FY2014 Radioactive Material Monitoring of Aquatic Organisms (December)

1. Survey Overview

Samples of aquatic organisms (algae, aquatic insects, crustaceans, shellfish, fish, and amphibians, etc.) were collected mainly in Fukushima Prefecture and concentrations of radioactive cesium and radioactive strontium in the samples were measured (survey period: December 1, 2014, to December 12, 2014).

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

○ Survey locations and dates

Area		Targeted water areas	Zone	Item	Survey dates	Remarks
River area	A	Abukuma River	Shinfuna Bridge to the Iinoentei Dam; Harase River (a tributary)	Aquatic organisms sampling	December 3, 2014	Algae,flora, aquatic insects, crustaceans, shellfish, fish, amphibians, fallen leaves, etc.
				Water/sediment sampling	December 4, 2014	(Water sampling) A-1, A-2 (Sediment sampling) A-1, A-2
	B		Confluence with the Matsukawa River (a tributary) to Taisho Bridge; Sumikari River (a tributary)	Aquatic organisms sampling	December 2, and 11, 2014	Algae,flora, aquatic insects, crustaceans, fish, amphibians, fallen leaves, etc.
				Water/sediment sampling	December 4, 2014	(Water sampling) B-1—B-3 (Sediment sampling) B-1—B-3
	C	Uda River	Kawahira Bridge to Horiita Bridge; Around Tamano Bridge	Aquatic organisms sampling	December 7, 2014	Algae,flora, aquatic insects, crustaceans, fish, fallen leaves, etc.
				Water/sediment sampling	December 5, 2014	(Water sampling) C-1—C-6 (Sediment sampling) C-1, C-2, C-4—C-6
	D	Mano River	Zennami Bridge to Ochiai Bridge	Aquatic organisms sampling	December 2, and 9, 2014	Algae,flora, aquatic insects, crustaceans, shellfish, fish, fallen leaves, etc.
				Water/sediment sampling	December 6, 2014	(Water sampling) D-1—D-5 (Sediment sampling) D-1—D-3, D-4a, D-5
	E	Niida River	Kashiwagi Bridge to Sugauchi Bridge	Aquatic organisms sampling	December 5, 2014	Algae,flora, aquatic insects, crustaceans, fish, fallen leaves, etc.
				Water/sediment sampling	December 2, 2014	(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 6, 2014	Algae,flora, aquatic insects, crustaceans, shellfish, fish, fallen leaves, etc.
				Water/sediment sampling	December 3, 2014	(Water sampling) F-1—F-6 (Sediment sampling) F-1—F-5
	G	Lake Hayama		Aquatic organisms sampling	December 1, 7, and 8, 2014	Algae,flora, aquatic insects, crustaceans, fish, fallen leaves, etc.
				Water/sediment sampling	December 7, and 8, 2014	(Water sampling) G-1, G-3, G-5 (Sediment sampling) G-1—G-5
Lake area	H	Lake Akimoto		Aquatic organisms sampling	December 3, and 4, 2014	Algae,flora, aquatic insects, crustaceans, shellfish, fish, amphibians, fallen leaves, etc.
				Water/sediment sampling	December 4, 2014	(Water sampling) H-1, H-3, H-5 (Sediment sampling) H-1—H-5
	I	Lake Inawashiro	North bank	Aquatic organisms sampling	December 3, 2014	fallen leaves, etc.
				Water/sediment sampling	December 4, 2014	(Water sampling) I-1, I-3 (Sediment sampling) I-1—I-4
	J		South bank	Aquatic organisms sampling	December 2, 4, 2014	Algae,flora, shellfish,amphibian
				Water/sediment sampling	December 4, 2014	(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, 2014	Fish
				Water/sediment sampling	December 11, 2014	(Water sampling) K-2 (Sediment sampling) K-1—K-3
	L	Offshore of Soma City	Matsukawaura	Aquatic organisms sampling	December 10, 2014	Seaweed,algae, polychaeta, crustaceans, shellfish, fish
				Water/sediment sampling	December 10, 2014	(Water sampling) L-2, L-3 (Sediment sampling) L-1—L-3
	M	Offshore of Iwaki City	Offshore of Hisanohama	Aquatic organisms sampling	December 12, 2014	Seaweed,algae, echinoderm, shellfish, fish
				Water/sediment sampling	December 12, 2014	(Water sampling) M-2 (Sediment sampling) M-1—M-3

2. Survey Items and Locations, etc.

2.1 Survey Items

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.

With regard to surveys of water and sediments, locations where aquatic organism samples were scheduled to be collected and where clay particles and coarse particulate organic matters (dead leaves at the bottom, etc.) are supposed to accumulate due to inflows from the surrounding environment, etc. were selected for the analysis of radioactive materials and general survey items.

Survey items and samples for aquatic organisms, water, and sediments are as shown in the following table.

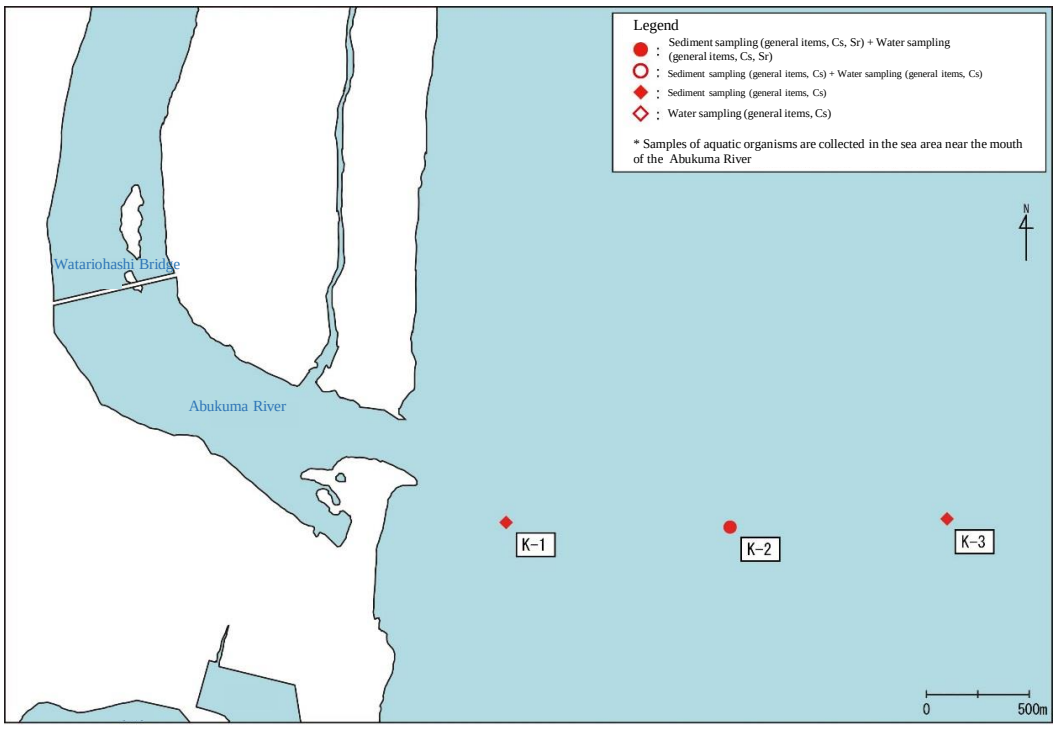
○ Survey targets and items

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	

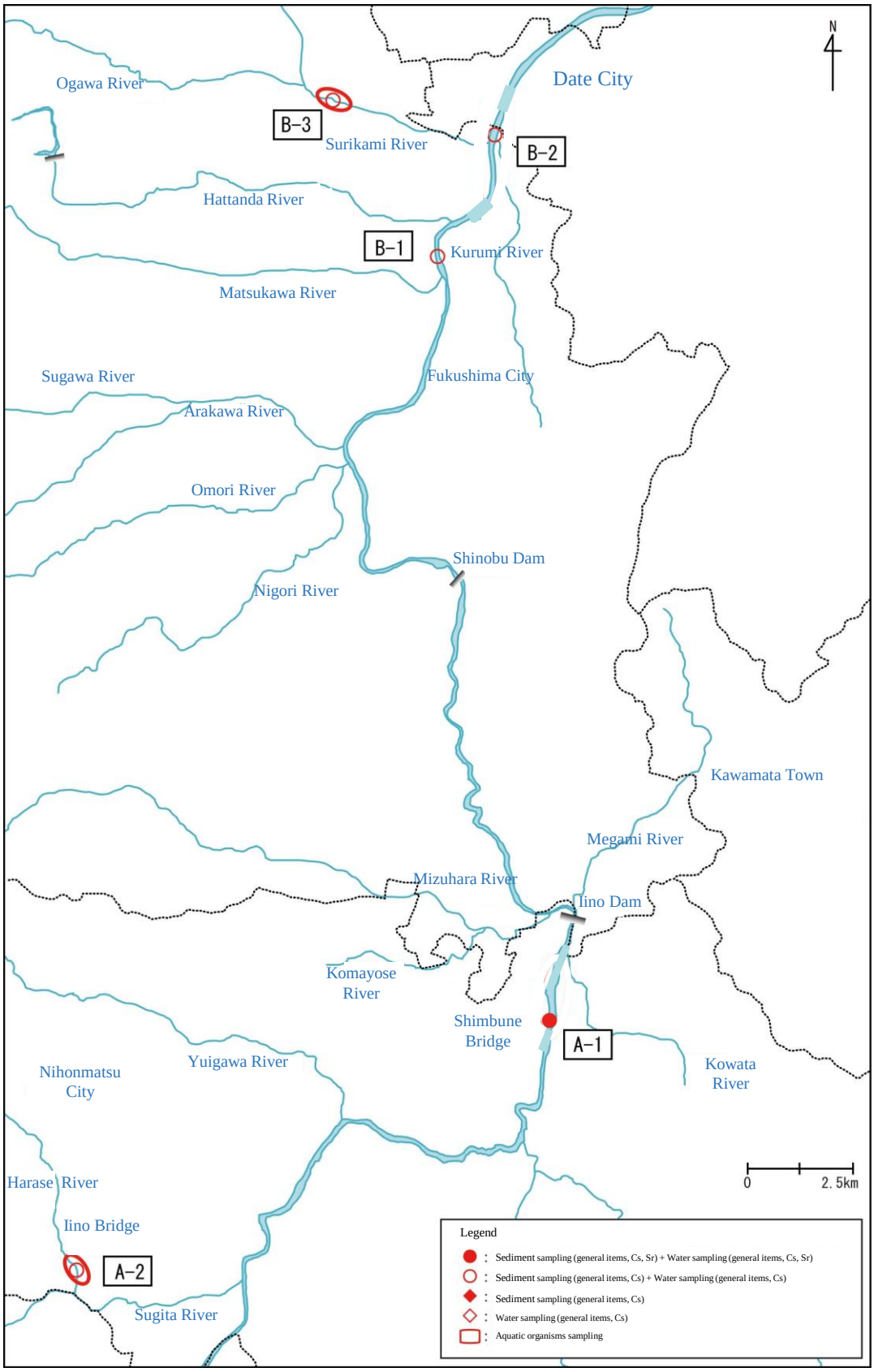
2.2 Survey Locations at Respective Water Areas

(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 (dead leaves at the bottom, etc.) 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) as well as the zone where a tributary to the Surikami River inflows. Additionally, Location K was set off the mouth of the Abukuma River in order to survey the sea area in front of the mouth of the Abukuma River, where the outflow of radioactive materials through the Abukuma River is suspected.



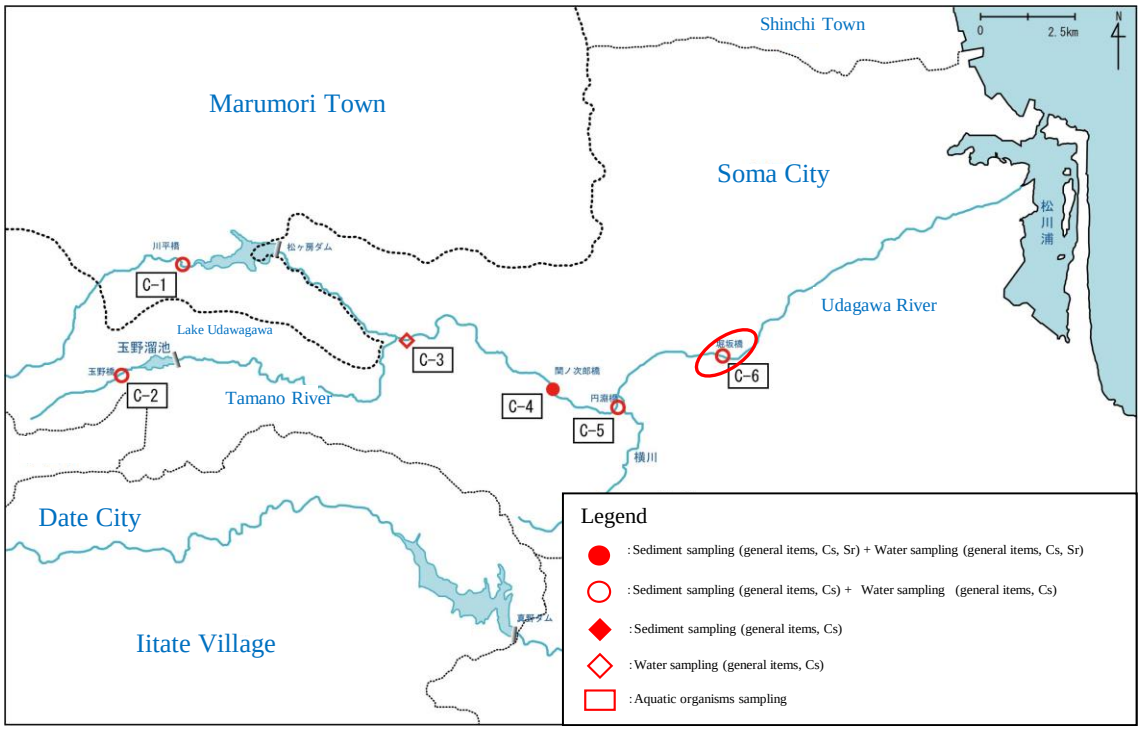
Detailed map showing Location K off the mouth of the Abukuma River



Map showing Location A and Location B along the Abukuma River

(2) Location C along the Uda River

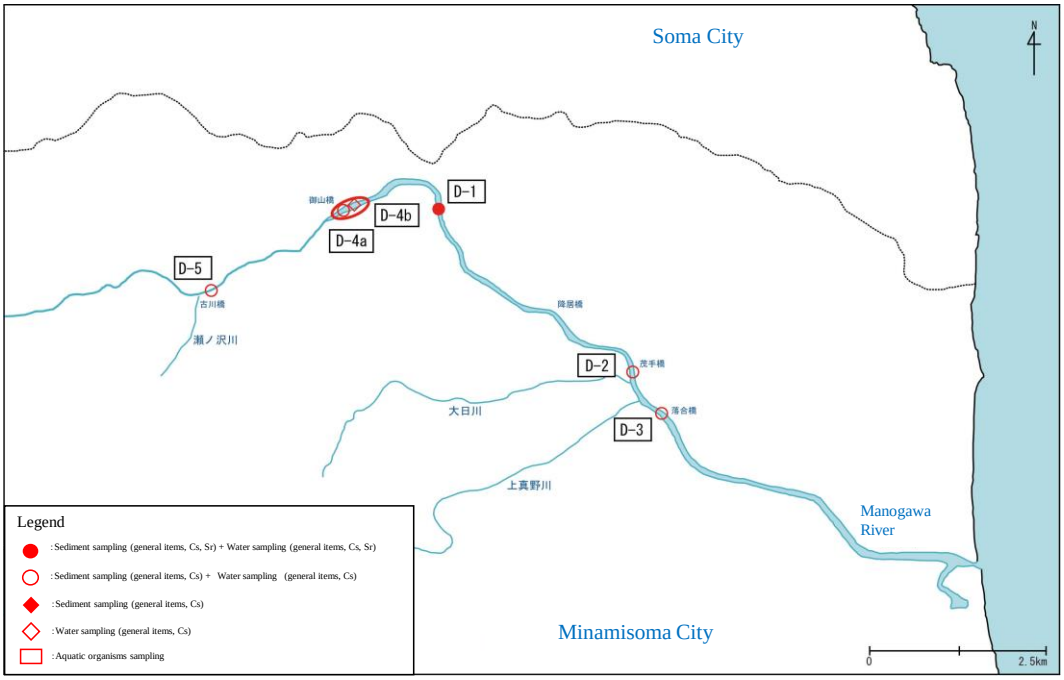
Surveys were started in the autumn term of FY2012 for the location from Kawahira Bridge to Horiita Bridge, where water flows into the Matsugafusa Dam (Lake Uda), and around Tamano Bridge, where water flows into the Tamano Reservoir (a tributary to the Tamano River).



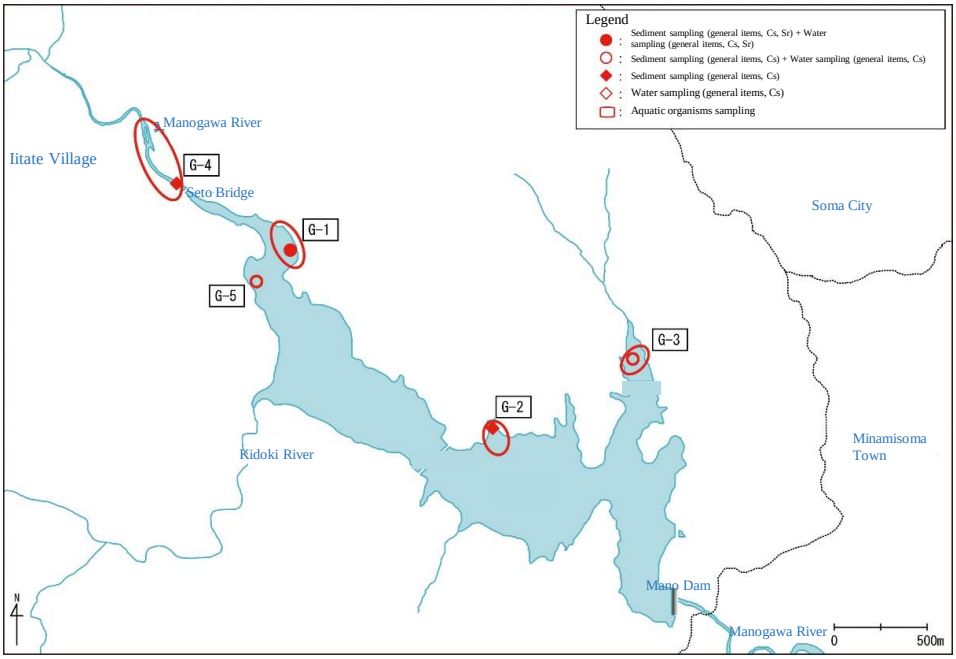
Detailed map showing Location C along the Uda River

(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.



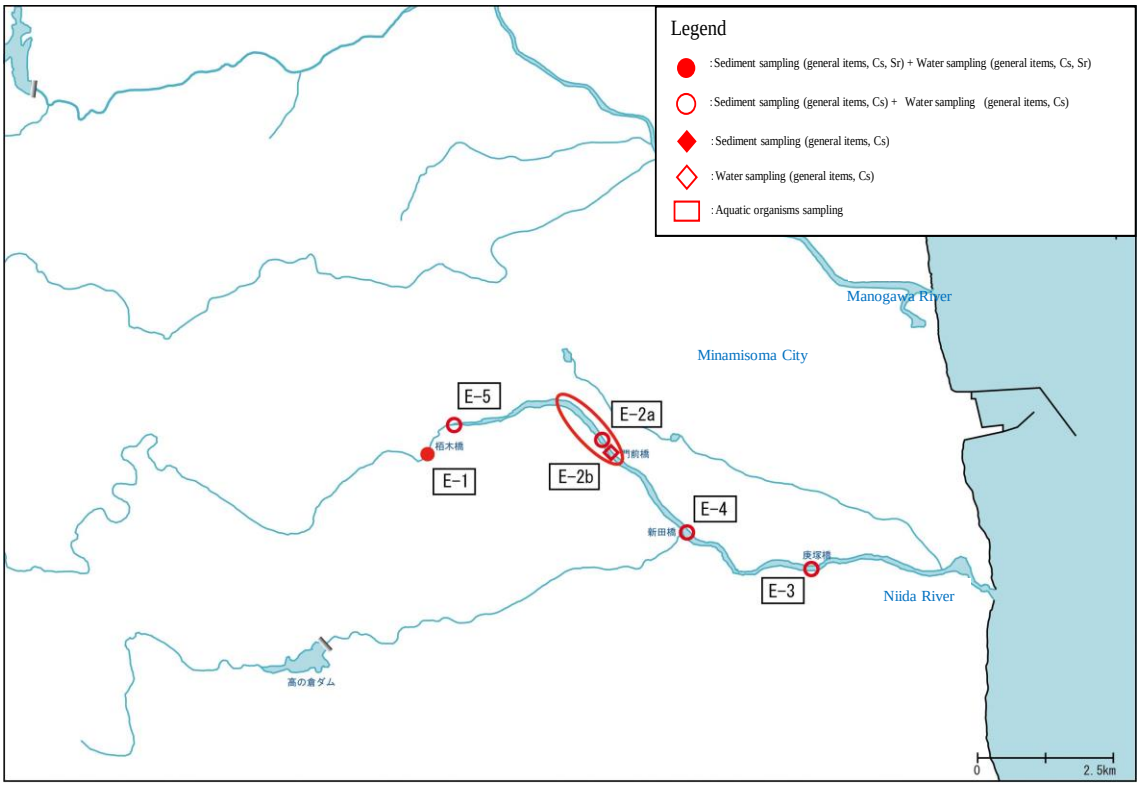
Detailed map showing Location D along the Mano River



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

(4) Location E along the Niida River

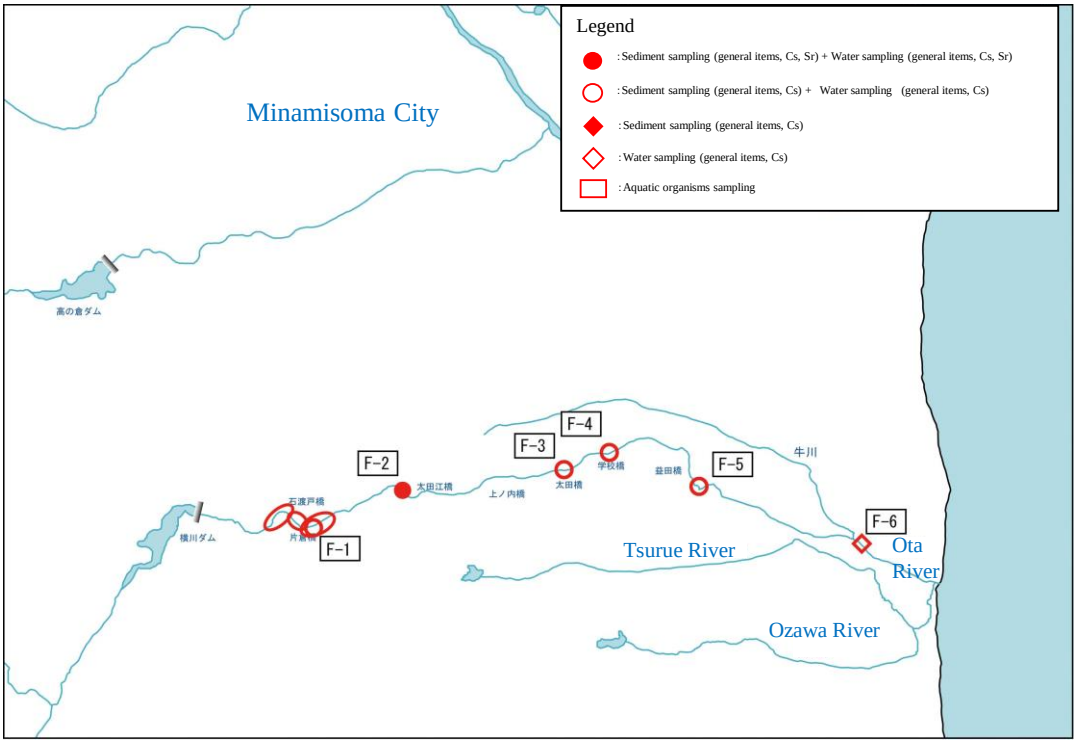
Surveys were conducted from Kayanoki Bridge to Sugauchi Bridge.



Detailed map showing Location E along the Niida River

(5) Location F along the Ota River

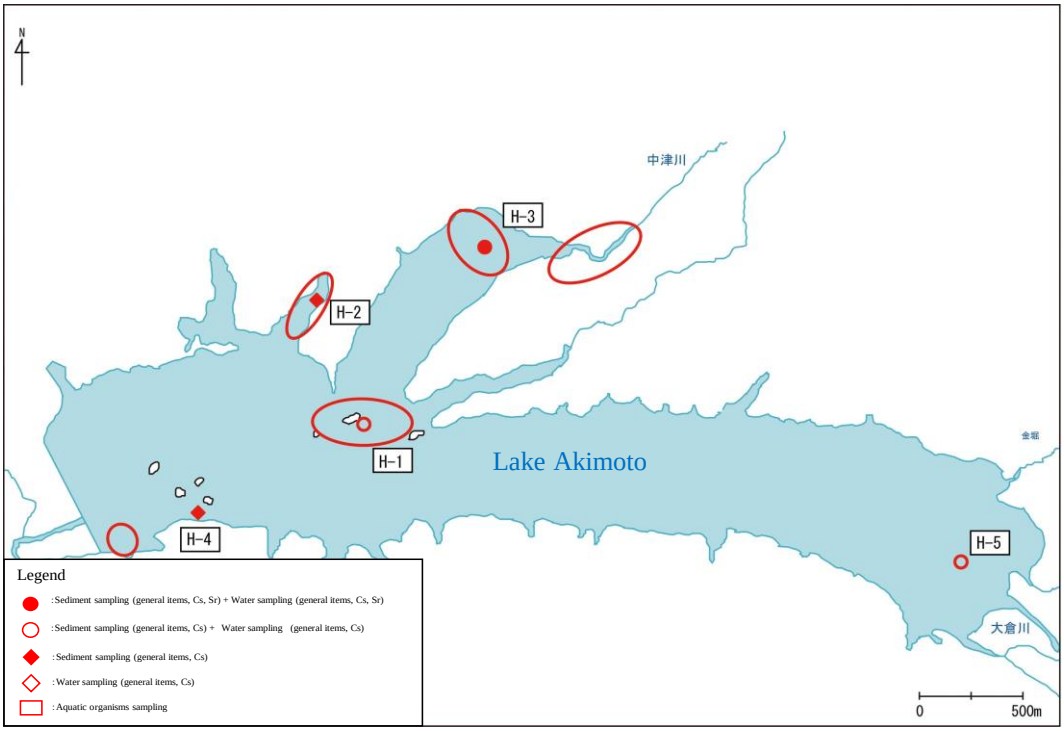
Surveys were started in the autumn term of FY2012 for the location from Yaeyonezawa Bridge to Memezawa District.



Detailed map showing Location F along the Ota River

(6) Location H in Lake Akimoto

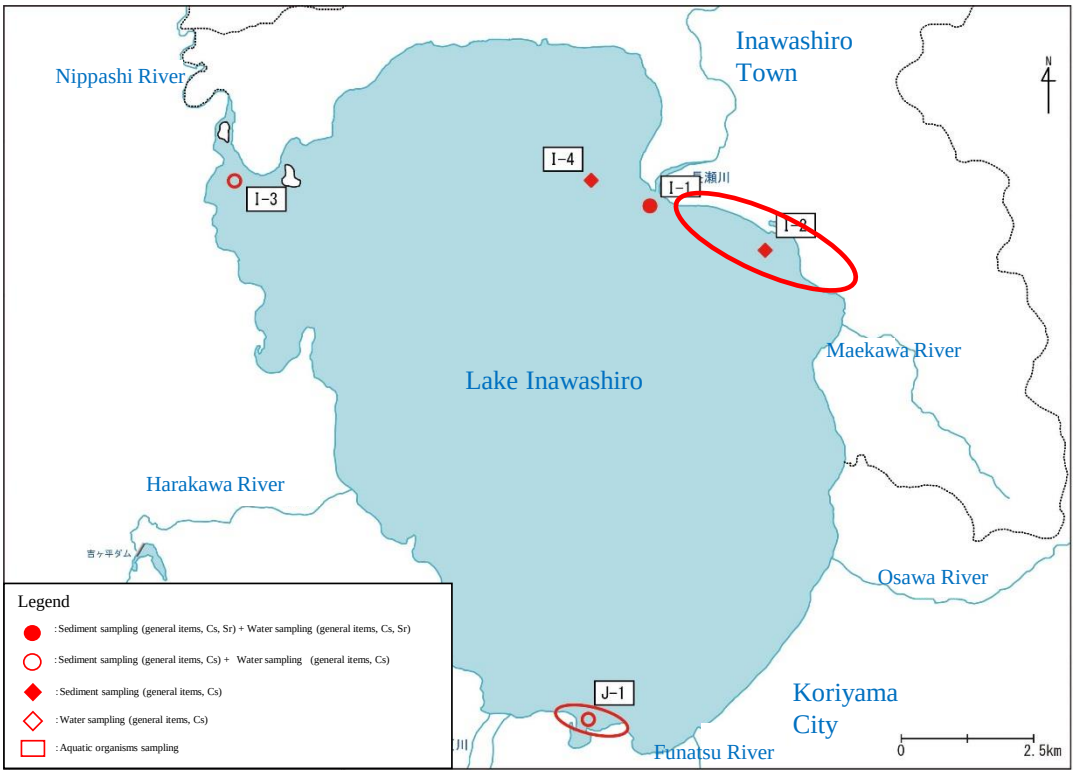
Surveys were conducted in the whole area of Lake Akimoto, the confluence with the Nakatsu River, and around Lake Akimoto.



Detailed map showing Location H in Lake Akimoto

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

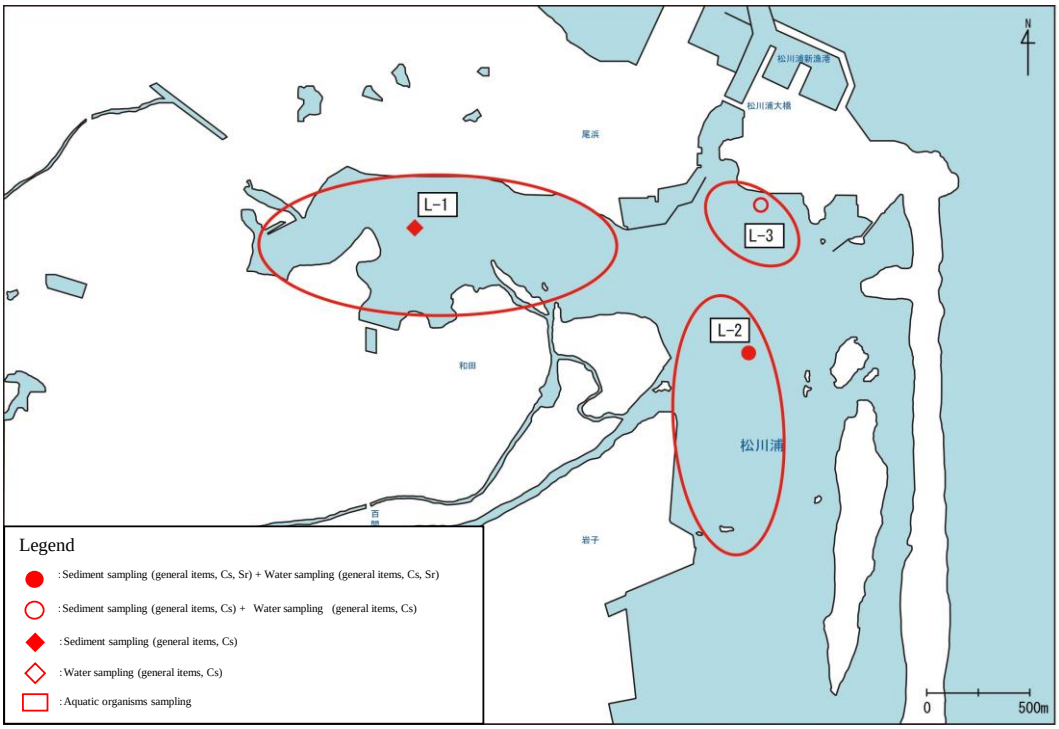
Surveys were conducted at around the point where the Nagase River inflows into Lake Inawashiro, and at around the point where lake water flows out into the Nippashi River (at the north lakeside), and at the south lakeside.



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

(8) Location L off Soma City

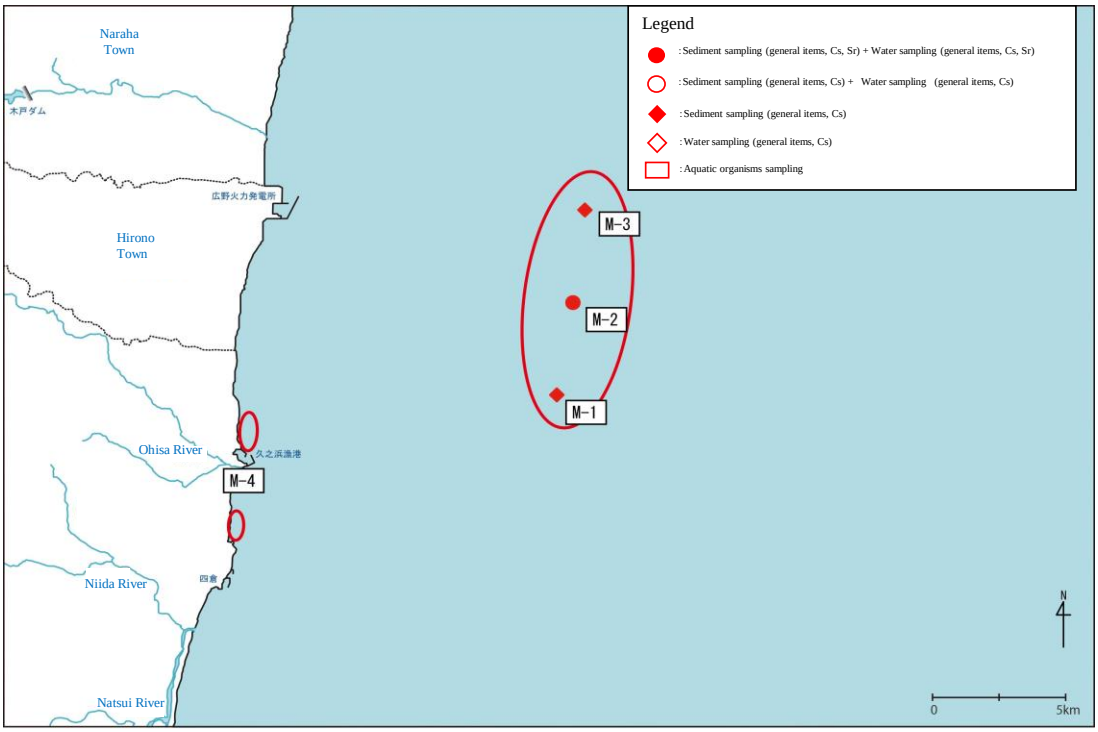
Surveys were conducted within the Matsukawaura Bay, centering on the estuary region of the Uda River.



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 past monitoring surveys.

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 past monitoring surveys.

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 times of the past monitoring surveys.

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

(i) Rivers and lakes

Unit: Bq/kg-wet

Water area		Time	Algae, Flora	Aquatic insects	Spiders	Crustaceans	Shellfish		Fish	Amphibia	CPOMs (fallen leaves, etc.)
							Molluscan body	Shell			
Abukuma River System	Abukuma River A	**FY2014 Dec.**	**333**	**16.8; 149 (2 species)**	**–**	**21.7**	**31.2**	**–**	**13.8-43 (4 species)**	**15.9; 17.9 (2 species)**	**51**
		FY2014 Oct.-Nov.	172	75	–	27.8; 30.0 (2 species)	23.1	–	17.0-45 (6 species)	12.1-166 (3 species)	237
		FY2014 Aug.-Sep.	214	21.7; 57 (2 species)	–	34.1	25.4	–	12.9-32.6 (7 species)	19.1-257 (3 species)	176
		FY2014 Jun.-Jul.	600	16; 109 (2 species)	–	36	30	–	7.0-66 (11 species)	16-274 (3 species)	313
	Abukuma River B	**FY2014 Dec.**	**91**	**N.D.-72 (5 species)**	**–**	**15.4**	**–**	**–**	**11.4-25.8 (3 species)**	**12.4; 99 (2 species)**	**42.8**
		FY2014 Oct.-Nov.	119	N.D.-108 (5 species)	–	–	–	–	9.2-24.8 (7 species)	163	78
		FY2014 Aug.-Sep.	30.3; 149 (2 species)	5.3-161 (6 species)	–	27.6	–	–	9.5-117 (22 species)	28.7-268 (3 species)	120
		FY2014 Jun.-Jul.	16; 202 (2 species)	7.8-132 (5 species)	–	32	–	–	6.5-51 (19 species)	11-254 (3 species)	132
Uda River C		**FY2014 Dec.**	**76**	**15.7; 91 (2 species)**	**–**	**22.2; 30.1 (2 species)**	**–**	**–**	**24.2-34.5 (3 species)**	**–**	**223**
		FY2014 Oct.-Nov.	199	12-114 (3 species)	–	23.9; 28.7 (2 species)	–	–	20.8-40.5 (4 species)	8.7	32.6
		FY2014 Aug.-Sep.	203	13.9-52 (3 species)	–	22.1-49 (3 species)	–	–	19.4-57 (4 species)	–	168
		FY2014 Jun.-Jul.	313	16-147 (3 species)	–	19-40 (3 species)	14	–	15-69 (8 species)	174	206
Mano River System	Lake Hayama G (Mano Dam)	**FY2014 Dec.**	**4.5; 630 (2 species)**	**166**	**–**	**129**	**–**	**–**	**38-1,320 (3 species)**	**–**	**247**
		FY2014 Oct.-Nov.	22.6; 367 (2 species)	13-600 (4 species)	–	141	–	–	55-590 (4 species)	–	120
		FY2014 Aug.-Sep.	27.4; 1,480 (2 species)	53; 74 (2 species)	–	160	–	–	37.9-147 (4 species)	–	810
		FY2014 Jun.-Jul.	104; 550 (2 species)	63; 80 (2 species)	–	–	111	–	179-1,200 (7 species)	–	640
	Mano River D	**FY2014 December**	**338**	**12.6-183 (5 species)**	**–**	**46**	**62**	**–**	**10.8-104 (4 species)**	**–**	**224**
		FY2014 Oct.-Nov.	103	26.0; 31.5 (2 species)	–	83; 89 (2 species)	104	–	61-126 (4 species)	–	116
		FY2014 Aug.-Sep.	12.8; 390 (2 species)	36.4-189 (3 species)	–	77	138	–	53; 94 (2 species)	113	317; 386 (2 species)
		FY2014 Jun.-Jul.	25; 221 (2 species)	39; 242 (2 species)	–	150-272 (3 species)	114; 202 (2 species)	–	44-293 (6 species)	50; 950 (2 species)	390

* ND means to be below the detection limit.
* Organisms were collected in or around the targeted water areas.
* Basically, measurement was conducted for all targeted samples.
* Since the autumn term of FY2012, sampling and analysis of aquatic insects had been conducted separately for four categories (Plecoptera, Trichoptera, Odonata, and Megaloptera) (by feeding habit and type). Since the FY2014 June-July Survey, Ephemeroptera was added and sampling and analysis were conducted for five categories.

(i) Rivers and lakes

Unit: Bq/kg-wet

Water area		Time	Algae, Flora	Aquatic insects	Spiders	Crustaceans	Shellfish		Fish	Amphibia	CPOMs (fallen leaves, etc.)
							Molluscan body	Shell			
Niida River E		**2014 Dec.**	**1,230**	**62-900 (4 species)**	**–**	**156-171 (3 species)**	**–**	**–**	**124-286 (3 species)**	**–**	**520**
		2014 Oct.-Nov.	172	25.0-550 (5 species)	–	162-187 (3 species)	–	–	119-280 (6 species)	43	1,180
		2014 Aug.-Sep.	470	111-970 (5 species)	33	229; 244 (2 species)	89	–	110-254 (7 species)	1,880	1,150
		2014 Jun.-Jul.	245	72-900 (4 species)	–	188-271 (3 species)	136	14	131-356 (6 species)	1,490	1,080
Ota River F		**2014 Dec.**	**1,840**	**128-1,450 (5 species)**	**–**	**780; 1,030 (2 species)**	**267**	**–**	**450-1,580 (4 species)**	**–**	**234**
		2014 Oct.-Nov.	1,860	288; 480 (2 species)	–	890; 1,010 (2 species)	404	–	118-1,830 (7 species)	–	1,040
		2014 Aug.-Sep.	314-4,400 (3 species)	243-820 (3 species)	–	660; 850 (2 species)	266	–	283-1,470 (6 species)	–	550
		2014 Jun.-Jul.	690; 1,330 (2 species)	404	–	770-1,160 (4 species)	212	–	480-2,200 (5 species)	269	–
Lake Akimoto H		**2014 Dec.**	**490**	**11.6**	**–**	**44**	**15.1**	**–**	**25.2-100 (5 species)**	**34.7**	**85**
		2014 Oct.-Nov.	7.7; 32.7 (2 species)	28.0; 122 (2 species)	–	36.9	28.9	–	12.9-74 (8 species)	8.5; 15.2 (2 species)	72
		2014 Aug.-Sep.	9.7; 94 (2 species)	13.5	–	53	54	–	8.5-107 (13 species)	6.2; 46 (2 species)	61
		2014 Jun.-Jul.	13; 149 (2 species)	4.4; 14 (2 species)	–	50	59	–	14-176 (13 species)	19-232 (3 species)	86
Lake Inawashiro	Lake Inawashiro I (north lakeside)	**2014 Dec.**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**23.9**
		2014 Oct.-Nov.	–	–	–	–	–	–	27.8-183 (4 species)	–	21.6
		2014 Aug.-Sep.	–	–	–	–	–	–	8.5-101 (9 species)	–	31.0
		2014 Jun.-Jul.	–	–	–	–	–	–	17-148 (10 species)	–	21
	Lake Inawashiro J (south lakeside)	**2014 Dec.**	**0.98; 9.1 (2 species)**	**–**	**–**	**–**	**0.73; 10.6 (2 species)**	**–**	**–**	**1.5; 2.2 (2 species)**	**–**
		2014 Oct.-Nov.	N.D.-3.47 (3 species)	2.4	–	5.1	2.88; 3.4 (2 species)	–	16.2-159 (6 species)	1.2; 9.5 (2 species)	–
		2014 Aug.-Sep.	0.73-7.8 (3 species)	–	–	22.6	28.2	–	N.D.-68 (12 species)	1.9; 39 (2 species)	–
		2014 Jun.-Jul.	0.45-3.6 (3 species)	–	–	16	12	–	1.9-99 (10 species)	2.9-47 (4 species)	–

* ND means to be below the detection limit.
* Organisms were collected in or around the targeted water areas.
* Basically, measurement was conducted for all targeted samples.
* Since the autumn term of FY2012, sampling and analysis of aquatic insects had been conducted separately for four categories (Plecoptera, Trichoptera, Odonata, and Megaloptera) (by feeding habit and type). Since the FY2014 June-July Survey, Ephemeroptera was added and sampling and analysis were conducted for five categories.

(ii) Sea areas

Unit: Bq/kg-wet

Water area	Time	Seaweed,algae	Polychaeta	Sea urchin, starfish, trepang	Crustaceans	Shellfish		Squid, octopus	Fish
						Molluscan body	Shell		
Location K off the mouth of the Abukuma River	**FY2014 Dec.**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**2.6-6.4 (3 species)**
	FY2014 Oct.-Nov.	–	–	–	0.28	–	–	–	0.43-1.5 (4 species)
	FY2014 Aug.-Sep.	–	–	–	0.43	–	–	–	1.9-2.9 (3 species)
	FY2014 Jun.-Jul.	–	–	–	3.2	–	–	0.30	2.2-3.5 (4 species)
Location L off Soma City (Matsukawaura Bay)	**FY2014 Dec.**	**N.D.-12.3 (3 species)**	**29.4**	**–**	**1.5-10.6 (4 species)**	**1.87; 2.45 (2 species)**	**–**	**–**	**N.D.-20.2 (3 species)**
	FY2014 Oct.-Nov.	0.46-690 (3 species)	–	–	7.3; 8.6 (2 species)	3.67; 3.91 (2 species)	–	–	2.3-3.6 (4 species)
	FY2014 Aug.-Sep.	0.63-105 (3 species)	–	–	N.D.-8.0 (5 species)	2.5; 3.5 (2 species)	–	–	N.D.-58 (6 species)
	FY2014 Jun.-Jul.	1.7-288 (3 species)	38	–	N.D.-15 (4 species)	0.85; 2.9 (2 species)	–	–	2.1-73 (3 species)
Location M off Iwaki City (Hisanohama)	**FY2014 Dec.**	**2.80**	**–**	**1.86**	**–**	**N.D.**	**–**	**–**	**1.55-21.0 (7 species)**
	FY2014 Oct.-Nov.	2.17	–	N.D.; 3.42 (2 species)	1.66	0.53	–	–	0.65-12.4 (15 species)
	FY2014 Aug.-Sep.	0.50	–	0.44; 3.1 (2 species)	0.93	0.57	–	–	1.1-30 (13 species)
	FY2014 Jun.-Jul.	0.71; 8.2 (2 species)	–	N.D.-10 (4 species)	–	3.0	–	–	0.92-55 (14 species)

* ND means to be below the detection limit.
* Basically, measurement was conducted for all targeted samples.