

## **A PRIMARY STUDY ON THE BIOACCUMULATION OF METALS IN *STEREODERMA KIRSCHBERGI* (HELLER, 1868) FROM SINOP COASTS OF THE SOUTHERN BLACK SEA**

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**ABSTRACT:** The amounts of toxic metals (Pb, Hg and Cd) in tissues of *Stereoderma kirschbergi* in the Sinop coasts of the south of the Black Sea were measured for the first time. Toxic metal analyses were made by the Inductively Coupled Plasma - Mass Spectrometer. The general tendency in all metal concentrations in both sediment and sea cucumber samples were Pb>Hg>Cd. The results demonstrated that the toxic metal concentrations in sediments were higher than organisms. Pb values in the sediment and sea cucumber were higher than Hg and Cd. The bio-sediment accumulation factors for Cd, Hg and Pb were lower than 1. *S. kirschbergi* is considered as a de-concentrator.

**KEYWORDS:** *Stereoderma kirschbergi*; Sinop coasts; Black Sea; toxic metals; bio - sediment accumulation factor

### **INTRODUCTION**

The Black Sea is a semi-enclosed sea and contaminant discharges of the many countries via major rivers have been ongoing for many decades. As results of agricultural activities, tourism and fishing activities, industrial activities and domestic wastes on their coasts cause pollution in the Black Sea (Bat *et al.*, 2018). The coastal environments of the Black Sea are at great risk for various contaminants. Metals are among the most important of these contaminants. The harmful effects of metals to marine biota are well known. When metals reach the seas, they eventually sink to the bottom (Bat and Özkan, 2019), and their harmful effects are much more to benthic organisms (Bat and Arici, 2018). One of these organisms is sea cucumber species. Therefore, many sea cucumber species are used in metal pollution monitoring studies. Sea cucumbers can accumulate metals from their environment (Ahmed *et al.*, 2018; Ahmed *et al.*, 2019; Ahmed and Bat, 2020).

In the current study, toxic metal levels namely Pb, Hg and Cd were determined for the first time in *Stereoderma kirschbergi* collected from the Sinop shores of the Black Sea. *S. kirschbergi* is widely distributed in the Atlantic Ocean, the Mediterranean Sea, and the Black Sea (Panning, 1949). This species had been only known in the Romania, Russia and Ukraine coasts of the Black Sea, however its occurrence on the Sinop coasts of the southern Black Sea comprised the first record for the holothurid fauna of the Turkish Black Sea coast (Sezgin *et al.*, 2007). Panning (1949) indicated that the typical habitat of *S. kirschbergi* is mainly among the algae or mussel beds.

## MATERIALS AND METHOD

Samples of surficial sediments and available species of the holothuroid samples collected by SCUBA diving from Sinop shores of the southern Black Sea at a depth of 30-40 m in 2016 (Fig. 1). There are fishing and touristic activities with living houses on the shoreline. Panning (1949) pointed out that the body of *Stereoderma kirschbergi* is up to about 1.7 cm long and pinkish red (Fig. 2). After collection animals were kept in clean seawater for 24 hours to dehydrate. Then each specimen was carefully rinsed with distilled water to away any material and other external adherent. All samples were frozen at 21°C till metal analysis. Sediment sampling was performed with sediment corer from the bottom. The core samples obtained was 10 centimeters in length with a diameter of 4 cm. Sediment samples were separately put in plastic bags and stored at 5°C till further analysis.

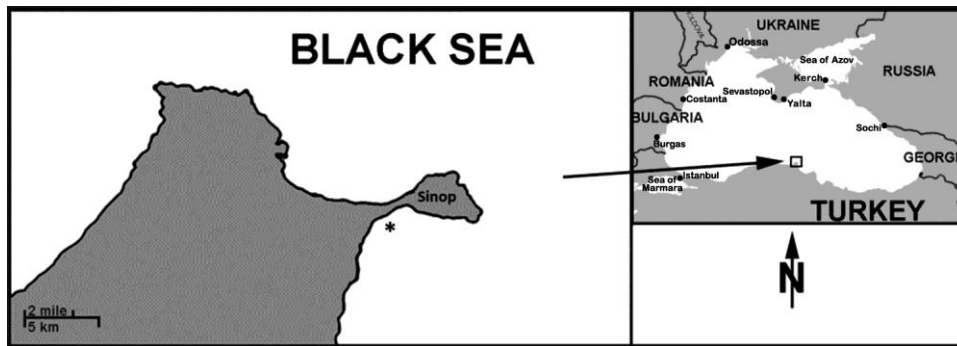


Fig. 1. Samples collection area.

*Stereoderma kerschbergi* analysis: Metal analysis of the animal samples were performed using m- AOAC 999, 10 - ICP/MS method by accredited Environment Industrial Analysis Laboratory Services Trade Company (TURKAK Test TS EN ISO IEC 17025 AB-0364-T). European Standard EN 15763 methods were used.

Sediment analysis: Metals except Hg in all subsampling pulverized to 85% passing 200 mesh was performed using 4 acid digestion and ultra-trace ICP-MS method by accredited ACME Analytical Laboratories Ltd. (Vancouver, Canada). For Hg analysis Ultra-trace Aqua Regia digestion method was used by accredited ACME Analytical Laboratories.

During the course of the experiences the blanks were performed with the reagents used, in order to check for possible contamination. The data obtained were statistically analysed for confirmation of the results. The results were expressed in weight.

### Statistical Analysis:

Results were analysed using the one-way analysis of variance (ANOVA) and group means were compared using Duncan's multiple range test and p values < 0.05 were considered significant. The bio-sediment accumulation factors (BSAF) for Cd, Hg and Pb were performed to know the efficiency of *Stereoderma kerschbergi* to accumulate heavy

metal from sediment and were calculated as overall mean heavy metal levels in the sea cucumbers / overall mean heavy metal levels in sediment.

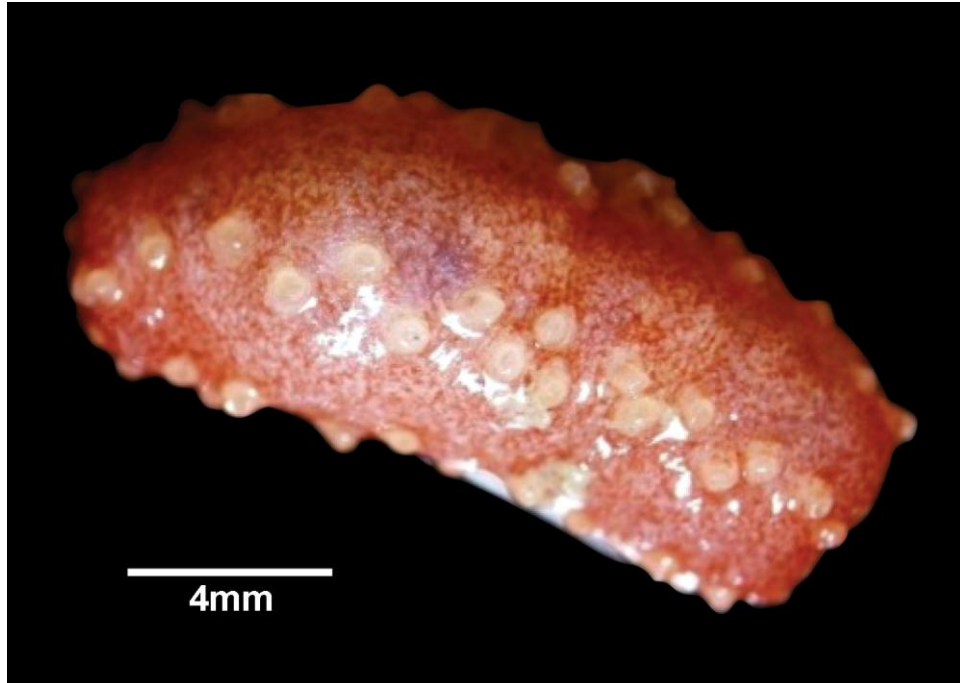


Fig. 2. *Stereoderma kerschbergi* (Heller, 1868) (from Sezgin *et al.*, 2007).

## RESULTS AND DISCUSSION

The concentrations of the toxic metals in the sediment and sea cucumber are given in Figures 3, 4 and 5. The results showed that the toxic metal concentrations in sediments were higher than those in organisms. Pb values in the sediment and sea cucumber were higher than Hg and Cd.

The result of the study has shown that sea cucumber *Stereoderma kerschbergi* is not suitable organism as bio-indicator. Aydin (2013) observed that sea cucumbers swallow sand and mud. It is known that metals are especially bound to organic substances and are found higher in muds. However, Cd, Hg and Pb values were low in *Stereoderma kerschbergi*. This shows that this species somehow does not accumulate in its body or does not absorb toxic metals in sediment or this sea cucumber appeared to regulate its toxic metal levels or can remove these metals without accumulating them from its body. In addition, since the amount of toxic metals in Sinop coasts is already low, sea cucumbers are not in contact with metals, so low levels of metals were found in their bodies. Biological properties in organisms and environmental factors can affect the relative metal uptake and excretion rates.

Sediment quality guideline values (SQGV) are very useful tools to protect and evaluation marine environment from hazard effects. The results of the current study

compared to the recommended SQGV (Simpson and Batley, 2016). The amounts of the toxic metals were quite lower than the levels indicated the sediment quality. SQGV and SQGV-high (upper sediment quality guideline value) for Hg, Cd and Pb are 0.15-1.0, 1.5-10 and 50-220 mg/kg dry wt., respectively (Simpson and Batley, 2016).

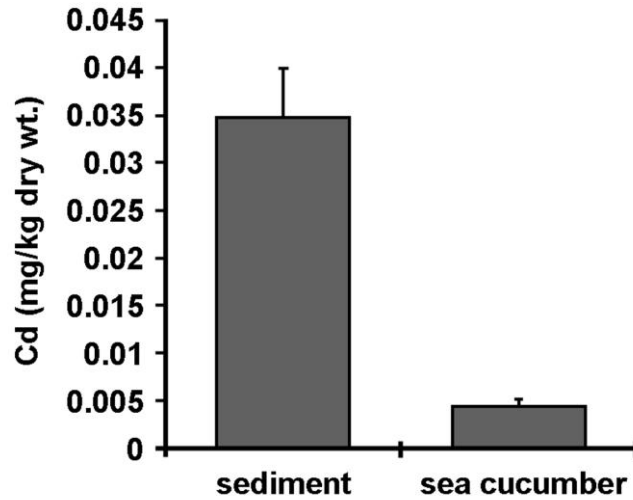


Fig. 3. The means with standard deviations (vertical line) of Cd levels in sediment and in *Stereoderma kerschbergi* from Sinop shores of the Black Sea.

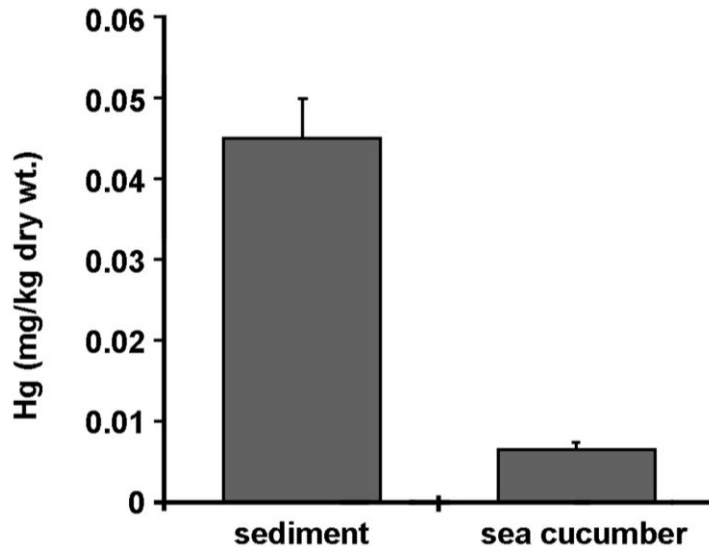


Fig. 4. The means with standard deviations (vertical line) of Hg levels in sediment and in *Stereoderma kerschbergi* from Sinop shores of the Black Sea.

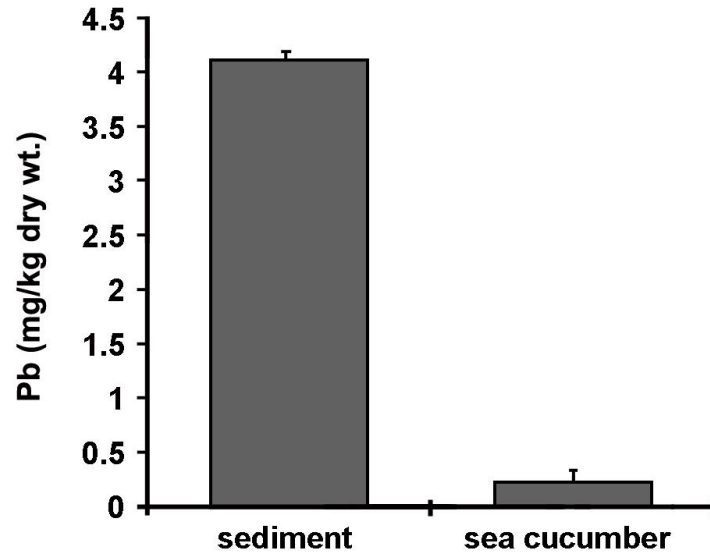


Fig. 5. The means with standard deviations (vertical line) of Pb levels in sediment and in *Stereoderma kerschbergi* from Sinop shores of the Black Sea.

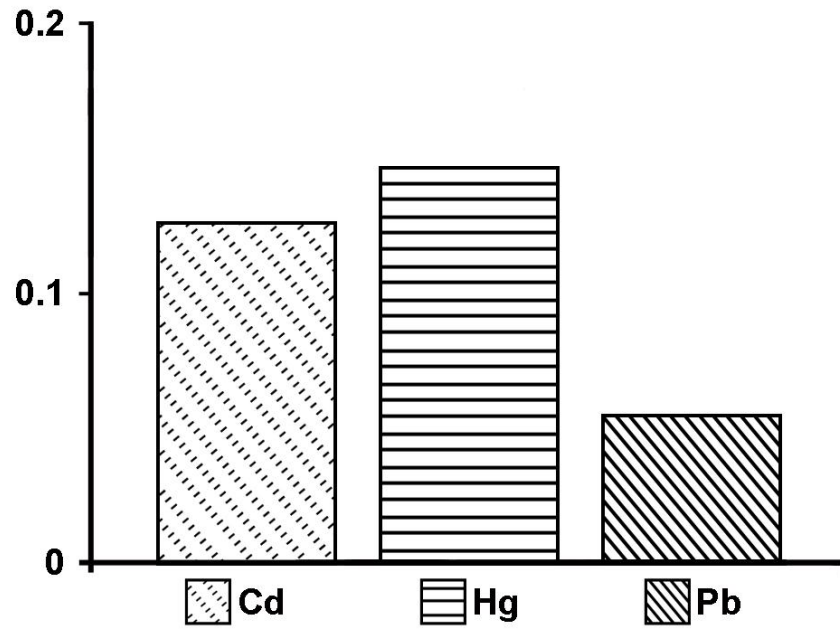


Fig. 6. The bio-sediment accumulation factor (BSAF) in *Stereoderma kerschbergi*

Hg had the highest BSAF mean followed by Cd and Pb showed the lowest BSAF values (Fig. 6). The BSAF is a parameter that assigns the bioaccumulation of sediment-bound Hg in tissues of the *Stereoderma kerschbergi*. BSAF was used to classify the sea cucumber species as a macro-concentrator (BSAF > 2), micro-concentrator (1 < BSAF < 2) or de-concentrator (BSAF < 1). Since the BSAF value is lower than 1, it is considered as a de-concentrator.

Ahmed and Bat (2020) showed that Hg was the highest accumulation rate in the skin tissue of *Holothuria leucospilota* with BSAF values ranging between 2 and 2.69 in Pakistan coasts of Arabian Sea; whereas the BSAF values in the muscles of *Holothuria leucospilota*, was between 1.44 and 1.63. Since the BSAF value was higher than 2 on the skin of *H. leucospilota*, it was considered as a macro-concentrator. However, the BSAF value varies between 1 and 2 in the muscle tissues, it has been determined as micro-concentrator (Ahmed and Bat, 2020).

In conclusion, even low toxic metal levels which occurred in Sinop shores of the southern Black Sea could be attributed to sewage and waste discharged from the city of Sinop and touristic and fishing activities. The results of the current study indicate that *Stereoderma kerschbergi* is not apt to accumulate these toxic metals at levels comparable to other species studied. Thus, it may not a suitable as bio-indicator organism. However, a more accurate conclusion can be made by analyzing different metals in the *Stereoderma kerschbergi* and studying samples from different regions.

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