

## **FY2012 Radioactive Material Monitoring of Aquatic Organisms (Winter Term)**

### 1. Survey Overview

Samples of aquatic organisms (aquatic insects, algae, crustaceans, shellfish, and fish, etc.) were collected mainly in Fukushima Prefecture and concentrations of radioactive cesium and radioactive strontium in the samples were measured (survey period: December 3, 2012, to January 18, 2013).

In order to clarify the environment of the water areas where aquatic organisms live, surveys were also conducted on general items concerning water and sediments (COD, TOC, SS, and turbidity, etc. for water samples and TOC, ignition loss, and grain size distribution, etc. for sediment samples) and activity concentrations in these water areas.

The following water areas were selected based on the results of the past Radioactive Material Monitoring of Aquatic Organisms and Radioactive Material Monitoring in the Water Environment in and around Fukushima Prefecture, as well as the results of the measurement of radioactive materials in fisheries products conducted by other relevant organizations and interviews with local fishermen.

(i) Rivers: Abukuma River, \*Uda River, Mano River, Niida River, and \*Ota River

(ii) Lakes: Lake Hayama, Lake Akimoto, Lake Inawashiro

(iii) Sea areas: Off the mouth of the Abukuma River, off Soma City, off Iwaki City

(\*: started in the autumn term of FY2012)

○ Survey locations and dates

Area	Targeted water areas	Zone	Item	Survey dates	Remarks	
River area	A	Shinfuna Bridge to the Inoentei Dam; Harase River (a tributary)	Aquatic organisms sampling	December 5, 2012	Fish, amphibians, aquatic insects, crustaceans, algae, litter	
			Water/sediment sampling	December 3, 2012	(Water sampling) A-1, A-2 (Sediment sampling) A-1, A-2	
	B	Abukuma River	Confluence with the Matsukawa River (a tributary) to Taisho Bridge; Sumikari River (a tributary)	Aquatic organisms sampling	December 6, and 14, 2012	Fish, amphibians, aquatic insects, shellfish, algae, litter
				Water/sediment sampling	December 3, 2012	(Water sampling) B-1—B-3 (Sediment sampling) B-1—B-3
	C	Uda River	Kawahira Bridge to Horita Bridge; Around Tamano Bridge	Aquatic organisms sampling	December 18, 2012	Fish, aquatic insects, crustaceans, litter
				Water/sediment sampling	December 4, 2012	(Water sampling) C-1—C-6 (Sediment sampling) C-1, C-2, C-4—C-6
	D	Mano River	Zemami Bridge to Ochiai Bridge	Aquatic organisms sampling	December 12, 13, 2012, and January 18 2013	Fish, amphibians, aquatic insects, algae, litter
				Water/sediment sampling	December 5, 2012	(Water sampling) D-1—D-5 (Sediment sampling) D-1—D-3, D-4a, D-5
	E	Nida River	Kashiwagi Bridge to Sugauchi Bridge	Aquatic organisms sampling	December 19, 2012	Fish, aquatic insects, crustaceans, litter
				Water/sediment sampling	December 6, 2012	(Water sampling) E-1—E-5 (Sediment sampling) E-1, E-2a, E-3—E-5
	F	Ota River	Yaeyoneita Bridge to Memezawa district	Aquatic organisms sampling	December 20, 2012	Fish, aquatic insects, litter
				Water/sediment sampling	December 7, 2012	(Water sampling) F-1—F-6 (Sediment sampling) F-1—F-5
G	Lake Hayama		Aquatic organisms sampling	December 10, 2012, and January 18, 2013	Fish, aquatic insects, algae, litter	
			Water/sediment sampling	December 10, 12, 2012	(Water sampling) G-1, G-3, G-5 (Sediment sampling) G-1—G-5	
Lake area	H	Lake Akimoto	Aquatic organisms sampling	December 4, 2012	Fish, crustaceans, algae, litter	
			Water/sediment sampling			
	I	Lake Inawashiro	North bank	Aquatic organisms sampling	December 4, 2012	(Water sampling) H-1, H-3, H-5 (Sediment sampling) H-1—H-5
				Water/sediment sampling	December 7, 2012	(Water sampling) I-1, I-3 (Sediment sampling) I-1—I-4
	J	Lake Inawashiro	South bank	Aquatic organisms sampling	December 7, 2012	Fish, amphibians, algae, shellfish
				Water/sediment sampling	December 7, 2012	(Water sampling) J-1 (Sediment sampling) J-1
Sea area	K	Off the Abukuma River Estuary	Sea area in front of the Abukuma River Estuary	Aquatic organisms sampling	December 11, 2012	Fish
				Water/sediment sampling	December 11, 2012	(Water sampling) K-2 (Sediment sampling) K-1—K-3
	L	Offshore of Soma City	Matsukawaura	Aquatic organisms sampling	December 10, 2012	Fish, crustaceans, shellfish, algae
				Water/sediment sampling	December 10, 2012	(Water sampling) L-2, L-3 (Sediment sampling) L-1—L-3
	M	Offshore of Iwaki City	Offshore of Hisanohama	Aquatic organisms sampling	December 14, and 24, 2012	Fish, echinoderm, shellfish, algae
				Water/sediment sampling	December 14, 2012	(Water sampling) M-2 (Sediment sampling) M-1—M-3

Note 1) “Litter” means coarse particulate organic matters (dead leaves, etc.)

Note 2) Surveys for the Uda River and Ota River were started in the autumn term of FY2012.

## 2. Survey Items and Locations, etc.

### 2.1 Survey Items

Targeted aquatic organisms, measurement items for water samples and sediment samples, and analyzed samples are as shown in the table below.

For all samples of aquatic organisms, analysis of Cs-134 and Cs-137 was conducted. Additionally, for samples of large fish higher on the food chain, crustaceans, and organisms with structure (shellfish, etc.), analysis of Sr-90 was also conducted.

The analysis of radioactive materials and general survey items was conducted with regard to water samples collected at the locations where aquatic organism samples were scheduled to be collected or other locations where clay particles and coarse particulate organic matters (CPOMs) are supposed to accumulate due to inflows from the surrounding environment, etc. (one to six locations in each water area for the analysis of radioactive cesium and general survey items, and one location in each water area for the analysis of radioactive strontium). In the same manner, the analysis of radioactive cesium and general survey items was conducted with regard to sediment samples collected at three to five locations in each water area, and the analysis of radioactive strontium was conducted with regard to samples collected at one location in each water area.

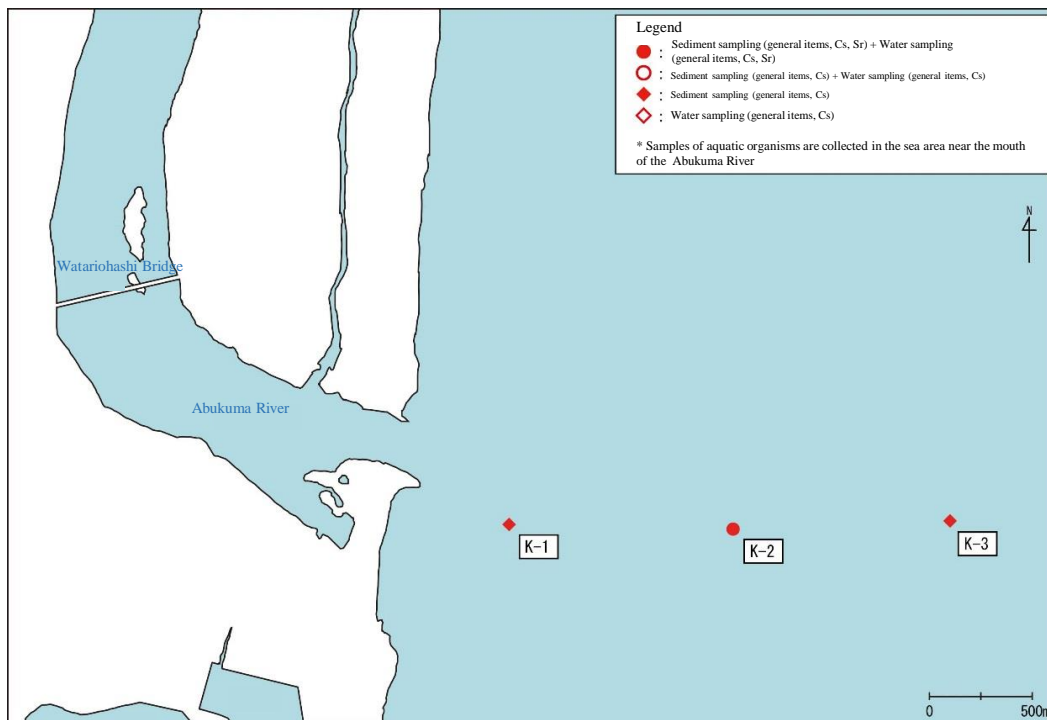
#### ○ Survey targets and items

Target	Measurement item		Analyzed samples
Aquatic Organisms	Radioactive materials	Radioactive cesium (Cs-134,Cs-137)	All samples
		Radioactive strontium (Sr-90)	Large fish, crustaceans, and shellfish, etc.
Water	Radioactive materials	Radioactive cesium (Cs-134,Cs-137)	Samples collected at one to six locations for each water area
		Radioactive strontium (Sr-90)	Samples collected at one location for each water area
	General items	pH	Samples collected at one to six locations for each water area
		BPD	
		COD	
		DO	
		Electrical conductivity	
		Salinity	
		TOC	
		SS	
Turbidity			
Sediments	Radioactive materials	Radioactive cesium (Cs-134,Cs-137)	Samples collected at three to five locations for each water area
		Radioactive strontium (Sr-90)	Samples collected at one location for each water area
	General items	pH	Samples collected at three to five locations for each water area
		Oxidation-reduction potential	
		Water content	
		TOC	
		Ignition loss	
		Soil particle density	
Grainsize distribution			

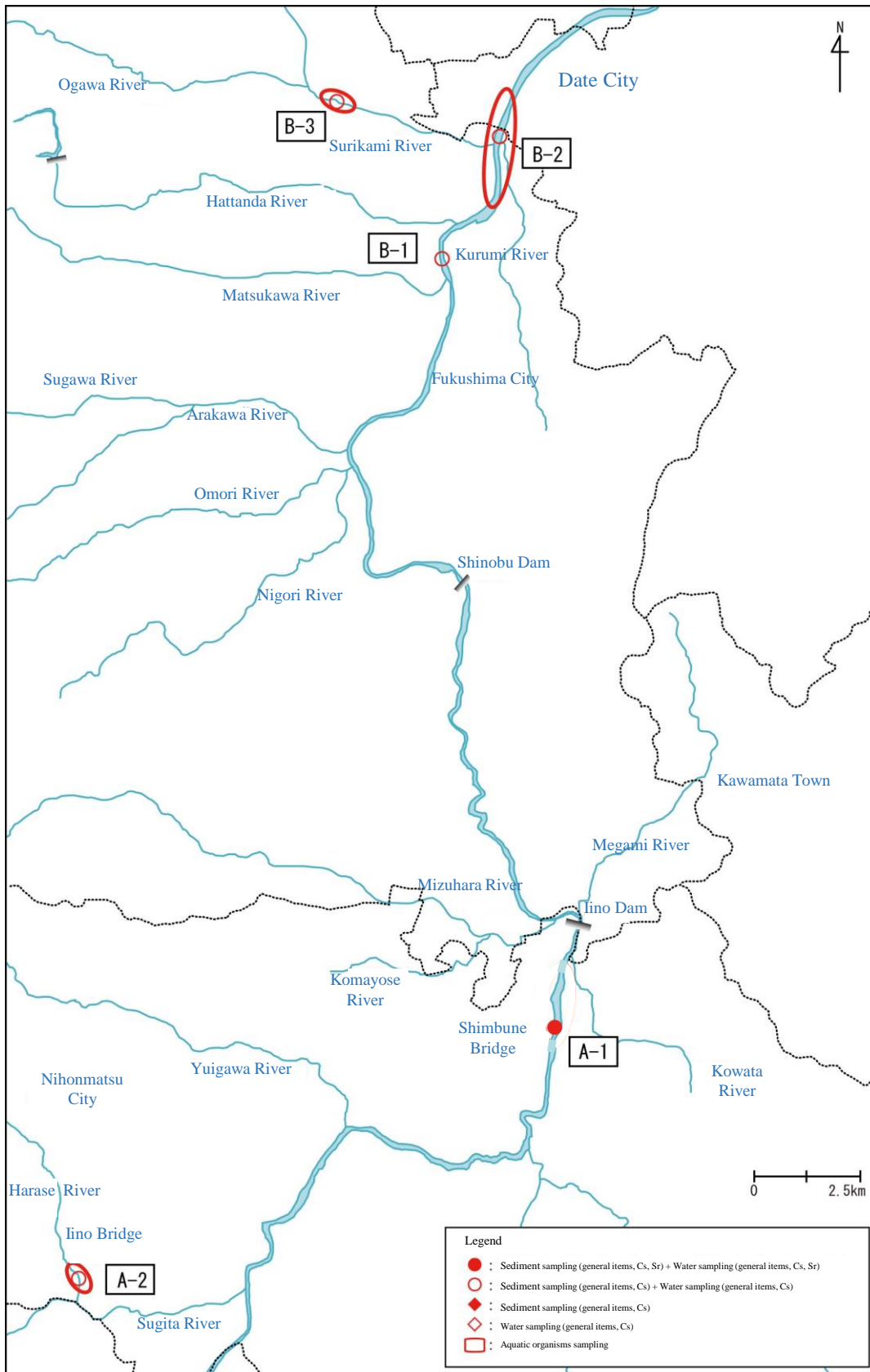
## 2.2 Survey Locations at Respective Water Areas

### (1) Tributaries to the Abukuma River (Location A along the Abukuma River; Location B along the Abukuma River; Location K off the mouth of the Abukuma River)

As water areas where clay particles and CPOMs are supposed to accumulate topographically, Location A along the Abukuma River was set from the Harase River (a tributary to the Abukuma River) and Shinfuna Bridge (Nihonmatsu City, Fukushima Prefecture) to the Iinoentei Dam (Horai Dam), and Location B along the Abukuma River was set from the confluence with the Matsukawa River to Taisho Bridge (Date City, Fukushima Prefecture) and the Surikami River as water areas containing the zone where the Matsukawa River, Surikami River, and other tributaries inflow. Additionally, the sea area in front of the mouth of the Abukuma River was set as Location K off the mouth of the Abukuma River as water areas where the outflow of radioactive materials through the Abukuma River is suspected.



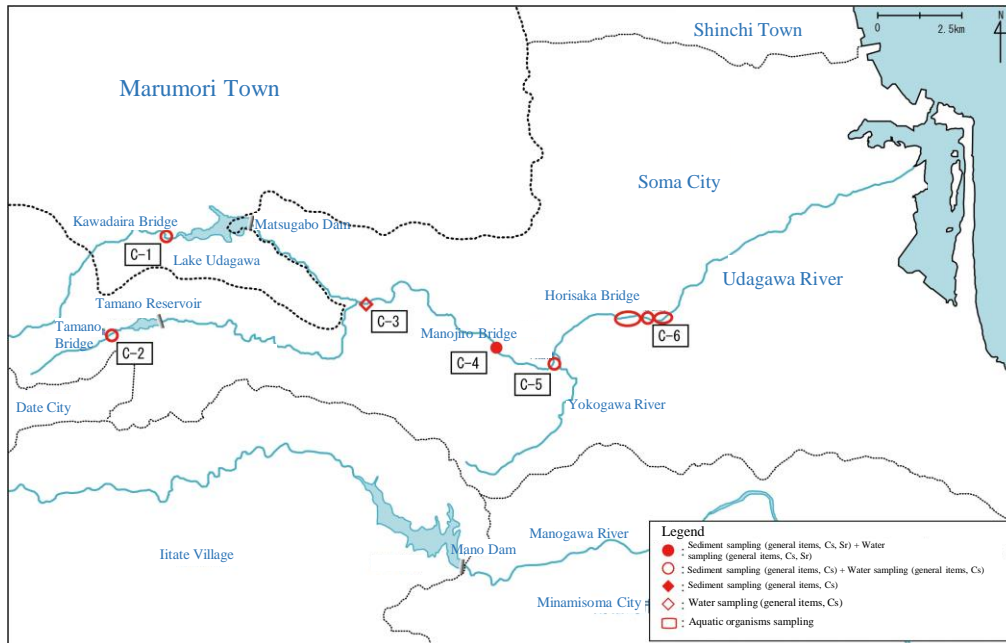
Detailed map showing Location K off the mouth of the Abukuma River



Map showing Location A and Location B along the Abukuma River

## (2) Location C along the Uda River

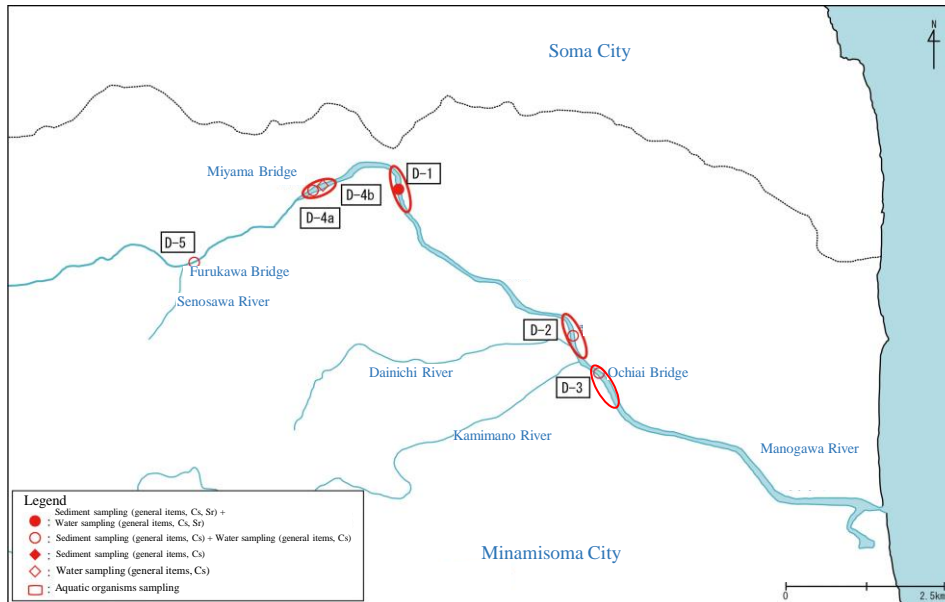
Surveys were started in the autumn term of FY2012 for the location from Kawahira Bridge to Horiita Bridge, where water flows into the Matsugafusa Dam (Lake Uda), and around Tamano Bridge, where water flows into the Tamano Reservoir (a tributary to the Tamano River).



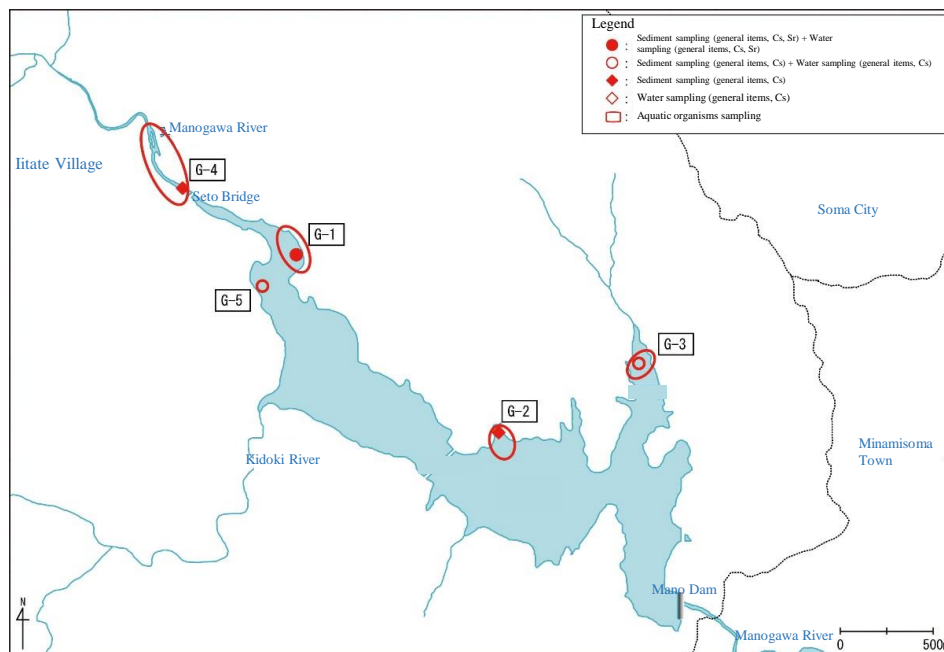
Detailed map showing Location C along the Uda River

(3) Tributaries to the Mano River (Location D along the Mano River; Location G in Lake Hayama)

Surveys were conducted at Location D along the Mano River, which covers from Yoshinami Bridge to Ochiai Bridge (Kashima Ward, Minamisoma City, Fukushima Prefecture), and at Location G in Lake Hayama, which covers the lake (Mano Dam) as a whole and inflow points.



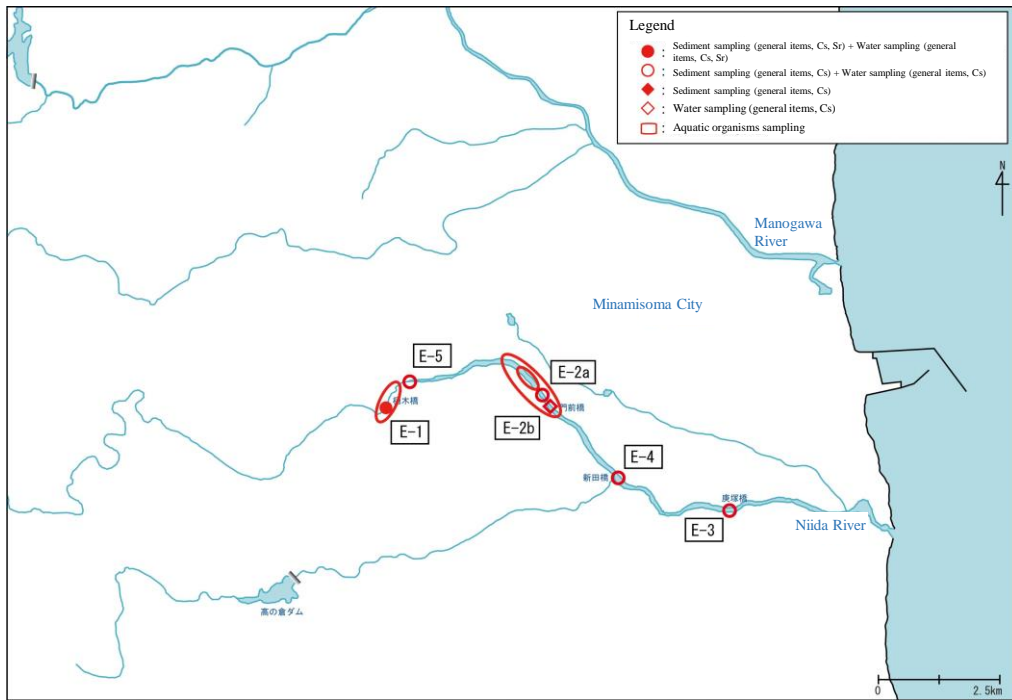
Detailed map showing Location D along the Mano River



Detailed map showing Location G in Lake Hayama (Mano Dam)

(4) Location E along the Niida River

Surveys were conducted from Kayanoki Bridge to Sugauchi Bridge.

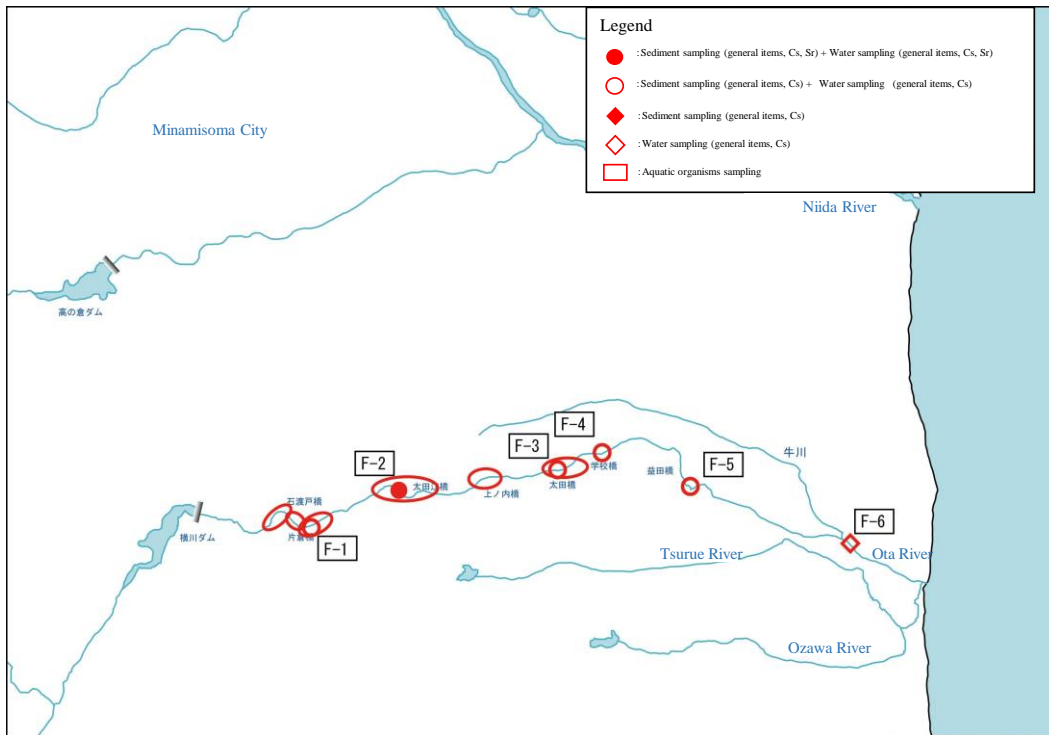


Detailed map showing Location E along the Niida River



(5) Location F along the Ota River

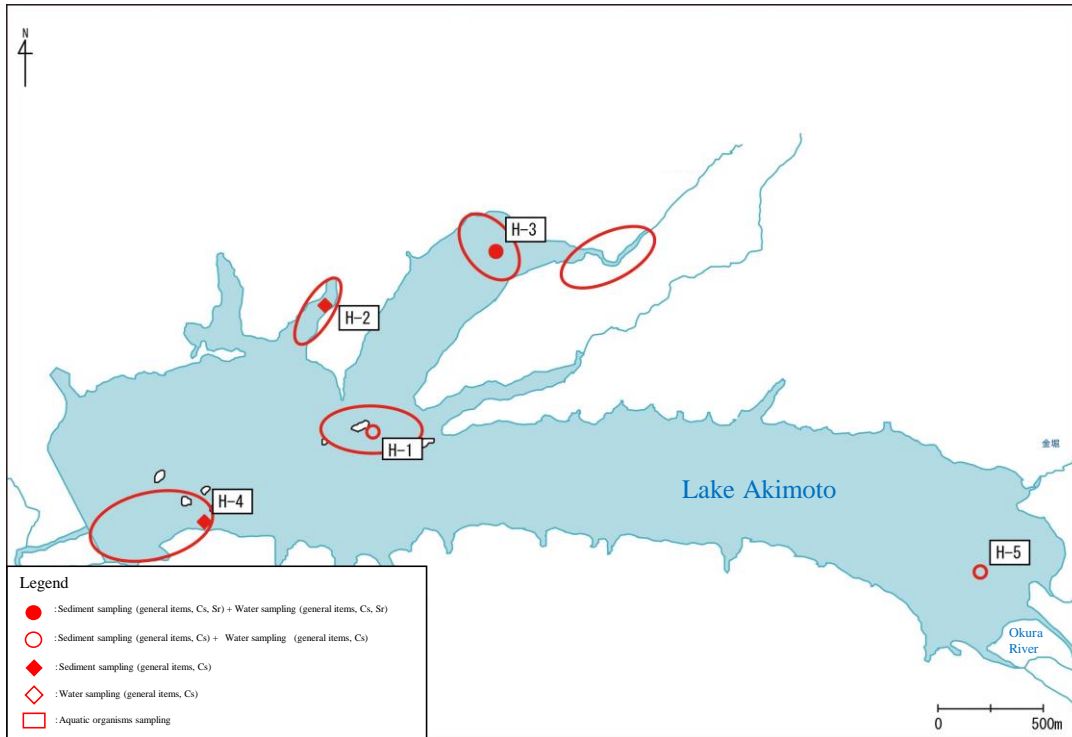
Surveys were started in the autumn term of FY2012 for the location from Yaeyonezawa Bridge to Memezawa District.



Detailed map showing Location F along the Ota River

(6) Location H in Lake Akimoto

Surveys were conducted in the whole area of Lake Akimoto, the confluence with the Nakatsu River, and around Lake Akimoto.



Detailed map showing Location H in Lake Akimoto

(7) Location I (North Lakeside) and Location J (South Lakeside) in Lake Inawashiro

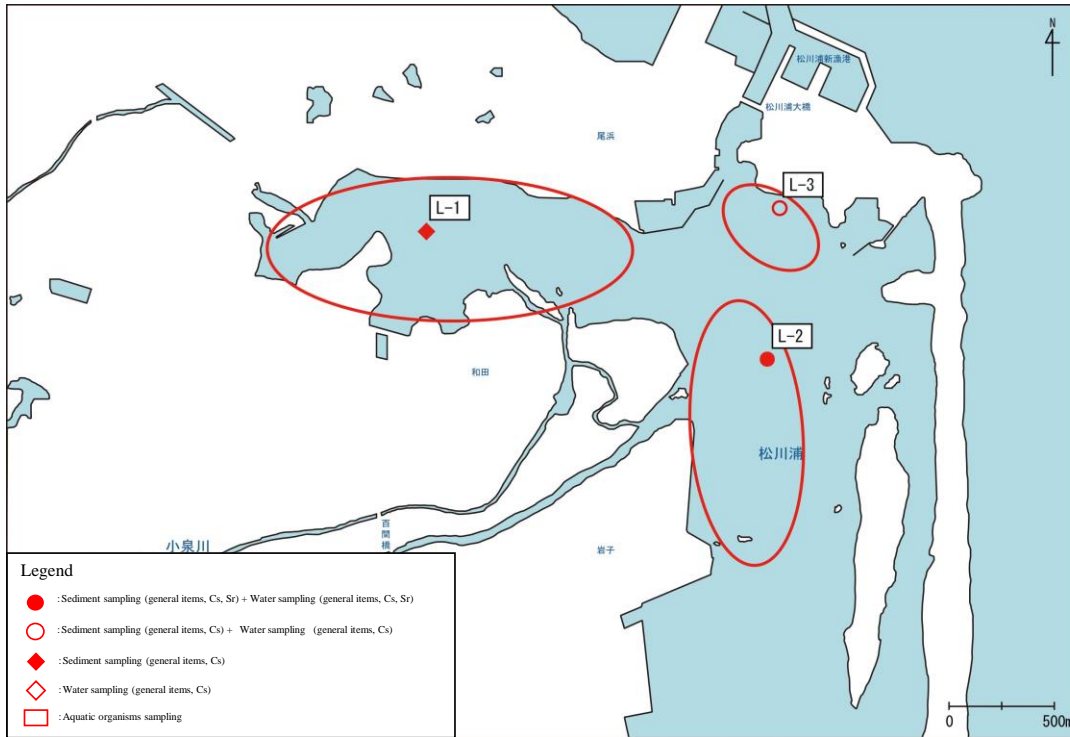
Surveys were conducted at around the point where the Nagase River inflows into Lake Inawashiro, and at around the point where lake water flows out into the Nippashi River (at the north lakeside), and at the south lakeside.



Detailed map showing Location I (north lakeside) and Location J (south lakeside) in Lake Inawashiro

(8) Location L off Soma City

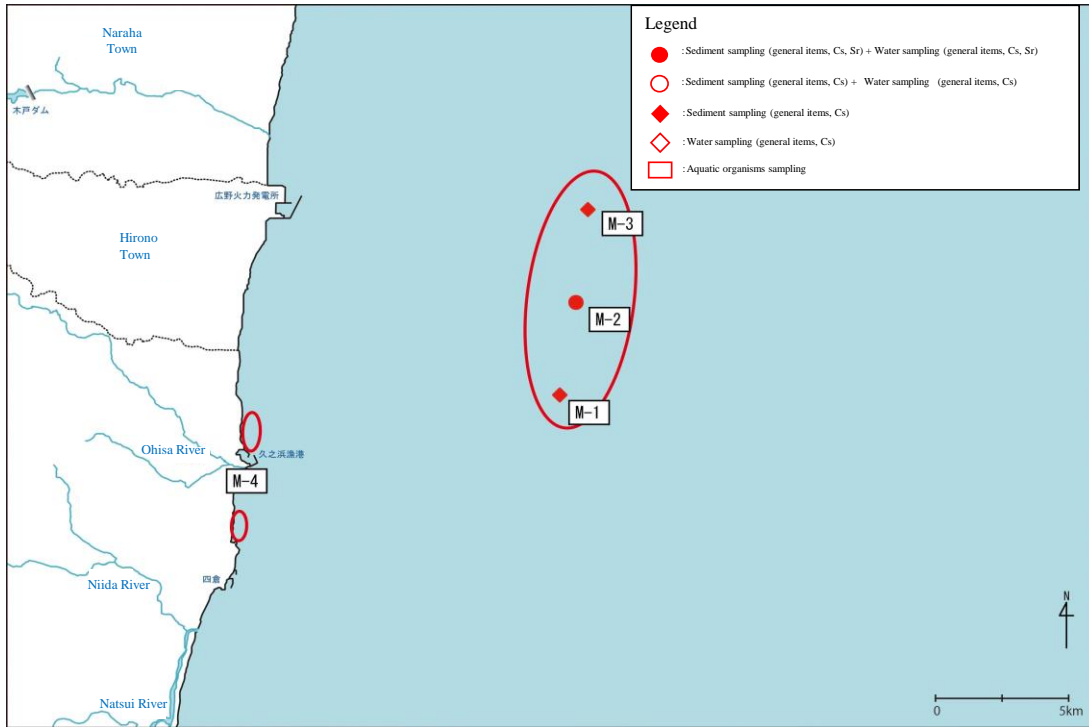
Surveys were conducted within the Matsukawaura Bay, centering on the estuary region of the Uda River.



Detailed map showing Location L off Soma City (Matsukawaura Bay)

(9) Location M off Iwaki City

Surveys were conducted off the Hisanohama Fishing Port and coastal areas in Hisanohama.



Detailed map showing Location M off Iwaki City

### 3. Results

Comparing concentrations of radioactive cesium in aquatic organisms in freshwater areas and seawater areas, aquatic organisms in freshwater areas showed relatively higher concentrations than those in seawater areas, as was observed in the autumn term monitoring survey.

Concentrations of radioactive cesium in sediment samples collected from the same river system tend to be higher for those collected at zones where water stalls (dams, etc.), and such tendency was especially notable for samples collected at points where water inflows into such zones, as was observed in the autumn term monitoring survey.

Concentrations of radioactive strontium in sediment samples were higher for those collected in freshwater areas, but no difference was observed between water samples collected in freshwater areas and those collected in seawater areas. This tendency was unchanged from the time of the autumn term monitoring survey.

○ Outline of the measurement results of radioactive cesium (Cs-134 + Cs-137)

(i) Rivers and lakes

Unit: Bq/kg-wet

Water area		Time	Flora (algae, etc)	Aquatic insects	Crustaceans	Shellfish	Fish	Amphibia	CPOMs (dead leaves, etc)
Abukuma River System	Abukuma River A	<b>FY2012 winter</b>	<b>N.D.</b>	<b>67; 170 (2 species)</b>	<b>58</b>	—	<b>44-88 (4 species)</b>	<b>58; 140 (2 species)</b>	<b>380</b>
		FY2012 autumn	9.3	54	30	24	33-172 (7 species)	52; 720 (2 species)	350
		FY2012 summer	94	199 (8-species mixture)	107; 156 (2 species)	39	34-70 (3 species)	104	1,330
		FY2012 spring	740	52 (4-species mixture)	181	170	40-167 (7 species)	290-420 (3 species)	—
	Abukuma River B	<b>FY2012 winter</b>	<b>19</b>	<b>26-132 (3 species)</b>	—	<b>63</b>	<b>35-170 (7 species)</b>	<b>82</b>	<b>235</b>
		FY2012 autumn	68	14-208 (4 species)	54	63	35-103 (5 species)	470	237
		FY2012 summer	360	139 (8-species mixture)	139	—	56-600 (13 species)	87; 750 (2 species)	270
		FY2012 spring	550	—	—	—	76-650 (10 species)	280, 370 (2 species)	—
Uda River C		<b>FY2012 winter</b>	<b>—</b>	<b>61; 182 (2 species)</b>	<b>65</b>	—	<b>65-242 (3 species)</b>	<b>—</b>	<b>92</b>
		FY2012 autumn	300	17-680 (4 species)	74; 74 (2 species)	—	83-430 (4 species)	—	101
Mano River System	Lake Hayama G (Mano Dam)	<b>FY2012 winter</b>	<b>94</b>	<b>580</b>	—	—	<b>480-2,600 (4 species)</b>	<b>—</b>	<b>206</b>
		FY2012 autumn	420	92; 1,100 (2 species)	—	—	193-5,400 (8 species)	—	320
		FY2012 summer	132	450 (10-species mixture)	—	—	232-4,300 (9 species)	—	740
		FY2012 spring	1,870	510 (7-species mixture)	—	—	280-4,400 (4 species)	—	3,200
	Mano River D	<b>FY2012 winter</b>	<b>0.97</b>	<b>61-470 (4 species)</b>	—	—	<b>51-590 (4 species)</b>	<b>790</b>	<b>231</b>
		FY2012 autumn	540	113-510 (3 species)	224	440	1.1-800 (4 species)	1,110	510
		FY2012 summer	23-570 (3 species)	460 (10-species mixture)	147-660 (3 species)	480	111-760 (7 species)	—	420
		FY2012 spring	260	198 (14-species mixture)	223	182	202-970 (4 species)	—	1,410
Niida River C		<b>FY2012 winter</b>	<b>—</b>	<b>91-980 (3 species)</b>	<b>420</b>	—	<b>238-1,040 (5 species)</b>	<b>—</b>	<b>580</b>
		FY2012 autumn	—	165-1,770 (4 species)	410	230	320-1,220 (8 species)	1,620	890
		FY2012 summer	—	—	—	—	199-1,620 (8 species)	—	—
		FY2012 spring	—	—	—	—	440-11,400 (5 species)	—	—
Ota River F		<b>FY2012 winter</b>	<b>—</b>	<b>550-1,510 (3 species)</b>	—	—	<b>1,880-9,800 (4 species)</b>	<b>—</b>	<b>1,550</b>
		FY2012 autumn	182	530; 820 (2 species)	1,320	—	450-2,440 (7 species)	—	1,740

- \* Surveys for the Uda River and Ota River were started in the autumn term of FY2012.
- \* The number of aquatic insect samples was small until the survey in the summer term of 2012. Therefore, measurement was conducted by mixing samples for each water area and each location. Since the autumn term of FY2012, sampling and analysis of aquatic insects have been conducted separately for four categories (Plecoptera, Trichoptera, Odonata, and Megaloptera).



## (ii) Rivers and lakes (cont')

Unit: Bq/kg-wet

Water area		Time	Flora (algae, etc)	Aquatic insects	Crustaceans	Shellfish	Fish	Amphibia	CPOMs (dead leaves, etc.)
Lake Akimoto H		<b>FY2012 winter</b>	<b>4.7</b>	—	<b>120</b>	—	<b>58-197 (7 species)</b>	—	<b>59</b>
		FY2012 autumn	16; 50 (2 species)	—	144	—	54-380 (6 species)	—	48
		FY2012 summer	7.1-44 (3 species)	—	156	—	63-310 (12 species)	71-136 (3 species)	156
		FY2012 spring	46	—	183	—	94-470 (7 species)	540	250
Lake Inawashiro		<b>FY2012 winter</b>	—	—	—	—	—	—	—
		FY2012 autumn	135	—	—	—	31-201 (6 species)	—	390
		FY2012 summer	42	—	—	—	9.1-330 (7 species)	—	172
		FY2012 spring	500	—	—	—	77-380 (6 species)	—	—
		<b>FY2012 winter</b>	<b>6.3</b>	—	—	<b>1.7</b>	<b>4.7</b>	<b>N.D.</b>	—
		FY2012 autumn	2.9; 13 (2 species)	—	—	9.0	39-181 (6 species)	43	—
		FY2012 summer	4.8-12 (3 species)	—	—	62	11-178 (9 species)	68	—
		FY2012 spring	9.0	—	—	—	46-430 (6 species)	—	—

\* ND means to be below the detection limit.

## (iii) Sea areas

Unit: Bq/kg-wet

Water area	Time	Flora (algae, etc)	Sea urchin, starfish, trepan	Crustaceans	Sandworm	Shellfish		Squid, octopus	Fish	
						Molluscan body	Shell			
Location K off the mouth of the Abukuma River (Off Watari Town)		<b>FY2012 winter</b>	—	—	—	—	—	—	<b>5.1-19 (4 species)</b>	
		FY2012 autumn	—	—	N.D.	—	—	—	0.9-32 (7 species)	
		FY2012 summer	—	—	0.95	—	—	—	N.D.-19 (7 species)	
		FY2012 spring	—	—	8.4; 21 (2 species)	—	—	—	11-42 (5 species)	
Location J off Soma City (Matsukawaura Bay)		<b>FY2012 winter</b>	<b>N.D.-1. 6 (3 species )</b>	—	<b>15</b>	—	<b>3.2; 9.4 (2 species)</b>	<b>3.7; 63 (2 species)</b>	<b>8.6</b>	
		FY2012 Autumn	N.D.; 4.1 (2 species )	—	13	6.4	N.D.; 13 (2 species)	1.9; 60 (2 species)	—	7.5; 23 (2 species)
		FY2012 summer	2.9; 3.1 (2)	—	3.0-300 (4)	107	5.3; 8.9 (2)	4.7; 29 (2)	—	5.9-36 (7 species)

		species )		species)		species)	species)		
	FY2012 spring	13-102 (3 species )	—	12-87 (4 species)	—	4.1; 5.7 (2 species)	9.0; 56 (2 species)	—	11-166 (5 species)
Location M off Iwaki City(Hisanohama )	<b>FY2012 winter</b>	<b>7.9</b>	<b>5.6; 73 (2 species)</b>	<b>—</b>	<b>—</b>	<b>3.0</b>	<b>23</b>	<b>—</b>	<b>13-139 (6 species)</b>
	FY2012 autumn	8.7	12; 42 (2 species)	—	—	5.1	16	—	6.7-118 (6 species)
	FY2012 summer	25	26; 50 (2 species)	—	—	6.1	49	7.4	14-126 (10 species)
	FY2012 spring	22; 33 (2 species )	21; 97 (2 species)	—	—	13	24	—	7.6-290 (8 species)

\* ND means to be below the detection limit.