anthropogenic factors, petrogenic and pyrolytic sources are the most important. Pyrolytic sources include combustion processes such as fossil fuel combustion and waste incineration, whereas PAHs introduced in the environment through contamination by petroleum products, such as oil spills, road construction materials and various refinery products, are considered as petrogenic inputs (Youngblood and Blumer, 1975). PAHs of petrogenic input are generally characterised by low-molecular weight (LMW) with up to four-rings, whereas compounds with high-molecular weight (HMW), containing four, five and six rings, are considered from pyrolytic input. The LMW PAHs are acutely toxic, but no carcinogenic to a broad spectrum of marine organisms, while the HMW compounds are less toxic but have greater carcinogenic potential (Neff, 1979; Kennish, 1997).

The Lagoon of Venice (Northern Adriatic Sea, Italy) (Fig. 1) is a transitional environment suffering from industrial and urban impact. Porto Marghera is a major oil port for Italy with an estimated 1000 ships entering the lagoon each year, of which approximately 60 are large crude oil

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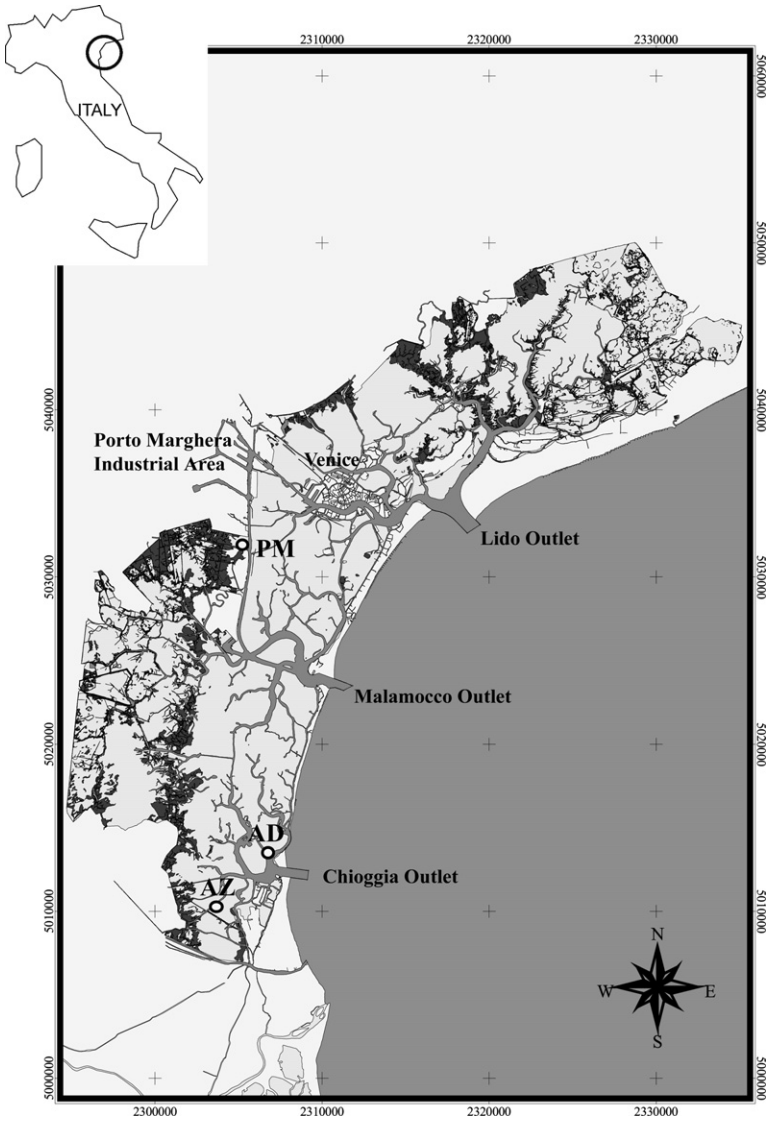

Fig. 1. Map of the Lagoon of Venice with the sampling sites PM, AD and AZ.

tankers (Wetzel and Van Vleet, 2004). Despite the increasing amounts of fossil fuels unloaded in the Porto Marghera industrial port, the main source of PAHs in this area is represented by combustion (Frignani et al., 2003; Secco et al., 2005). Because PAHs tend to accumulate in bottom sediments, benthic organisms may be continuously exposed to the contaminants, especially in the industrial area of Porto Marghera, receiving large pollutant loads. Bivalve molluscs are often used as sentinel organism for retaining PAHs compounds, since they rapidly accumulate and have little capacity for metabolizing them, due to lack of detoxification enzyme (Wade et al., 1989; Baussant et al., 2001). *Tapes philippinarum* is a suspension filter/deposit feeding benthic clam considered as an useful bioindicator of PAHs pollution, concentrating and tolerating high levels of these compounds in its tissues. It is sedentary, soft bottom dweller and widely distributed in Mediterranean and European waters and represents an important commercially and food source (Nasci et al., 2000; Byrne and O'Halloran, 2001, 2004; Pranovi et al., 2003). Filter feeding animals which efficiently filter particles from seawater could accumulate large amount of these contaminants in their body tissues through these particles. Accumulation of sediment-associated contaminants could occur either via the aqueous phase or through ingestion of contaminated sediment particles (Kukkonen and Landrum, 1995). The relative importance of these routes depends on the ecology and feeding behavior of the organism and the characteristics of the sediments and chemicals. Several studies showed that *T. philippinarum* appears to be a suitable indicator for sediment contamination monitoring (Nasci et al., 2000; Byrne and O'Halloran, 2001, 2004). Manila clams were imported in the Lagoon of Venice and particularly in the central part starting from the 1980s. Such presence became more and more intense as well as the rapid increase in harvesting after the first introduction (Secco et al., 2005;