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Heavy metal levels in crustaceans in Sinop shores of the southern Black Sea coast

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Crustacean species belonging to Isopoda, Amphipoda and Decapoda were collected using a van Veen grab from Sinop coast of the Black Sea, Turkey in 2015. Concentrations of Zn, Cu, Pb, Hg and Cd were determined in the total samples. The mean heavy metal levels followed order: Zn> Cu> Pb> Cd> Hg. . Zn was the highest heavy metal in Isopoda, Amphipoda and Decapoda species, while Hg was lowest. High Hg and Pb levels were found in Amphipoda. On the other hand high Cd and Zn levels were exist in Decapoda. Finally high Cu was in Isopoda. Pb, Cd and Hg levels in Crustacean species from Sinop coasts of the Black Sea were below the tolerable values.

Keywords: Heavy metals, Isopoda, Amphipoda, Decapoda, Black

Introduction

In the last few decades the Black Sea has suffered major changes induced by anthropogenic activities. Pollution and eutrophication process effected irreversible changes in the structure of the benthic species. Indeed human activities are no doubt the greatest driver of change in marine biodiversity at all levels of organization; thus, future trends will depend mostly on human-related impacts (Bat et al., 2018a).

In Turkish coasts the Black Sea shelf is only a narrow intermittent strip. Although the coastal area is free of hydrogen sulphide, concentrations increase rapidly under the thermocline owing to the restricted ventilation of deeper shelf water. Consequently, the number of macro-benthic species decreases rapidly with increasing depth. Communities of macro-benthos especially Crustaceans play an important role in the functioning of littoral and sublittoral zones ecosystem of the Black Sea. They are main food items for fish, the quality and productivity of which determine abundance of fish resources. They possess filtrating qualities, determining the course of the processes of biological purification and its intensity and the participation of the bottom fauna in the destruction and accumulation of organic substances. Heavy metals bind tendency to suspended particles material and bottom sediments of coastal waters (Bat et al., 2016). This have caused to the Black Sea to deteriorate especially benthic communities and sediment and eventually human health, through direct contact of organisms or re-suspension into the overlying water (Bat & Özkan, 2015).

The study area (Sinop Bay) is located at the central part of the southern Black Sea. The Bay is one of the most important natural harbours of the Black Sea and is characterized by high hydrodynamic conditions. Environmental parameters can significantly influence the diversity, density and structure of ecosystems. The significance of the use of bio-indicators to detect contaminants put forwarded by the Marine Strategy Framework Directive. Macro-benthic organisms are used as bio-indicators, because these species are more stable than planktonic organisms and they respond relatively rapidly to anthropogenic stress and contaminants especially heavy metals. Little studies are available on the heavy metal determination in Crustacea from the Black Sea coast of Turkey. In this

respect, the heavy metal concentrations have been measured Crustacean species belonging to Isopoda, Amphipoda and Decapoda from Sinop coast of the Black Sea, Turkey in 2015.

Material and Methods

Crustacea species were collected by van Veen grab from Sinop Peninsula in 2015 (Fig. 1). Isopoda, Amphipoda and Decapoda were selected due to the amount of biomass of specimen required for heavy metal analysis was sufficient. The most commonly found species belonging to Isopoda, Amphipoda and Decapoda were used for metal analysis. All species used for metal analysis were identified. These species are identified by Prof. Dr. Murat Sezgin.

The samples were dried in an oven at 100°C in 24 hours and weighted. All samples were stored deep frozen at -21°C until their analysis. Metal analyses were performed using m-AOAC 999.10- ICP/MS method by accredited Environment Industrial Analysis Laboratory Services Trade Company (TÜRKAK Test TS EN ISO IEC 17025 AB-0364-T). The method for determination of heavy metals, used acid, standard reference material, wet digestion was used by European Standard method with number EN 15763. Analytical quality control sample was routinely run through during the period of metal analysis. Standard solutions were prepared from stock solutions (Merck, multi-element standard). Certified Reference Material No: 414 trace elements in plankton (powder) were used for calibration. The results showed good agreement between certified and analytical values. Recovery rates were 97-105% (modified from Bat et al., 2016).

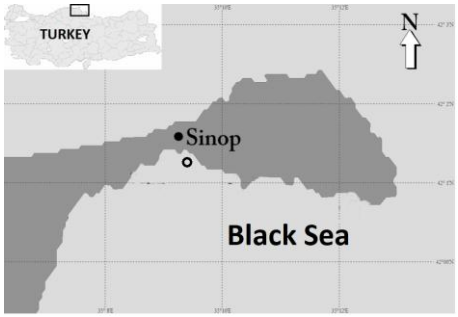

Figure 1. Map of the study area.

Results

The list of Isopoda, Amphipoda and Decapoda species were given in Table 1.

Table 1. List of Isopoda, Amphipoda and Decapoda species during this study.

Species
Isopoda
Idotea balthica (Pallas, 1772)
Sphaeroma serratum (Fabricius, 1787)
Synisoma capito (Rathke, 1837)
Amphipoda
Ampelisca pseudospinimana Bellan-Santini & Kaim-Malka, 1977
Atylus massiliensis Bellan-Santini, 1975
Dexamine spinosa (Montagu, 1813)
Gammarus insensibilis Stock 1966
Microdeutopus algicola Della Valle, 1893
Decapoda
Athanas nitescens (Leach, 1814)
Diogenes pugilator (Roux, 1829)
Upogebia pusilla (Petagna, 1792)

The mean heavy metal concentrations in Crustacean species of the current study are shown in Figs. 2-6. The extent of different heavy metals in Crustacea followed as, Zn> Cu> Pb> Cd> Hg. All metals in the currentt study in detectable amounts, showing some degree of heavy metal pollution in

the studied area. Zn was the highest heavy metal in Isopoda, Amphipoda and Decapoda species, while Hg was lowest. High Hg and Pb levels were found in Amphipoda. On the other hand high Cd and Zn levels were exist in Decapoda. Finally high Cu was in Isopoda.

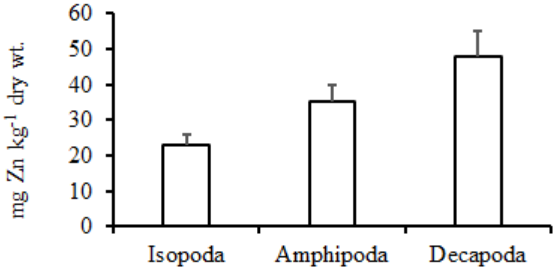

Figure 2. Mean levels and standard deviation of Zn (mg kg^{-1} dry wt.) in Isopoda, Amphipoda and Decapoda species from Sinop coast of the Black Sea, Turkey in 2015.

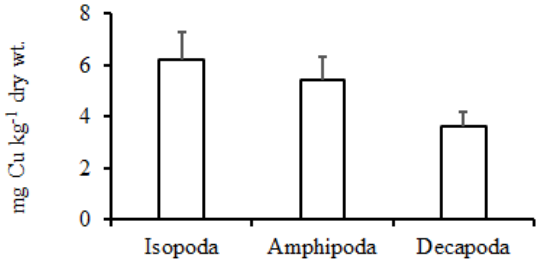

Figure 3. Mean levels and standard deviation of Cu (mg kg^{-1} dry wt.) in Isopoda, Amphipoda and Decapoda species from Sinop coast of the Black Sea, Turkey in 2015.

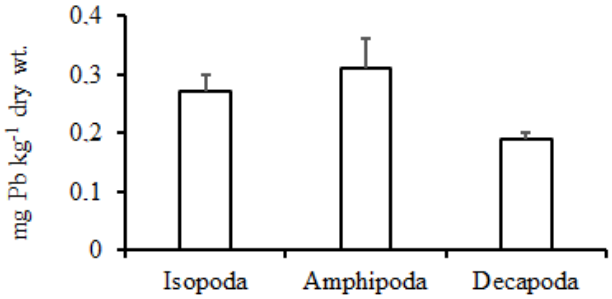

Figure 4. Mean levels and standard deviation of Pb (mg kg^{-1} dry wt.) in Isopoda, Amphipoda and Decapoda species from Sinop coast of the Black Sea, Turkey in 2015.

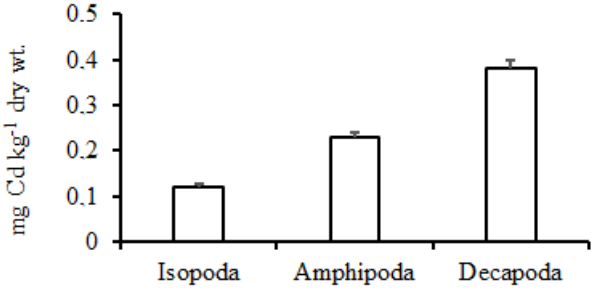

Figure 5. Mean levels and standard deviation of Cd (mg kg^{-1} dry wt.) in Isopoda, Amphipoda and Decapoda species from Sinop coast of the Black Sea, Turkey in 2015.

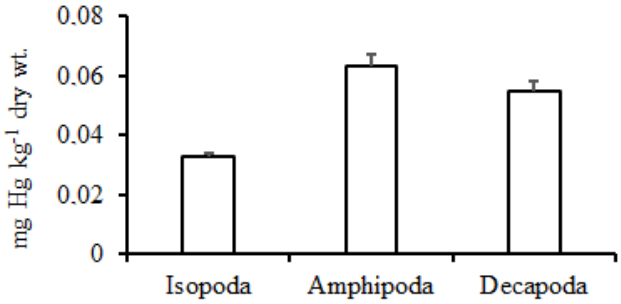

Figure 6. Mean levels and standard deviation of Hg (mg kg^{-1} dry wt.) in Isopoda, Amphipoda and Decapoda species from Sinop coast of the Black Sea, Turkey in 2015.

Discussion

Studies on heavy metals in Crustacean species have been performed for many years (Bat 2014; Bat & Arıcı, 2018). Meanwhile there is little information on heavy metal levels in Isopoda, Amphipoda and Decapoda species from Sinop coast of the Black Sea are exist (Bat & Öztürk, 1997; Bat et al., 2013; Bat et al., 2018b). Zn was the most common heavy metal in Isopoda, Amphipoda and Decapoda species, Cu was the other heavy metal commonly exists in the samples. Regarding Zn and Cu the reported patterns are in good agreement with the literature obtained in the current study. High accumulation of Zn in Crustacea may be due to co-precipitation of Zn with calcium carbonate (Rejomon et al. 2008). Many Cu ores are processed at the Black Sea coast of Turkey. The Zarbana River bed close to Etibank Küre mine and Zarbana river mouth placed at the Northern Anatolia are highly polluted with respect to heavy metals (Bat et al., 2018a). The tolerable values of Cu and Zn in the crustacea were 20 and 50 mg/kg wet wt., respectively (MAFF, 1995; TFC, 2002). In the current study showed that Cu and Zn levels in Crustecea from Sinop coasts of the Black Sea are acceptable values.

Isopoda, Amphipoda and Decapoda species from Sinop coasts of the Black Sea show non essential metals Pb; Cd and Hg concentrations in detectable levels. Robin et al. (2012) pointed out that salinity had a big role in the depletion of the dissolved Pb in the coastal water. If salinity decreased, the concentrations of dissolved Pb increased. Pb is also known to form colloids in coastal water, and such colloids would have adsorbed onto planktonic debris, which consequently might have resulted in higher concentration of the metals in Crustacea (Rejomon et al. 2008). Moreover, in point of the large surface-to-volume ratio of the organisms, it is accepted that differences in the levels taken up by adsorption-exchange may be greatly responsible for the observed variations of the metals (Martin, 1970). It may be true for the Black Sea (Bat et al., 2016).

The amounts of these heavy metals in organisms from the Black Sea may be due to industrial and domestic effluents into the harbor and its passage to the coastal areas, together with land based sourses from rivers (Altaş and Büyükgüngör, 2007; Bat et al., 2018a). It is indicated that absorption of dissolved Cd by algae and dilution of particulate Cd by high loads of organic matter originating in the process of primary production and resulted in Cd depletion in marine organisms (Pempkowiak et al. 2006). Human activities in Sinop coasts of the Black Sea region were food manufacturing such slaughtering, dairy products, canning of fruits/vegetables/fish, grain mill and bakery products, sugar factories, etc. (Bakan and Büyükgüngör, 2000). It is indicated that Sinop coasts were affected with intensive land-based pollution and organic matter originating from domestic discharge (Bat & Gökkurt Baki, 2014). Although some metal levels were found high in biota of the Black Sea coast, Turkey, the amounts of the heavy metal were not high in Sinop coast and did not present a serious problem (Bat, 2014 and 2017; Bat and Arıcı, 2018).

Moreover the tolerable value of Pb, Cd and Hg in the Crustacea was 0.5 mg/kg wet wt. (EC, 2006; TFC, 2009). In this study Pb, Cd and Hg levels in Isopoda, Amphipoda and Decapoda species

from Sinop coasts of the Black Sea are below these values. However recent review (Bat & Arıcı, 2018) showed that potentiality of Crustacean species as bio-indicator is highly recommended.

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