Accumulation and retention of ^{137}Cs in selected marine biota from Turkish waters

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At present the question of radioactive pollution along the coast of Black Sea and Marmara Sea of Turkey is considered very important. Radioactivity levels in these seas have increased from the Chernobyl accident and other uncontrolled releases of certain radioactive waste materials (TOPCUOGLU *et al.*, 1990; GUVEN *et al.*, 1990). In addition, the Danube river and others flow into this sea system carrying contaminated waters from countries with large nuclear facilities.

The radionuclide ^{137}Cs has been the major contributor to contamination of the marine environment after the reactor accident at Chernobyl, and it is also the main long-lived component of radioactive fallout which has arisen from nuclear weapon tests. In addition, ^{137}Cs enters the marine environment from nuclear reactors. The Marmara and Black Sea have been likewise influenced to some degree by all these sources.

The macroalgae (*Enteromorpha linza*), polychaetes (*Nereis diversicolor*), isopods (*Idothea primastica*), brown shrimp (*Crangon crangon*) and fish (*Proterorhinus marmoratus* and *Syngnathus abaster*) were used in laboratory studies to assess the biokinetics of ^{137}Cs. The objectives of the studies were (1) to study the behaviour of ^{137}Cs in marine biota under varying environmental parameters, and (2) to obtain better bioindicator organisms for use in our monitoring studies.

The test organisms were obtained from the Kucukcekmece Lagoon (Brakish water) and Marmara Sea at Istanbul. Similar-sized animals and macroalgae were selected and acclimated to the laboratory conditions. ^{137}Cs uptake and loss in all samples was measured by using a multi-channel analyzer coupled to a well-type NaI (Tl) crystal. An internal ^{137}Cs reference standard was used to correct for the different geometries. The overall propagated counting error was generally less than 5% at the 1 level.

The data in Table 1 show that the macroalgae and fish species did not accumulate the radionuclide to any great degree and concentration factors were correspondingly low, ranging from 1 to 6. However, brown shrimp and isopods were found to have a much higher affinity for cesium (Table 1). The results also indicated that salinity and temperature differences did not play an important role in the bioaccumulation of ^{137}Cs from water.

The elimination of ^{137}Cs from contaminated fish was examined under different temperature regimes. The bioelimination kinetics were clearly biphasic and were influenced by temperatures between 6°C and 16°C. Furthermore, longer biological half-lives were obtained when compared to the other loss experiment with polychaetes.

Cesium concentration factors in the same range as those for macroalgae and fish (*Proterorhinus marmoratus*) have been determined previously for other similar species (GUTKNECHT, 1965; HEWETT and JEFFERIES, 1976). On the other hand, the steady-state ^{137}Cs concentration factors in the isopod and brown shrimp were higher than those which have been reported for similar marine invertebrates.

From the data obtained with isopods and brown shrimp, we conclude that these organisms would be useful bioindicators for monitoring these Turkish coastal waters.

Table 1. Parameters for the ^{137}Cs biokinetic experiments.

Organisms	Temp. (°C)	Salinity* Regime	CF	K (d^{-1})	$Tb_{1/2}$ (day)	Function
			Uptake Experiment			
Enteromorpha linza	6	Lagoon	6	0.15395	4.5	$CF=6(1-e^{-0.15395})$
Nereis diversicolor	16	Lagoon	11	0.11773	5.9	$CF=11\ (1-e^{-0.11773})$
Idothea primastica	16	Lagoon	32	0.4058	1.7	$CF=32(1-e^{-0.4058})$
	6	Lagoon	33	0.2057	3.4	$CF=33(1-e^{-0.2057})$
	16	Sea	22	0.1303	5.3	$CF=22(1-e^{-0.1303})$
Crangon crangon	16	Lagoon	30	0.22381	3.1	$CF=30(1-e^{-0.22381})$
Proterorhinus marmoratus	16	Lagoon	2	0.13696	5.1	$CF=2(1-e^{-0.13696})$
	6	Lagoon	1	0.10126	6.8	$CF=1(1-e^{-0.10126})$
	16	Sea	3	0.17086	4.1	$CF=3(1-e^{-0.17086})$
			Loss Experiment			
Nereis diversicolor	16	Lagoon		0.1267	5.5	Log y=1.960-0.055 X
Syngnathus abaster	16	Lagoon				
		Slow comp.		0.0065	107	Log y=1.865-0.003 X
		Fast comp.		0.4149	1.7	Log y=1.428-0.179 X
	6	Lagoon				
		Slow comp.		0.0044	157	Log y=1.932-0.002 X
		Fast comp.		0.2887	2.4	Log y=0.962-0.123 X

* Salinity was 21.5°‰ in sea water and 6‰ in lagoon water.

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