Journal of Environmental Radioactivity 102 (2011) 713–717

Contents lists available at ScienceDirect

Journal of Environmental Radioactivity

journal homepage: www.elsevier.com/locate/jenvrad

Short communication

Determination of concentration factors for Cs-137 and Ra-226 in the mullet species *Chelon labrosus* (Mugilidae) from the South Adriatic Sea

Ivanka Antovic [a], Nevenka M. Antovic [b,*]

[a] Department for Biochemical and Medical Sciences, State University of Novi Pazar, Vuka Karadzica bb, 36 300 Novi Pazar, Serbia
[b] Faculty of Natural Sciences and Mathematics, University of Montenegro, Dzordza Vasingtona bb, 20 000 Podgorica, Montenegro

ARTICLE INFO

Article history:
Received 4 June 2010
Received in revised form
24 March 2011
Accepted 5 April 2011
Available online 22 April 2011

Keywords:
C. labrosus
Cs-137
Ra-226
Concentration factors

ABSTRACT

Concentration factors for Cs-137 and Ra-226 transfer from seawater, and dried sediment or mud with detritus, have been determined for whole, fresh weight, *Chelon labrosus* individuals and selected organs. Cesium was detected in 5 of 22 fish individuals, and its activity ranged from 1.0 to 1.6 Bq kg^{-1}. Radium was detected in all fish, and ranged from 0.4 to 2.1 Bq kg^{-1}, with an arithmetic mean of 1.0 Bq kg^{-1}. In regards to fish organs, cesium activity concentration was highest in muscles (maximum – 3.7 Bq kg^{-1}), while radium was highest in skeletons (maximum – 25 Bq kg^{-1}). Among cesium concentration factors, those for muscles were the highest (from seawater – an average of 47, from sediment – an average of 3.3, from mud with detritus – an average of 0.8). Radium concentration factors were the highest for skeleton (from seawater – an average of 130, from sediment – an average of 1.8, from mud with detritus – an average of 1.5). Additionally, annual intake of cesium and radium by human adults consuming muscles of this fish species has been estimated to provide, in aggregate, an effective dose of about 4.1 μSv y^{-1}.

© 2011 Elsevier Ltd. All rights reserved.

1. Introduction

Radiocontamination in fish is usually analyzed to estimate doses to fish consumers, for which the radionuclide contents in the edible parts of fish are needed. Radionuclide transfer to fish tissues is also important for understanding isotope dynamics in the aquatic environment.

Cesium-137 and ^{226}Ra have been already measured by other researchers in different marine environments, as well as in some fish species (for example, Alam et al., 1995; Pyle and Clulow, 1997; Clulow et al., 1998). Concentration factors (CFs) for transfer of cesium and radium from water to fish were also determined (Porntepkasemsan and Nevissi, 1990; Hameed et al., 1997; etc.), and showed a considerable ability for fish to accumulate some radionuclides from water even when they were present in very small concentrations. However, ^{137}Cs and ^{226}Ra uptake, distribution and bioaccumulation in different fish species are not well known.

These radionuclides, ^{137}Cs (a fission product with a half-life of 30.1 y) and ^{226}Ra (naturally occurring, from the ^{238}U series, with a half-life of 1600 y) are radioecologically important because both of them are, or can be, significant contributors to dose rates.

In the light of possible radioecological significance, the present study investigated the distribution of these two radionuclides in some components of the South Adriatic Sea (Boka Kotorska Bay – Coast of Montenegro) ecosystem, for which no data are available. Therefore, the mullet species *Chelon labrosus* Risso 1826 (Mugilidae) has been analyzed, together with seawater, surface sediment, and mud with detritus. This fish species, generally distributed in the Black Sea, Mediterranean and eastern Atlantic, is consumed by the local population in Montenegro, and it is one of six mullet species that occur in the South Adriatic Sea.

Cesium-137 and ^{226}Ra activity measurements have been performed on whole *C. labrosus* individuals, and some organs (gills, gastrointestinal system, fins, muscle and skeleton).

Moreover, ^{137}Cs and ^{226}Ra activity concentrations in fish muscle were used to calculate an effective dose provided by annual intake of ^{137}Cs and ^{226}Ra by human consumers of this fish species.

2. Materials and methods

2.1. Sampling and sample preparation

Fish material was collected in the South Adriatic Sea (area of Kotor – in the Boka Kotorska Bay), using the trawl net. Sampling locations are shown in Fig. 1 by circles.

* Corresponding author. Tel.: +382 20 266 150; fax: +382 20 244 608.
E-mail address: nenaa@rc.pmf.ac.me (N.M. Antovic).

0265-931X/$ – see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.jenvrad.2011.04.006

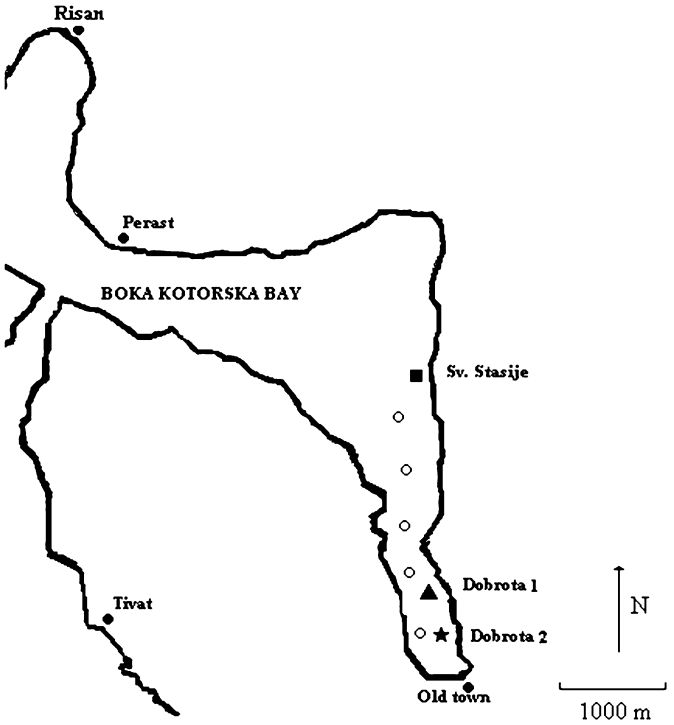

Fig. 1. Sampling locations: Circle – Fish sampling; Square – Seawater, sediment and mud with detritus sampling in Sveti Stasije; Triangle – Seawater, sediment and mud with detritus sampling in Dobrota 1; Star – Seawater, sediment and mud with detritus sampling in Dobrota 2. N – North.

Twenty-two individuals of *C. labrosus* were selected on the basis of taxonomic characteristics (Thomson, 1966). After washing and removing any dirt, four samples (1, 2, 3 and 4) were weighed (wet wt are given in Table 1), placed in plastic vessels and measured (without any preparation or sealed storage to minimise emanation of the radium progeny ^{222}Rn) to determine ^{137}Cs activity. Then, these samples were dissected. The organs – gills, fins, muscle, gastrointestinal system (which contains *oesophagus*, gaster, pyloric caeca, liver, pancreas, gall bladder and intestine) and skeleton were selected, freshly ground (i.e., homogenized), weighed and placed in the 50 mL and 250 mL cylindrical beakers. Distilled water was added to several samples. In the 50 mL beakers (height: 8 cm, diameter: 4 cm) samples had height of 5 cm, while in the 250 mL beakers (height: 13 cm, diameter: 6 cm) – 8 cm. The beakers were hermetically sealed for 38 days before measurement. With reference to the detector described below, samples were placed in the center of the spectrometer-measuring chamber, on the lower detector, giving distances from the top detector of about 12.5 cm (50 mL beaker) and 9.5 cm (250 mL beaker), and from the lateral detectors of about 6.5 cm (50 mL beaker) and 5.5 cm (250 mL beaker).

The other eighteen fish samples (whole individuals, which included gut contents) were also (wet) weighed (Table 1) and hermetically sealed in plastic vessels.

Three samples of surface seawater were taken using boat and pails – from two locations in Dobrota (Dobrota 1 and Dobrota 2 – near by the Institute of Marine Biology and Faculty of Marine Studies – triangle and star in Fig. 1, with coordinates: N 42°26.150′, E 18°45.820′ and N 42°25.973′, E 18°45.988′, respectively) and one in the Sveti Stasije area (square in Fig. 1, coordinates: N 42°28.107′, E 18°45.547′), where the highest occurrence and relative abundance of *C. labrosus* had been previously registered. The samples (30 L each) were prepared in a standard procedure for γ-spectrometry (evaporation). In that way, 1 L samples were obtained, placed in Marinelli beakers and kept for more than 38 days before the analysis at airtight condition to allow secular equilibrium between radium and its daughters.

Surface sediment was sampled at the same three locations using sediment sampler (dredge), while mud with detritus was collected (by hand of diver) at the same general locations, but slightly closer to the coast. These samples were dried at room temperature before being weighed, hermetically sealed in 1 L Marinelli beakers for a minimum of 38 days and measured using the same method as in the case of the other samples.

2.2. Spectrometry

The activity of ^{137}Cs was determined by γ-spectrometry using the 662 keV γ-ray of its progeny ^{137}Ba. Radium-226 has a decay chain which contains eight daughter radionuclides. In γ-spectrometry, the 609 keV photopeak, which follows β^--decay of ^{214}Bi to ^{214}Po, is the most commonly used to estimate ^{226}Ra, assuming that ^{226}Ra is in radioactive equilibrium with its daughters, i.e., no losses via ^{222}Rn emanation.

Table 1
^{137}Cs and ^{226}Ra activity in whole individuals (wet wt) of the mullet species *C. labrosus* from the South Adriatic Sea

C. labrosus sample	Total length, cm	Wet wt, kg	^{137}Cs, Bq kg^{-1}	^{226}Ra, Bq kg^{-1}	Radium CF_1	Radium CF_2	Radium CF_3
1	40.2	0.480	0.97 ± 0.14	–	–	–	–
2	34.7	0.385	1.61 ± 0.28	–	–	–	–
3	32.6	0.290	1.51 ± 0.32	–	–	–	–
4	30.3	0.280	1.03 ± 0.35	–	–	–	–
5	29.7	0.240	–	0.75 ± 0.25	6.25	0.09	0.07
6	29.3	0.205	–	0.97 ± 0.29	8.08	0.12	0.09
7	26.5	0.145	–	1.58 ± 0.62	13.2	0.19	0.15
8	30.7	0.278	–	0.43 ± 0.11	3.58	0.05	0.04
9	30.4	0.238	–	0.96 ± 0.21	8.00	0.11	0.09
10	34	0.342	–	0.49 ± 0.14	4.08	0.06	0.05
11	28.5	0.238	–	1.13 ± 0.45	9.42	0.13	0.11
12	31.2	0.250	–	0.48 ± 0.08	4.00	0.06	0.05
13	31.5	0.251	–	1.47 ± 0.36	12.2	0.17	0.14
14	28.7	0.188	–	1.22 ± 0.32	10.2	0.15	0.12
15	35.7	0.438	–	1.01 ± 0.18	8.42	0.12	0.10
16	30	0.289	–	0.76 ± 0.21	6.33	0.09	0.07
17	32.8	0.321	–	0.75 ± 0.24	6.25	0.08	0.07
18	30.2	0.245	–	0.98 ± 0.24	8.16	0.12	0.09
19	29	0.230	–	1.00 ± 0.34	8.33	0.12	0.10
20	31.2	0.283	–	1.27 ± 0.21	10.6	0.15	0.12
21	33.4	0.323	1.00 ± 0.24	1.33 ± 0.22	11.1	0.16	0.13
22	31.4	0.258	–	2.05 ± 0.43	17.1	0.24	0.19

Download English Version:

https://daneshyari.com/en/article/1738660

Download Persian Version:

https://daneshyari.com/article/1738660

Daneshyari.com