Transfer Factors of Nuclides for Five Fish Species Inhabiting the Sea near the Younggwang Nuclear Power Plant

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1. Introduction

Transfer factor (TF) expressed as the concentration ratio between an organism and an environmental medium is a key parameter in evaluating radiation doses to wild lives. The IAEA is going to publish a handbook of the TF values of various radionuclides for a number of plant and animal species[1]. However, it is recommended that they be used in case there is no site-specific data. This is because TF values can vary considerably with wild-life species and environmental conditions. Therefore, it is necessary to urgently establish our own database of wild-life transfer factors for use in the wild-life dose assessment probably in the near future. In the present study, TF values of various radionuclides were investigated for several marine fish species living around the Younggwang NPP. It was done by measuring the concentrations of stable isotopes in fish and seawater samples[2].

2. Materials and Methods and Results

2.1 Sampling

In late September, fish and seawater samples were collected from three points in the sea within 10 km from the Younggwang NPP. Fig. 1 shows the sampling points. Fishing nets and Van Dorn water sampler were put at depths of several meters from a boat. The temperature, pH and salinity were measured on site for the seawater samples. About 300 ml aliquots of them were put into polyethylene bottles and treated with 0.3 ml concentrate HNO_3. The fish samples were measured for their fresh weights of the whole bodies and contained in plastic bags before carried to the laboratory.

2.2 Nuclide Analysis

Fish samples were freeze-dried and homogenized using a grinder. Aliquots (1−3 g) of the homogenized samples were changed into about 50 ml liquid samples as a result of chemical treatments. Sea water samples were filtered using a membrane filter (0.2 um in pore size). Measurements of nuclide concentrations were performed by means of the ICP-MS and ICP-AES in the KBSI (Korea Basic Science Institute). The results were reported as the means of triplicate measurements

3. Results and Discussions

3.1 Physicochemical Properties of Seawater

Table 1 shows the temperature, pH and salinity of the seawater. There was little difference in the pH and the salinity among the three sampling points but the temperature was higher at A than at B and C. The salinity was comparatively low because of geographical characteristics of the West Sea.

Table 1. Physicochemical Properties of Seawater

Points	Temperature (^{o}C)	pH	Salinity ($^{0}/_{00}$)
A	26.2	7.99	31
B	23.8	8.01	31
C	23.9	8.00	31

3.2 Nuclide Concentrations in Seawater

Table 2 presents the concentrations of several selected nuclides in the seawater. The concentration of Na was markedly higher than those of the other nuclides as is the case with normal seawater. Strontium (Sr) showed much higher concentrations than Cesium (Cs) as is generally found in soil.

Table 2. Concentrations of Some Nuclides in Seawater

Points	Concentration in seawater (mg L^{-1})			
	K	Na	Sr	Mn
A	2.8E+02	7.9E+03	4.7E+00	2.4E−02
B	3.1E+02	8.4E+03	5.3E+00	1.8E−02
C	3.0E+02	8.3E+03	5.2E+00	3.9E−02

(continued)

Points	Concentration in seawater (mg L^{-1})			
	Zn	Co	Cs	U
A	1.5E−02	4.9E−04	1.4E−04	2.7E−03
B	9.0E−03	4.3E−04	9.0E−05	2.6E−03
C	9.3E−03	6.3E−04	1.4E−04	2.6E−03

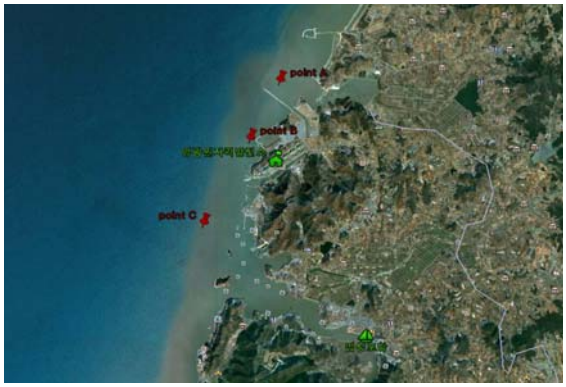

Fig. 1. Sampling points

3.3 Transfer Factors

TF values of a total of 21 nuclides were determined for five different fish species. The results are summarized in Table 3.

Table 3. TF Values of Nuclides for Marine Fish

Points	Species	TF values (L / kg-fresh)			
		K	Ca	Na	Mg
A	S1	1.2E+01	1.9E+01	1.0E−01	1.7E−01
	S2	1.7E+01	3.3E+01	1.2E−01	2.5E−01
	S3	7.4E+00	2.0E+01	8.8E−02	1.7E−01
B	S1	1.1E+01	2.1E+01	1.4E−01	1.6E−01
	S3	9.4E+00	2.0E+01	1.2E−01	1.8E−01
	S4	9.2E+00	1.6E+01	1.5E−01	1.4E−01
C	S4	8.0E+00	1.6E+01	1.0E−01	1.3E−01
	S5	1.4E+01	1.3E+01	1.1E−01	2.0E−01

(continued)

Points	Species	TF values (L / kg-fresh)			
		Al	Fe	Ti	Sr
A	S1	3.5E+02	2.1E+01	5.0E+01	3.7E+00
	S2	2.0E+03	9.8E+01	1.9E+02	1.4E+01
	S3	2.8E+02	2.3E+01	6.1E+01	3.2E+00
B	S1	9.9E+01	2.0E+01	2.2E+01	4.4E+00
	S3	1.7E+02	2.7E+01	3.9E+01	4.3E+00
	S4	1.5E+02	2.8E+01	2.5E+01	3.4E+00
C	S4	1.5E+01	7.2E+00	2.7E+00	3.9E+00
	S5	1.9E+01	1.1E+01	4.7E+00	2.1E+00

(continued)

Points	Species	TF values (L / kg-fresh)			
		Mn	Cr	Cu	Zn
A	S1	1.1E+02	4.1E+01	1.2E+02	5.3E+02
	S2	1.4E+02	1.3E+02	1.6E+02	6.9E+02
	S3	1.5E+02	2.7E+01	2.9E+02	1.0E+03
B	S1	1.0E+02	4.9E+01	1.5E+02	9.8E+02
	S3	1.8E+02	3.0E+01	3.2E+02	2.1E+03
	S4	1.2E+02	1.3E+02	1.5E+02	8.2E+02
C	S4	6.3E+01	4.7E+01	1.1E+02	8.7E+02
	S5	3.5E+01	4.3E+00	2.1E+02	1.1E+03

(continued)

Points	Species	TF values (L / kg-fresh)			
		Li	Ni	Co	Rb
A	S1	1.6E−01	8.4E+00	2.5E+01	7.1E+00
	S2	1.6E+00	3.9E+01	6.9E+01	1.6E+01
	S3	3.9E−01	5.2E+00	2.8E+01	3.1E+00
B	S1	2.5E−01	1.1E+01	2.8E+01	6.6E+00
	S3	6.4E−01	5.8E+00	3.4E+01	4.6E+00
	S4	1.8E−01	6.4E+01	3.0E+01	5.6E+00
C	S4	2.0E−01	7.9E+00	1.5E+01	5.1E+00
	S5	1.9E−01	9.8E−01	1.3E+01	6.0E+00

(continued)

Points	Species	TF values (L / kg-fresh)			
		Cs	Ba	Th	U
A	S1	9.0E+01	1.7E+01	4.4E+00	1.0E+00
	S2	2.0E+02	2.0E+02	3.5E+01	5.5E+00
	S3	7.7E+01	1.5E+01	2.7E+00	1.8E+00
B	S1	9.1E+01	1.2E+01	2.1E+00	4.1E−01
	S3	1.6E+02	1.3E+01	3.1E+00	1.5E+00
	S4	7.5E+01	3.2E+01	2.5E+00	6.8E−01
C	S4	4.4E+01	4.0E+01	3.4E−01	2.0E+00
	S5	9.7E+01	6.1E+00	7.5E−01	6.1E−01

Note) S1: Sciaenoid fish, S2: Flathead mullet, S3: Large-eyed herring, S4: Croaker, S5: Japanese mackerel.

TF values of Na and Mg were always lower than 1.0, whereas the opposite was true of most of the other nuclides including Sr, Mn, Zn, Co, Cs and Ba. In almost all the cases, Zn had the highest values. Variation in the TF value with the fish species was greatest in Al and Th, which showed two orders' variations.

3. Conclusions

TF values of 21 nuclides were measured for five fish species inhabiting the sea near the Younggwang NPP. They showed considerable variations with the nuclides and fish species. Determination of TF values needs to be extended to various kinds of domestic wild lives so as to establish an input data file for a Korean assessment model such as K-BIOTA[3].

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