

Contents

Contents.....	VII
1 History and methods	1
1.1 History of investigations	2
1.2 Methods.....	8
2 Sources and pathways of artificial radionuclides in northern seas	17
2.1 Primary sources of radioactive pollutants	18
2.1.1 Nuclear explosions.....	18
2.1.2 Sea Dumping.....	24
2.1.3 Large river supplies.....	26
2.1.4 Sea burial	30
2.1.5 Land discharges	33
2.1.6 Nuclear accidents at sea	36
2.2 Secondary sources	38
2.3 Transboundary transfer of radioactive substances.....	44
2.3.1 Water circulation within the Arctic Ocean.....	44
2.3.2 Deep-water troughs as pathways for shelf-ocean exchange.....	51
2.3.3 Transfer by ice drift - the Kara and Laptev Seas.....	56
2.3.4 Biological transfer mechanisms	58
3 The pelagic ecosystem	64
3.1 Patterns of radionuclide distribution.....	65
3.1.1 Baltic, North and Irish Seas	65
3.1.2 Norwegian, Barents and White Seas	76
3.1.3 Kara and Laptev Seas.....	84
3.1.4 North Atlantic and Central Polar Basins	89
3.2 Biofiltration of radionuclides	90
3.2.1 Ecological characteristics of plankton	90
3.2.2 Radionuclide accumulation by marine plankton	93
3.3 Radionuclides in pelagic ecosystems	96
4 The benthic zone	103
4.1 Patterns of radionuclide distribution.....	104
4.1.1 Barents Sea	104
4.1.2 West European and Black Seas.....	115
4.1.3 Kara Sea shelf.....	123
4.1.4 Laptev Sea	135
4.2 Sedimentation of radioactive substances on the shelf	137
4.3 Ecological characteristics of benthic organisms.....	144
4.4 Radionuclide accumulation by benthic organisms	146

VIII

4.5 Radionuclides in the ecosystem of the Murmansk Bank (site of the submarine “Kursk” accident)	156
5 The coastal zone.....	161
5.1 Biogeographical characteristics.....	162
5.2 Patterns of radionuclide distribution	164
5.2.1 Barents Sea coastal zone.....	167
5.2.2 Kola Bay	167
5.2.3 The White Sea.....	177
5.2.4 Pechora and Cheshskaya Bays.....	179
5.2.5 Bays of Novaya Zemlya	184
5.2.7 Sea of Azov	194
5.3 Contaminant classification of coastal sea areas.....	204
5.4. Artificial radioactivity in macrophytes.....	208
5.5 Filtration of anthropogenic radionuclides in coastal ecosystems	219
6 Marine vertebrates.....	224
6.1 Marine fish	225
6.2 Sea birds.....	245
6.3 Marine mammals.....	256
7 Transfer and assimilation of radionuclides in marine ecosystems.....	266
7.1 Natural purification of marine systems	267
7.1.1 Conditions of radionuclides assimilation.....	267
7.1.2 Geomorphological and hydrodynamic factors.....	271
7.1.3 Influence of the marginal filter	273
7.1.4 Significance of biological composition	275
7.1.5 Salinity and radionuclide transfer	277
7.1.6 Radionuclide sorption processes.....	281
8 Radioactive monitoring principles for marine ecosystems	284
8.1 Important considerations in radioecological monitoring.....	285
8.1.1 Marine sediments as an indicator of radioactive contamination ..	285
8.1.2 Secondary radiation contamination of the benthic zone	291
8.2. Role of bioindicators in radiological monitoring	292
8.3 Human radiological dose estimates for consumption of sea food	296
8.4 Modeling as a tool in radioecological monitoring.....	298
8.5 Withdrawal of commercial bioresources.....	307
8.6 Framework for monitoring in northern seas	308
Conclusion.....	311
References	316