THE SEASONAL ANALYSIS OF HEAVY METAL CONTENT IN SOFT TISSUES AND SHELL OF THE SPECIES MYTILASTER MARIONI (LOCARD, 1889), GATHERED FROM THE LAKE BAFA

Aykut Yozukmaz [1]*, Murat Yabanli [1], Idris Sener [1] and Murat Barlas [2]
[1] Mugla Sitki Kocman University Faculty of Fisheries Department of Hydrobiologhy - aykutyoz@gmail.com
[2] Mugla Sitki Kocman University Faculty of science

Abstract
The purpose of this study is to reveal the existence of elements Cu, Ni, Cr, Cd, and Pb in the shells and soft tissues of the species *Mytilaster marioni* (Locard, 1889) gathered seasonally from Lake Bafa. In this regard, after digestion of soft tissues and shells, heavy metal concentrations were determined with ICP-MS. The elements of Cu and Pb were found more in shells and Ni, Cr and Cd were found more in soft tissues. Pb and Cd amounts in soft tissues did not exceed the maximum residue limits specified for bivalve mollusks in EC 1881/2006.

Keywords: Metals, Aegean Sea, Bivalves, Brackish water, Bio-accumulation

Introduction
Lake Bafa is located on Dilek Peninsula National Park at 37 ° 29' N and 27 ° 28' E at 2 m above sea level. The lake has an area of 68.6 km^2, a catchment area of 315 km^2 and a maximum depth of 21m. It is one of the largest coastal lakes in Turkey. Bafa Lake is situated 30 km southeast from the delta of Büyük Menderes River. In the past six or so millennia, the river sediments have gradually in filled nearly the whole marine embayment of the so-called Latmian Gulf, thereby separating its southeastern part from the Aegean Sea (Mullenhoff et al. 2004). *Mytilaster* Monterosato (1884: 89) is a genus of the family *Mytilidae* composed of small species inhabiting mainly the Mediterranean and Black Sea basins. Species of *Mytilaster* are typical epibenthic forms, living attached with their byssus threads to a wide array of hard substrata. During field studies carried out in 1997 to determine the ecological characteristics of Bafa Lake, located in the south-western part of Turkey, *M.marioni* are observed in some regions of the lake and it was recorded for the first time from the coastal lakes of the Aegean Sea (Öztürk et al., 2002). As there is not any study on heavy metal accumulation within relevant species that has been encountered during literature review, the current study is significant for filling the gap within the literature. In the hatcheries around the Lake Bafa, larvae of saltwater fish (Gilthead seabream, *Sparus aurata* and European sea bass, *Dichentrachus labrax*) are produced. These larvae entered in Lake Bafa in various ways have formed a population in the lake, though they are not a local species. *M. marioni* is an important food source for these species. Therefore, it is worth researching transmission of heavy metals in this mussel species through food pyramid to upper levels.

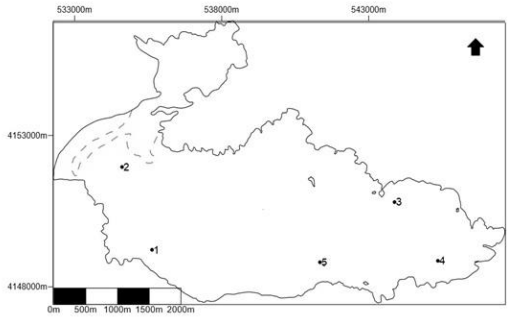

Fig. 1. Sampling site.

Material and Method
A total of 394 samples of the wild mussel *M. marioni* (Locard, 1889**)** with shell length of between 8-20 mm were collected from five different locations in the Bafa Lake in between December 2013-October 2014 (Fig. 1). The shells and soft tissues of the mussel samples were separated by dissection. After shells were pounded in a ceramic press and transformed into powder and after soft tissues were homogenized, they were digested according to the method of Licata et al., (2004). Inductively coupled plasma-mass spectroscopy (ICP-MS) was used to determine the concentrations of the elements. The results were given as mg kg^{-1}. Statistics were performed using SPSS software version 21.0. The data obtained by the values of studied elements were subjected to analysis of covariance (ANCOVA) followed by nonparametric correlation analyses based on the Spearman test.

Results and Discussions
The concentrations of five different heavy metals in mussel shells and soft tissues of 394 samples gathered in four seasons from Lake Bafa were determined (Table 1).

Tab. 1. Descriptive statistics of all results.

	Tissue	Mean	Minimum	Maximum	S.D.
Shell Length (mm)		1,340	0,700	2,400	0,223
Cr	S*	0,389	0,031	1,040	0,360
	ST**	1,985	0,259	6,746	1,657
Ni	S	1,115	UDL	6,626	1,682
	ST	4,038	0,334	17,506	4,365
Cu	S	5,524	1,646	15,376	4,363
	ST	5,168	1,922	12,903	2,693
Cd	S	0,072	0,008	0,231	0,070
	ST	0,278	0,119	0,925	0,177
Pb	S	2,433	0,558	7,105	2,145
	ST	1,418	0,286	3,415	0,830

***S:** Shell
****ST:** SoftTissue

According to the results, the concentrations of Cu (p= 0.0011), Pb (p= 0.0275) and Cd (p= 0.0001) in the shells showed significant difference seasonally (p<0.01). The length of shells with Cu concentration in shells and the length of shells with Pb concentrations in soft tissues showed strong negative correlation (r^2=-0.571 and r^2=-0.598 respectively) . The mean concentrations obtained from Pb and Cd did not exceed maximum residue limits [Pb (1.50 mg kg^{-1}) and Cd (1.0 mg kg^{-1})] which could be found in bivalve mollusks according to EC 1881/2006. Nonetheless, as heavy metals are transmitted to next level in food pyramid incrementally and heavy metal input into ecosystem shows constant change, it is important that these kinds of studies should be done in a continuous way.

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References
1 - European Union. Commission Regulation (EU) No 835/2011 of 19 August 2011 amending Regulation (EC) No 1881/2006 as regards maximum levels for heavymetals in shellfish. Off J Eur Union. L214:5.
2 - Licata, P., Trombetta, D., Cristani, M., Martino, D. and Naccari, F. (2004) Organochlorine compounds and heavy metals in the soft tissues of mussel Mytilus galloprovincialis collected from Lake Faro (Sicily, Italy). Environment International 30:805–810.
3 - Müllenhoff M, Handl M, Knipping M, Brückner H (2004) The evolution of Lake Bafa (Western Turkey)–Sedimentological, microfaunal and palynological results. Coastline Rep 1:55–66.
4 - Öztürk B, Poutiers JM, Sari HM, Özbek M (2002). On the occurrence of Mytilaster marioni (Locard, 1889) (Mollusca; Bivalvia; Mytilidae) in Bafa Lake (Turkey), with a redescription of the species. Hydrobiologia 485: 121–131.