

# RADIONUCLIDES IN MUSSELS FROM THE EASTERN ADRIATIC COAST, CROATIA – A CASE STUDY OF THE MEDITERRANEAN MUSSELWATCH PROGRAM

Delko Barišić<sup>1\*</sup> and Goran Kniewald<sup>2</sup>

<sup>1\*</sup> Laboratory for Radioecology, Center for Marine and Environmental Research, Rudjer Bošković Institute, Zagreb, Croatia - \* dbarisic@rudjer.irb.hr

<sup>2</sup> Laboratory for Physical Trace Chemistry, Center for Marine and Environmental Research, Rudjer Bošković Institute, Zagreb, Croatia

## Abstract

This communication reports first data from the monitoring of radionuclides in the mussel *Mytilus galloprovincialis* from croatian coastal waters, within the scope of the Mediterranean Mussel Watch program. Data from 2 sampling stations are given, from the Šibenik harbour in the Krka river estuary and from Kaštela bay near the city of Split, where elevated radionuclide activities were expected and found.

**Keywords:** Mediterranean Mussel Watch, radionuclides, Adriatic Sea

## Introduction

In 2002 the Commission Internationale pour l'Exploration Scientifique de la Mer Méditerranée (CIEM) launched a program called the *Mediterranean Mussel Watch* (MMW), thereby designing a regional program for detecting radionuclides and trace contaminants in "sentinel" organisms (1).

Considering the growing public concern as well as the institutional enforcement over marine environmental quality, the main objective of the MMW is to identify spatial and temporal trends through long-term monitoring at the regional scale. The first phase of the project requires the identification of existing baseline levels of certain key radionuclides in Mediterranean coastal waters, measured by the total body burden of filter feeder mollusks, preferably Mytilidae. A comprehensive technical scheme was formulated which focuses on monitoring strategy (indicator species, sampling sites, sampling frequencies, selection of calibrated individual organisms), sampling and treatment of samples, trace level radionuclide measurement, data management and reporting.

The chosen bio-indicator species is the mussel *Mytilus galloprovincialis*, with a geographic distribution recorded on all coasts of the Mediterranean basin.

The MMW has started with a limited number of sampling sites in each country. Existing information (and sources thereof) on previous investigation related to the monitoring of bivalves, other marine organisms and recent sediments on the eastern Adriatic Coast, Croatia, have been reported as background information to the project implementing agency – CIEM (2, 3).

Studies of radionuclides in marine bivalves from croatian waters have been comparatively few, and little data has been published in scientific literature. Some recent investigations, dealing with the distribution of radionuclides between mussels and associated sediments showed the following activities for some radionuclides in mussel tissue (wet weight) collected from several sites on Adriatic coast including the location where fly and bottom ash (residual after coal burning) was deposited: <sup>40</sup>K = 94-105 Bq/kg, <sup>232</sup>Th = 0.9-2.3 Bq/kg, <sup>137</sup>Cs = bdl - 1.2 Bq/kg, <sup>238</sup>U = 3-20 Bq/kg (unpublished internal data of Laboratory for radioecology).

## Sampling sites



For specific purposes of radionuclide monitoring in the mussel *Mytilus galloprovincialis* on the Croatian coast, two sampling stations were established where the identification of possibly elevated radionuclide concentrations due to specific activities might be expected. Station 1 (Fig. 1) is in the harbour of the city of Šibenik in the Krka river estuary. Station 2 (Fig. 1) is in Kaštela bay, north-east of the city of Split. Samples were taken in April 2003.

## Results

Table 1. gives data on mussels and the sampling environment. Radionuclide activities are given in Table 2.

**Table 1. a. Data on mussels and the sampling environment (Station 1 – Šibenik with sublocations). b. Data on mussels and the sampling environment (Station 2 – Split with sublocations)**

a)				
Description/location	Sv. Nikola	Šibenik bri.	Mandalina	Šibenik h.
Fresh sample weight (g)	2134	2662	2760	2035
Shell weight (g)	1057	1202	1331	1015
Fresh sample/shell ratio	<b>2.022</b>	<b>2.215</b>	<b>2.074</b>	<b>2.005</b>
Tissue and water (g)	745	828	1085	606
Lost sea-water (g)	332	632	244	414
Weight before drying (g)	701.3	788.3	1025.4	566.6
Dry weight (g)	188.0	94.8	206.5	61.6
Concentration factor	<b>3.730</b>	<b>8.315</b>	<b>4.967</b>	<b>9.198</b>
Salinity (o/oo)	29	26	19	18
Water temp.(°C)	13.4	13.0	13.6	13.1
Coastal zone	Limestone	Limestone	Limestone	Limestone

b)				
Description	Vranjic	Adriavinil	Marina	Stobre
Fresh sample weight (g)	3384	3453	4759	Not sampled
Shell weight (g)	1520	1544	1709	
Fresh sample/shell ratio	<b>2.2263</b>	<b>2.2364</b>	<b>2.7847</b>	
Tissue and water (g)	1062	742	1287	
Lost sea-water (g)	802	1165	1763	
Weight before drying (g)	1014.8	690.7	1235.6	
Dry weight (g)	141.1	97.4	220.0	
Concentration factor	<b>7.192</b>	<b>7.091</b>	<b>5.616</b>	
Salinity (o/oo)	25	35	39	
Water temp.(°C)	15.7	15.8	13.0	
Coastal zone	Flysch margin	Limestone	Limestone	

**Table 2. Radionuclide activity (Bq/kg dry weight) in shells tissue**

Location	<sup>40</sup> K	<sup>232</sup> Th	<sup>137</sup> Cs	<sup>226</sup> Ra	<sup>238</sup> U
Adriavinil	266.6 ± 12.2	1.27 ± 0.65	0.49 ± 0.19	8.06 ± 0.87	9.68 ± 3.62
Marina	239.5 ± 10.8	1.02 ± 0.55	0	1.48 ± 0.62	5.94 ± 2.85
Vranjic	251.1 ± 11.0	1.51 ± 0.62	0.26 ± 0.17	2.35 ± 0.64	3.67 ± 2.77
Stobreč	Not sampled				
Mandalina	330.1 ± 11.0	1.92 ± 0.6	0	3.84 ± 0.66	7.24 ± 3.06
Sv. Nikola	182.7 ± 8.4	0.63 ± 0.42	0	3.78 ± 0.54	5.33 ± 2.39
Šibenik h.	329.0 ± 15.9	1.11 ± 0.84	0	5.94 ± 1.09	13.39 ± 4.79
Šibenik br.	215.1 ± 10.4	0.85 ± 0.53	0	2.25 ± 0.64	2.65 ± 2.60

**Acknowledgements.** The authors thank the Ministry of Science and Technology of the Republic of Croatia for financial support of partial studies which have resulted in the present communication. Authors also thank CIEM for inviting the Center for Marine and Environmental Research of the Rudjer Boskovic Institute, Zagreb, Croatia, to join the efforts of the MMW project.

## References

- 1 - CIEM, 2002. Mediterranean Mussel Watch – designing a regional program for detecting radionuclides and trace-contaminants. Briand, F. (ed.) *CIEM Workshop Series No. 15, 136 pages, Monaco.*
- 2 - Kniewald, G., and Barišić, D., 2002. Investigations related to the monitoring of bivalves and other marine organisms on the Eastern Adriatic Coast (Croatia). Pp. 77-78. In: Briand, F. (ed.) *CIEM Workshop Series No. 15, 136 pages, Monaco.*
- 3 - Barišić, D., Vertačnik, A., Lulić, S., Mihelčić, G., Sondi, I., Juračić, M., Prohić, E. and Crmarić, R., 1998. Natural radionuclides in recent marine sediments of the Adriatic Sea. *Rapp. Comm. int. Mer Médit.* 35: 228-229.