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Multi-compartment kinetic–allometric (MCKA) model of radionuclide bioaccumulation in marine fish

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Table S1 Parameters of the MCKA model for fish used to simulate the experiments (Mathews and Fisher, 2008; Mathews et al., 2008) on pulse-like feeding.

Fish	*m*, kg	λ_2 , d^{-1}	λ_3 , d^{-1}	λ_4 , d^{-1}	λ_5 , d^{-1}
Juvenile *Sparus auratus*	0.0001	7.5	0.07	0.01	0.275
Sparus auratus	0.012	2.3	0.021	0.003	0.083
Psetta maxima	0.027	1.85	0.017	0.0025	0.068
Scyliorhinus canicula	0.008	2.5	0.023	0.0033	0.092

Table S2. Transfer rate $k_{2,3}$ (d^{-1}) for radionuclides used to simulate the experiments (Mathews and Fisher, 2008; Mathews et al., 2008) on pulse-like feeding.

Fish	^{134}Cs	^{57}Co and ^{60}Co	^{54}Mn	^{65}Zn
Juvenile *Sparus auratus*	21.45	0.127	1.39	1.35
Sparus auratus	6.58	0.039	0.425	0.414
Psetta maxima	5.29	0.031	0.342	0.333
Scyliorhinus canicula	7.15	0.042	0.462	0.45

Table S3. Transfer rate $k_{2,4}$ (d^{-1}) for radionuclides used to simulate the experiments (Mathews and Fisher, 2008; Mathews et al., 2008) on pulse-like feeding.

Fish	^{134}Cs	^{57}Co and ^{60}Co	^{54}Mn	^{65}Zn
Juvenile *Sparus auratus*	0.3	0.0069	0.083	0.069
Sparus auratus	0.092	0.0021	0.025	0.021
Psetta maxima	0.074	0.0017	0.02	0.017
Scyliorhinus canicula	0.1	0.0023	0.028	0.023

Table S4. Transfer rate $k_{2,5}$ (d^{-1}) for radionuclides used to simulate the experiments (Mathews and Fisher, 2008; Mathews et al., 2008) on pulse-like feeding.

Fish	^{134}Cs	^{57}Co and ^{60}Co	^{54}Mn	^{65}Zn
Juvenile *Sparus auratus*	1.625	0.522	0.774	0.715
Sparus auratus	0.498	0.16	0.237	0.219
Psetta maxima	0.401	0.129	0.191	0.176
Scyliorhinus canicula	0.542	0.174	0.258	0.238

Table S5. Parameters of MCKA model for fish used to simulate the experiments (Mathews et al., 2008; Jeffree et al., 2006) on uptake of activity from sea water.

Fish	m, kg	λ_1, d^{-1}	λ_3 , d^{-1}	λ_4 , d^{-1}	λ_5 , d^{-1}
Juvenile *Sparus auratus*	0.0002	6727	0.058	0.0085	0.231
Psetta maxima	0.0061	2862	0.025	0.0036	0.098
Scyliorhinus canicula	0.0067	2796	0.024	0.0035	0.096

Table. S6 Transfer rate $k_{1,3}$ (d^{-1}) for radionuclides used to simulate the experiments (Mathews et al., 2008; Jeffree et al., 2006) on uptake of activity from sea water.

Fish	^{134}Cs	^{57}Co and ^{60}Co	^{54}Mn	^{65}Zn
Juvenile *Sparus auratus*	6.082	3.247	17.789	25.914
Psetta maxima	2.588	1.381	7.569	11.952
Scyliorhinus canicula	2.528	1.35	7.394	11.675

Table. S7 Transfer rate $k_{1,4}$ (d^{-1}) for radionuclides used to simulate the experiments (Mathews et al., 2008; Jeffree et al., 2006) on uptake of activity from sea water.

Fish	^{134}Cs	^{57}Co and ^{60}Co	^{54}Mn	^{65}Zn
Juvenile *Sparus auratus*	0.0851	0.175	1.064	1.33
Psetta maxima	0.0362	0.074	0.453	0.613
Scyliorhinus canicula	0.0353	0.072	0. 443	0.599

Table. S8 Transfer rate $k_{1,5}$ (d^{-1}) for radionuclides used to simulate the experiments (Mathews et al., 2008; Jeffree et al., 2006) on uptake of activity from sea water.

Fish	^{134}Cs	^{57}Co and ^{60}Co	^{54}Mn	^{65}Zn
Juvenile *Sparus auratus*	0.461	13.321	9.933	13.73
Psetta maxima	0.196	5.668	4.227	6.33
Scyliorhinus canicula	0.191	5.537	4.129	6.186

Table S9. Food preference P_{ij} for predator of type *i*, and prey of type *j*. (Bezhenar et al., 2016).

Predator Prey	2	3	4	6	7	8	9	10	11
0				0.5			0.1		
1	1.0				0.6	0.1			
2		1.0			0.2	0.8			
3			1.0						0.2
5				0.5	0.2	0.1			
6							0.7	0.3	0.25
7							0.1	0.2	0.1
8							0.1	0.2	0.2
9								0.3	0.25

Table S10. Main parameters of boxes around the Forsmark NPP

Box number	Volume, km^3	Depth, m	Area, km^2	Exchange rate with outer box, $km^3\ y^{-1}$
68	35.7	32.5	1100	3355*
"inner box"	3.0	12.5	240	140
"coastal box"	0.076	11.0	6.9	30

* total exchange rate with all neighbouring boxes

Table. S11 Parameters of the MCKA model for prey fish (*Clupea harengus membras*) and predator fish (*Esox lucius*, *Hexagrammos otakii*, *Triakis scyllium*, *Squatina japonica*, *Sebastes cheni*, *Lateolabrax japonicus*) in POSEIDON-R model applications.

fish	m, kg	K_f, kg/(kg d)	K_w, m^3/(kg d)	λ_3 , d^{-1}	λ_4 , d^{-1}	λ_5 , d^{-1}
Prey fish	0.2	0.018	0.12	0.011	0.0015	0.041
Predator fish	4	0.0085	0.057	0.005	0.0007	0.019

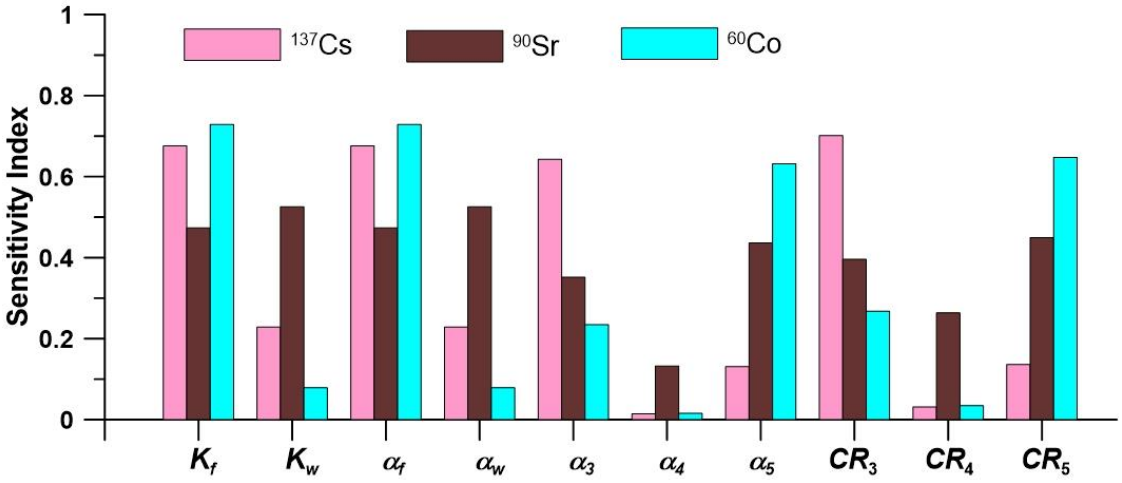

Fig.S1. Dependence of sensitivity index on model parameters for ^{137}Cs, ^{90}Sr and ^{60}Co.

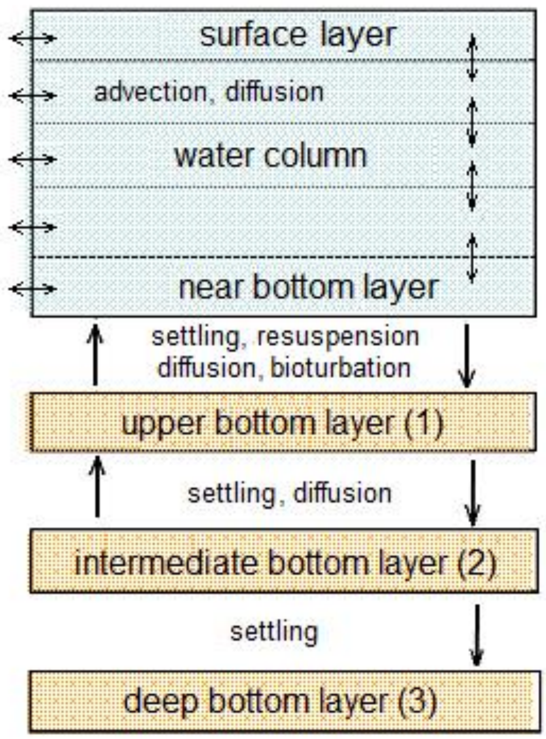

Fig.S2. Vertical structure and radionuclide transfer processes in the compartment model POSEIDON-R.

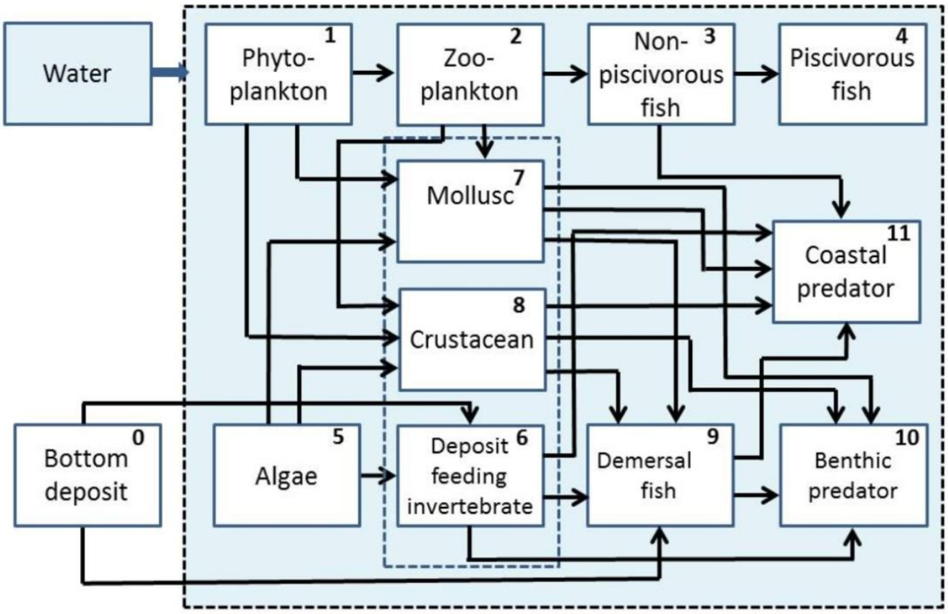

Fig. S3. Radionuclide transfer from the water and bottom sediment boxes to marine organisms (Bezhenar et al., 2016). The radionuclide transfers among marine food web compartments are given for 11 types of marine organisms.