FY2015 Radioactive Material Monitoring of Aquatic Organisms (July to September)

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: July 15, 2015, to September 22, 2015).

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	August 25, 2015	Algae,flora, aquatic insects, crustaceans, shellfish, fish, amphibians, fallen leaves, etc.
				Water/sediment sampling	August 18, 2015	(Water sampling) A-1, A-2 (Sediment sampling) A-1, A-2
	B		Confluence with the Matsukawa River (a tributary) to Taisho Bridge; Surikami River (a tributary)	Aquatic organisms sampling	July 15, August 4, 21, 23, 25, 30, September 6, and 22, 2015	Algae,flora, aquatic insects, crustaceans, fish, amphibians, fallen leaves, etc.
				Water/sediment sampling	August 18, 2015	(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	August 19, 2015	Algae,flora, aquatic insects, crustaceans, fish, amphibians, fallen leaves, etc.
				Water/sediment sampling	August 19, 2015	(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	August 20, and 22, 2015	Algae,flora, aquatic insects, crustaceans, shellfish, fish, fallen leaves, etc.
				Water/sediment sampling	August 20, 2015	(Water sampling) D-1—D-5 (Sediment sampling) D-1—D-3, D-4a, D-5
	E	Niida River	Kayanoki Bridge to Sugauchi Bridge	Aquatic organisms sampling	August 22, 2015	Algae,flora, aquatic insects, crustaceans, fish, amphibians, fallen leaves, etc.
				Water/sediment sampling	August 22, 2015	(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	August 21, 2015	Algae,flora, aquatic insects, crustaceans, fish, fallen leaves, etc.
				Water/sediment sampling	August 21, 2015	(Water sampling) F-1—F-6 (Sediment sampling) F-1—F-5
	G	Lake Hayama		Aquatic organisms sampling	August 18, 24, and September 5, 2015	Algae,flora, aquatic insects, crustaceans, fish, fallen leaves, etc.
				Water/sediment sampling	August 24, 2015	(Water sampling) G-1, G-3, G-5 (Sediment sampling) G-1—G-5
Lake area	H	Lake Akimoto		Aquatic organisms sampling	August 26, 27, and September 10, 2015	Algae,flora, aquatic insects, crustaceans, shellfish, fish, amphibians, fallen leaves, etc.
				Water/sediment sampling	August 27, 2015	(Water sampling) H-1, H-3, H-5 (Sediment sampling) H-1—H-5
	I	Lake Inawashiro	North bank	Aquatic organisms sampling	August 26, 2015	Fish, fallen leaves, etc.
				Water/sediment sampling	August 27, 2015	(Water sampling) I-1, I-3 (Sediment sampling) I-1—I-4
	J		South bank	Aquatic organisms sampling	August 9, 10, 21, 22, 26, and 27, 2015	Algae,flora, shellfish, fish, amphibian
				Water/sediment sampling	August 27, 2015	(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	August 19, 2015	Crustaceans, Fish
				Water/sediment sampling	August 19, 2015	(Water sampling) K-2 (Sediment sampling) K-1—K-3
	L	Offshore of Soma City	Matsukawaura	Aquatic organisms sampling	August 20, 2015	Seaweed,algae, crustaceans, shellfish, fish
				Water/sediment sampling	August 20, 2015	(Water sampling) L-2, L-3 (Sediment sampling) L-1—L-3
	M	Offshore of Iwaki City	Offshore of Hisanohama	Aquatic organisms sampling	August 21, 2015	Seaweed,algae, sea urchin, crustaceans, shellfish, fish
				Water/sediment sampling	August 21, 2015	(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, 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.

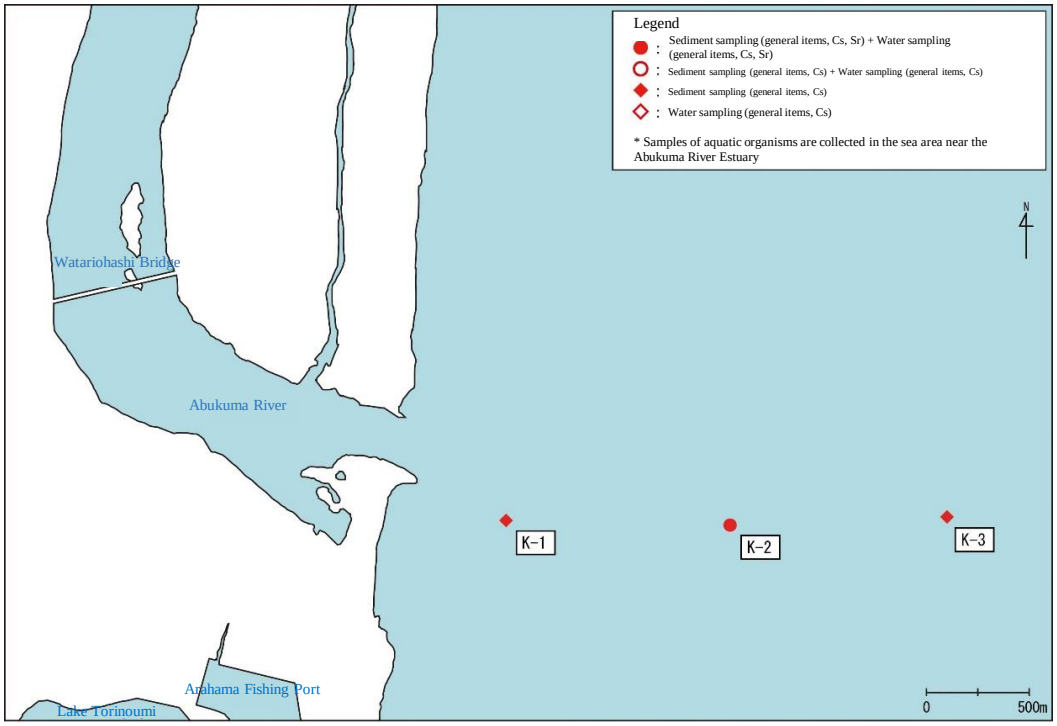
○ Survey targets and items

Target	Measurement item		Analyzed samples
Aquatic Organisms	Radioactive materials	Radioactive cesium (Cs-134,Cs-137)	All samples
		Radioactive strontium (Sr-90)	Large fish
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
		BOD (Biological oxygen demand)	
		COD (Chemical oxygen demand)	
		DO (Dissolved oxygen level)	
		Electrical conductivity	
		Salinity	
		TOC (Total organic carbon)	
		SS (Suspended solids)	
		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 (Total organic carbon)	
		IL (Ignition loss)	
		Soil particle density	
		Grainsize distribution	

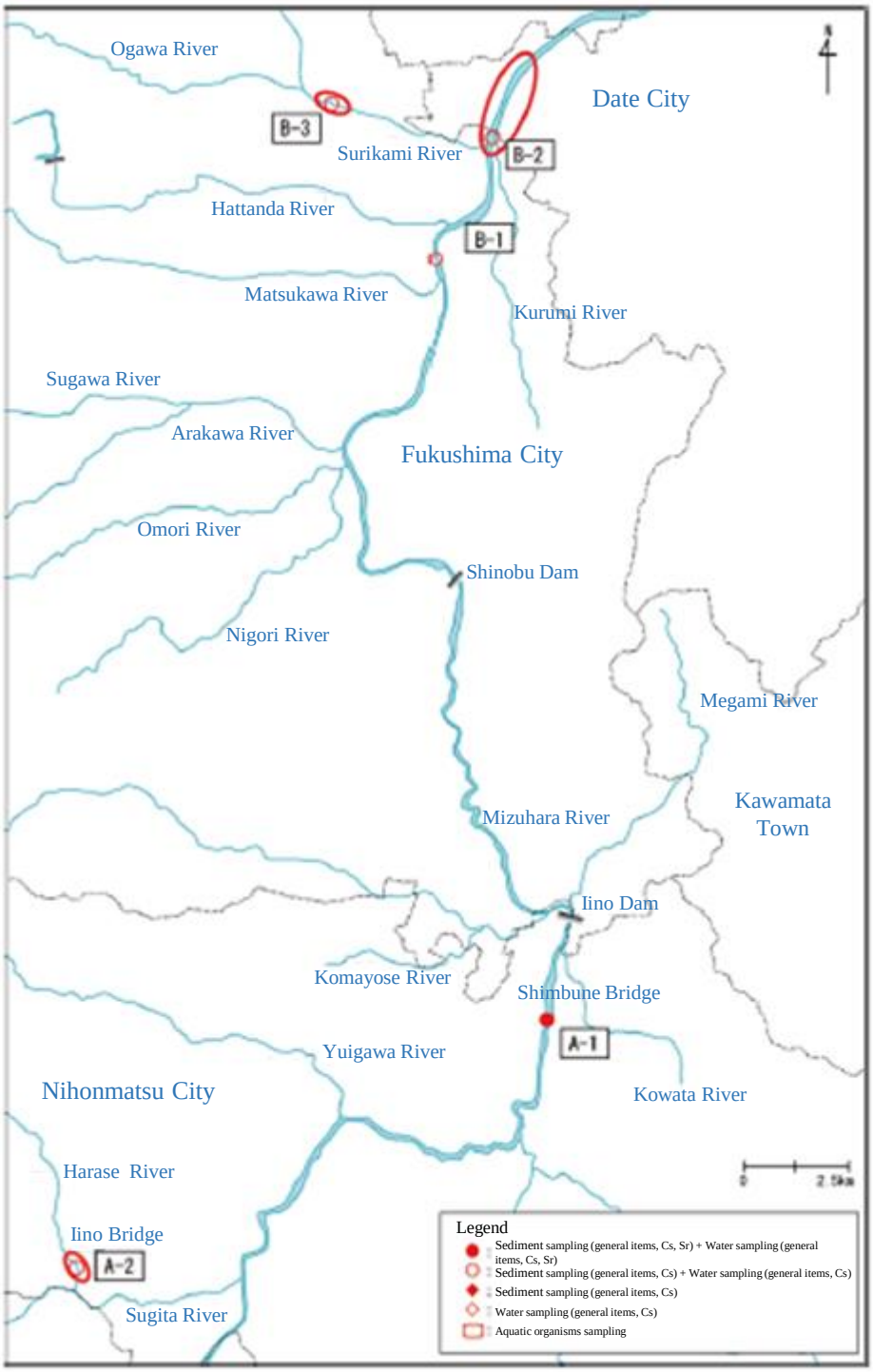
2.2 Survey Locations at Respective Water Areas

(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 Iino 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.



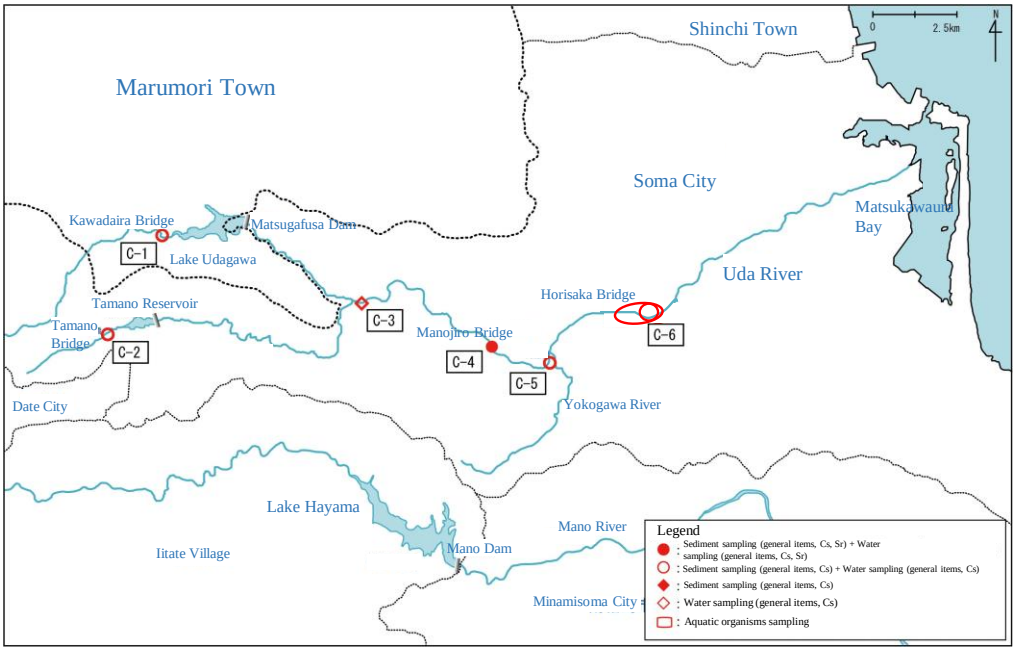
Detailed map showing Location K off the mouth of the Abukuma River



Map showing Location A and Location B along the Abukuma River

(2) Location C along the Uda River

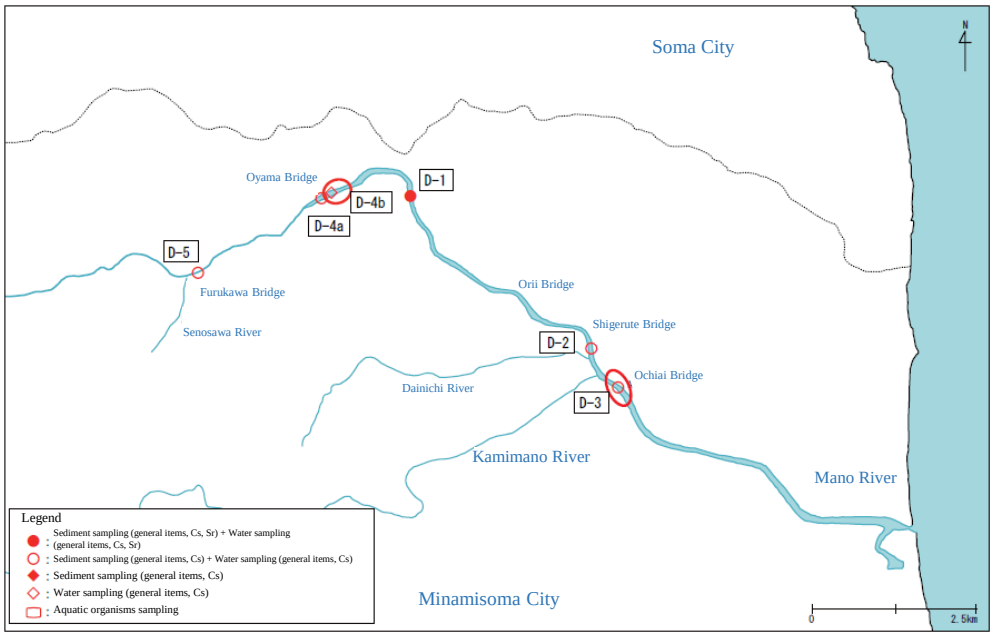
Surveys were started in the autumn term of FY2012 for the location from Kawahira Bridge to Horisaka Bridge, where water flows into the Matsugafusa Dam (Lake Udagawa), and around Tamano Bridge, where water flows into the Tamano Reservoir (a tributary to the Tamano River).



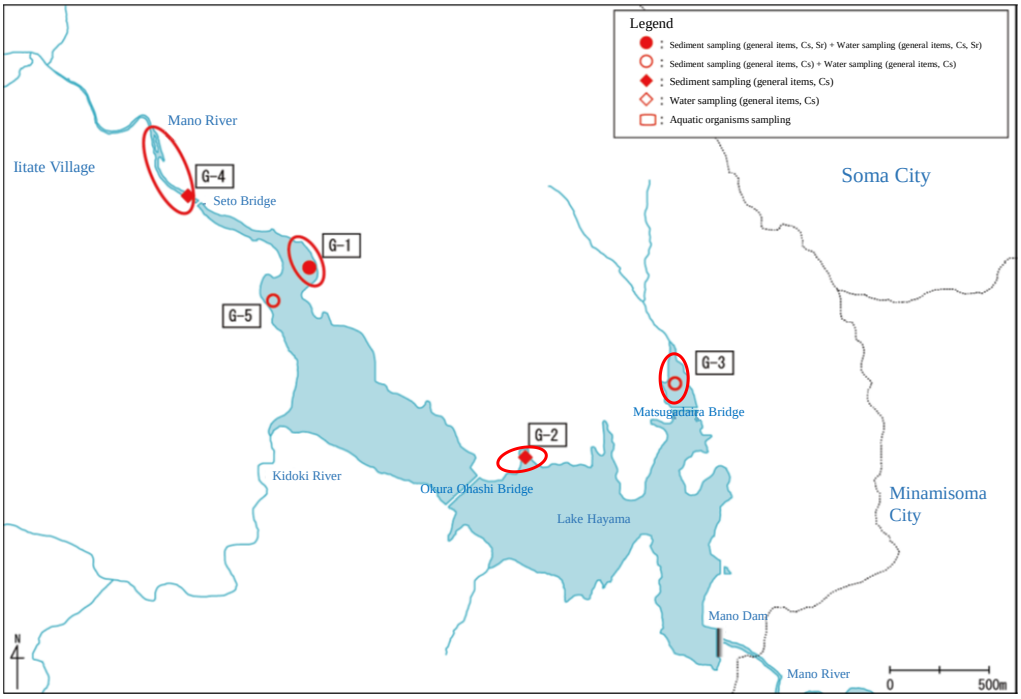
Detailed map showing Location C along the Uda River

(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 Zennami Bridge to Ochiai Bridge (Kashima Ward, Minamisoma City, Fukushima Prefecture), and at Location G in Lake Hayama (Mano Dam), which covers the lake as a whole and inflow points.



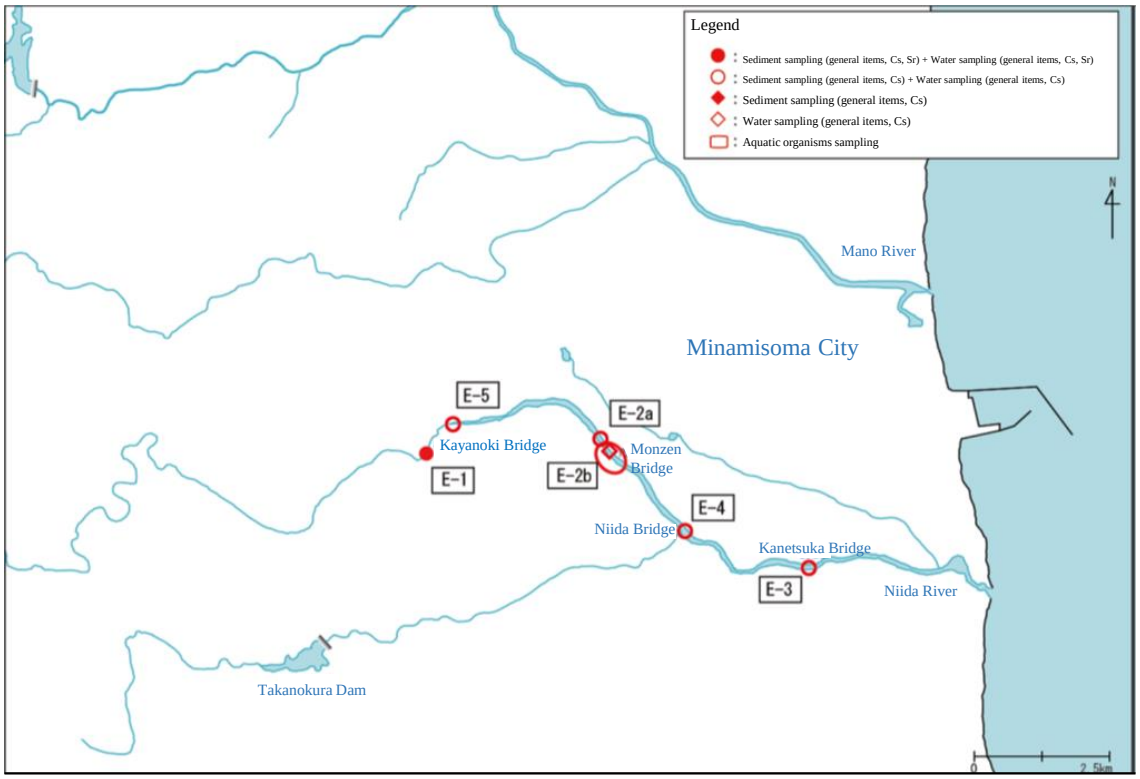
Detailed map showing Location D along the Mano River



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

(4) Location E along the Niida River

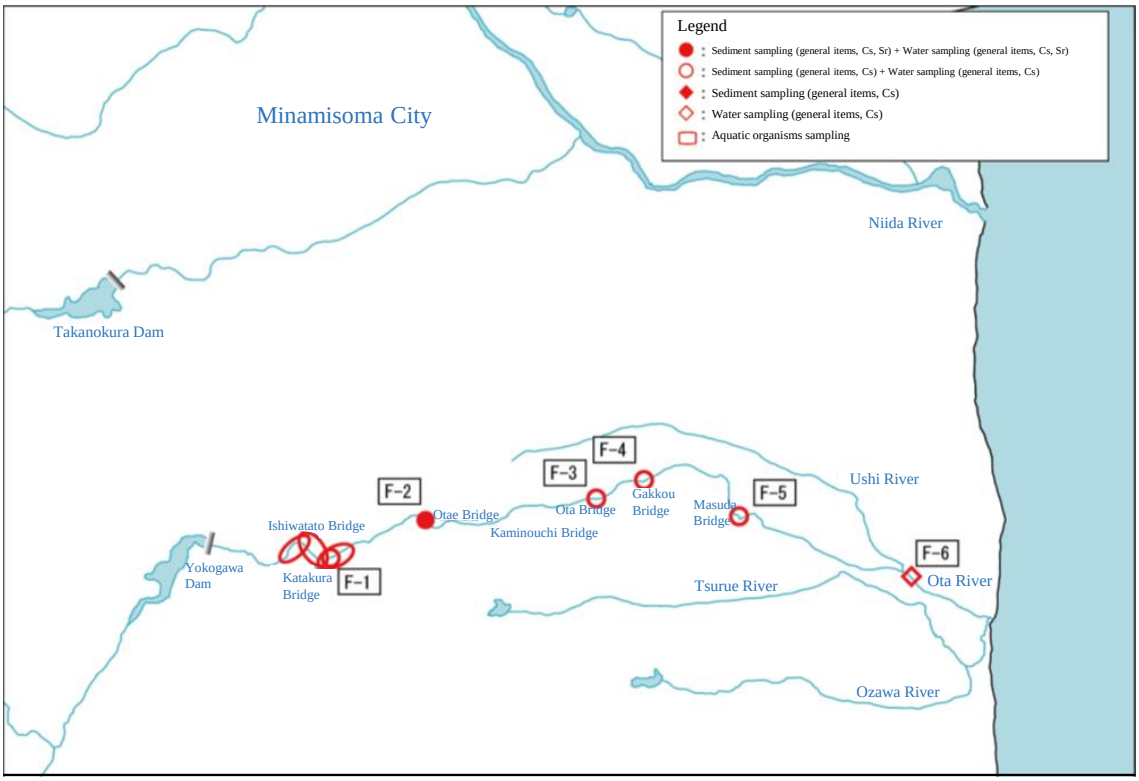
Surveys were conducted from Kayanoki Bridge to Sugauchi Bridge.



Detailed map showing Location E along the Niida River

(5) Location F along the Ota River

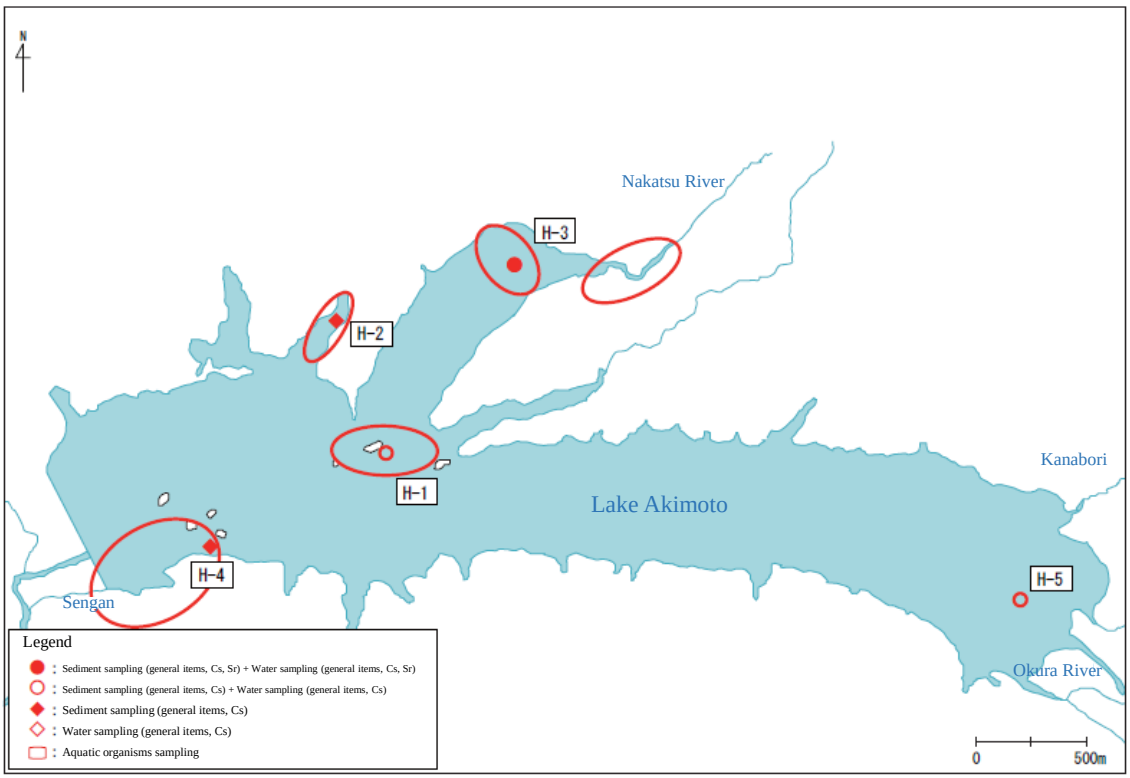
Surveys were started in the autumn term of FY2012 for the location from Yaeyonezaka Bridge to Memezawa District.



Detailed map showing Location F along the Ota River

(6) Location H in Lake Akimoto

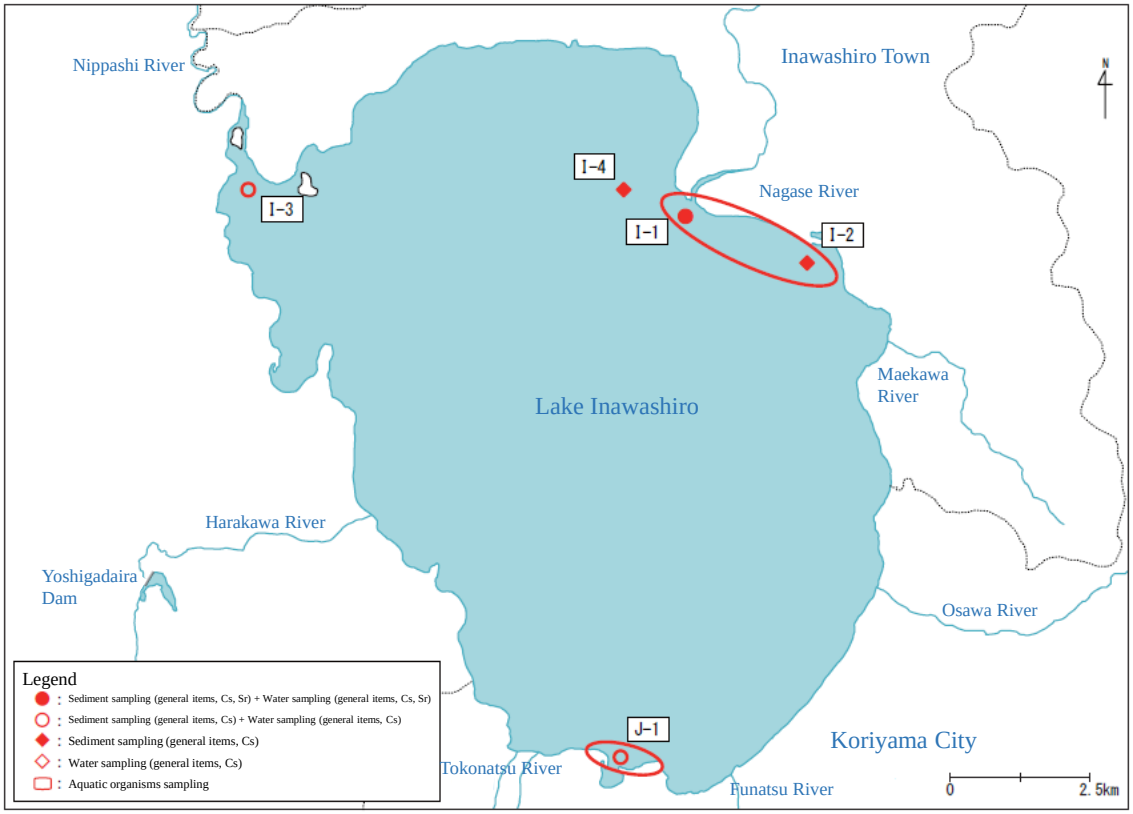
Surveys were conducted in the whole area of Lake Akimoto, the confluence with the Nakatsu River, and around Lake Akimoto.



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.

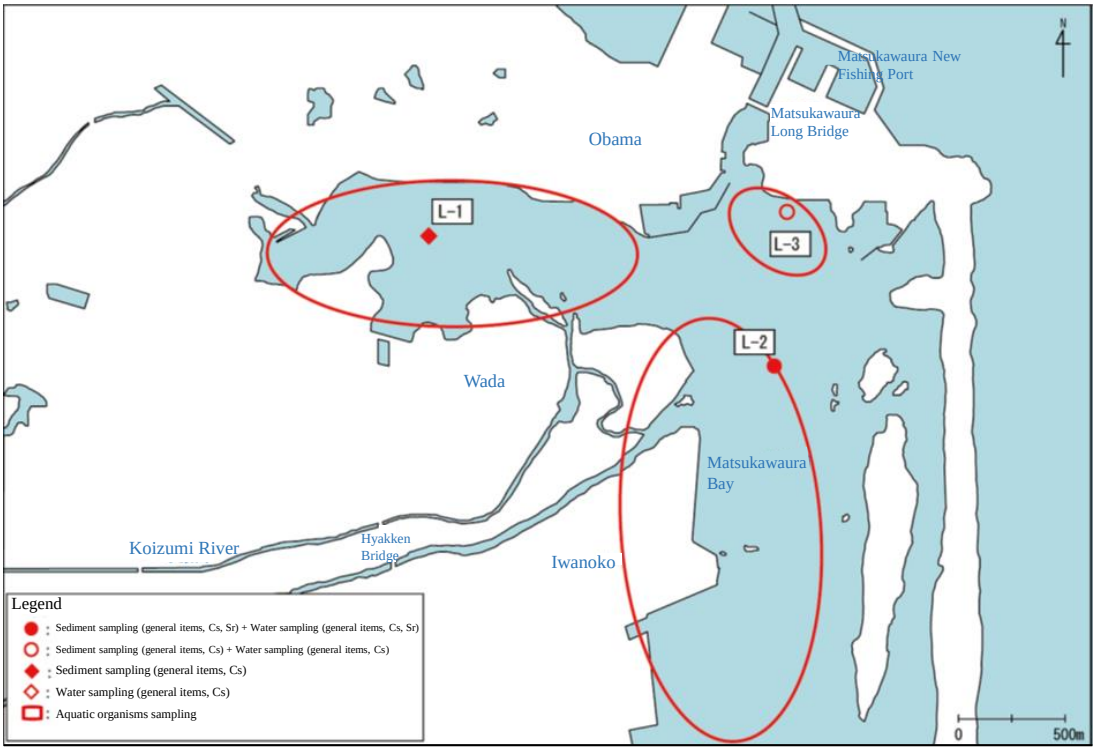


Detailed map showing Location I (north lakeside) and Location J (south lakeside) in Lake Inawashiro

(8) Location L off Soma City

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

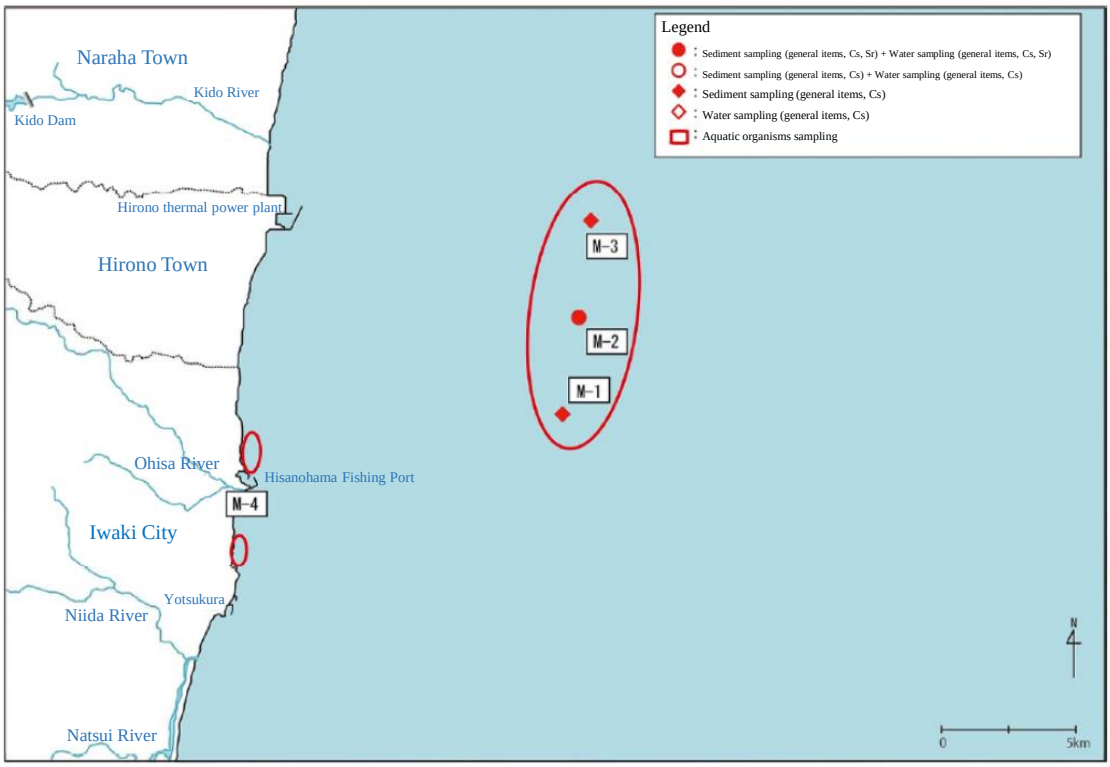
Sampling point in Location L-2 was expanded to the south in the FY2015 survey because sampling was impossible at the conventional point due to bank protection work.



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.

Regarding concentrations of radioactive cesium in the water environment, concentrations in sediment samples collected from the same river system tend to be higher for those collected at zones where water stalls (dams, etc.), as in the cases of 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	Crustaceans	Shellfish (Molluscan body)	Fish	Amphibia	CPOMs (fallen leaves, etc.)
Abukuma River System	Abukuma River A	FY2015 Aug.	175	25.1 , 27.7 (2 species)	35.2	17.3	12.6 - 16.4 (4 species)	52	288
		FY2015 Jun.	257	19.8 - 40.3 (3 species)	16.4 , 21.4 (2 species)	26.3	5.2 - 14.8 (5 species)	8.8 - 152 (3 species)	442
	Abukuma River B	FY2015 Jul. - Sep.	123	5.2 - 50.9 (3 species)	22.7	–	9.0 - 136 (14 species)	111	36.8
		FY2015 Jun.	8.5 , 125 (2 species)	4.6 - 41 (3 species)	25.4	68	N.D. - 66 (9 species)	138 , 267	30
Uda River C		FY2015 Aug.	249	11 , 23.5 (2 species)	19.1 , 24.2 (2 species)	–	9.8 - 30.5 (3 species)	–	23.8
		FY2015 Jun.	439	6.9 - 88 (3 species)	19.3 - 32.9 (3 species)	–	6.5 - 20.8 (4 species)	34.3	118
Mano River System	Lake Hayama G	FY2015 Aug. - Sep.	17.6 , 1640 (2 species)	38.6 - 227 (3 species)	71	–	58 - 600 (6 species)	–	351
		FY2015 Jun. - Jul.	N.D. , 2140 (2 species)	76	122	–	9.7 - 650 (12 species)	–	403
	Mano River D	FY2015 Aug.	192	29.0 - 89 (3 species)	37.2 , 163 (2 species)	288	18.8 - 150 (6 species)	–	426
		FY2015 Jun. - Jul.	192	19.4 - 190 (3 species)	75 - 164 (4 species)	100	14.4 - 203 (14 species)	–	236
Niida River E		FY2015 Aug.	341	71 - 300 (3 species)	70 , 82 (2 species)	–	56 - 212 (6 species)	1070	172
		FY2015 Jun.	680	59 - 472 (3 species)	163 , 202 (2 species)	–	44.5 - 193 (8 species)	–	358
Ota River F		FY2015 Aug.	421	150 - 478 (3 species)	186 - 570 (3 species)	–	540 , 1050 (2 species)	–	76
		FY2015 Jun.	1810	140 - 520 (3 species)	431 - 620 (3 species)	–	247 - 930 (4 species)	361 , 488 (2 species)	69

* 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, not limited to edible parts.
* 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.

Unit: Bq/kg-wet

Water area		Time	Algae, Flora	Aquatic insects	Crustaceans	Shellfish (Molluscan body)	Fish	Amphibia	CPOMs (fallen leaves, etc.)
Lake Akimoto H		FY2015 Aug. - Sep.	122 , 197 (2 species)	9.2	42.8	21.6	18.3 - 74 (9 species)	14.1 , 33.6 (2 species)	108
		FY2015 Jun.	13.8 , 219 (2 species)	N.D. - 229 (3 species)	39	7.1	16.3 - 126 (12 species)	10.5 - 151 (3 species)	42.4
Lake Inawashiro	Lake Inawashiro I (north lakeside)	FY2015 Aug.	–	–	–	–	8.9 - 104 (5 species)	–	42.2
		FY2015 Jun.	–	–	–	–	5.9 - 95 (9 species)	–	25.6
	Lake Inawashiro J (south lakeside)	FY2015 Aug.	0.89 - 1.6 (3 species)	–	–	1.6	N.D. - 30.1 (7 species)	0.7 , 1.9 (2 species)	–
		FY2015 Jun.	N.D. - 28 (3 species)	N.D.	8.9	N.D. , 3.1 (2 species)	N.D. - 56 (11 species)	1.7 - 19.1 (3 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, not limited to edible parts.
* 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 (Molluscan body)	Squid, octopus	Fish
Location K off the mouth of the Abukuma River	FY2015 Aug.	–	–	–	0.29	–	–	N.D. - 6.2 (5 species)
	FY2015 Jun.	–	–	–	0.35	–	–	0.41 - 1.33 (6 species)
Location L off Soma City (Matsukawaura Bay)	FY2015 Aug.	3.43 , 11.2 (2 species)	–	–	1.3 , 2.1 (2 species)	1.41 , 2.00 (2 species)	–	2.8 - 14.8 (3 species)
	FY2015 Jun.	0.47 - 34 (3 species)	–	–	N.D. - 3.66 (3 species)	0.80 , 2.03 (2 species)	–	N.D. - 3.7 (8 species)
Location M off Iwaki City (Hisanohama)	FY2015 Aug.	10.0	–	0.79	2.34	0.72	–	0.95 - 30.8 (9 species)
	FY2015 Jun.	N.D.	–	2.9 , 3.13 (2 species)	–	0.66	–	N.D. - 11.9 (16 species)

* ND means to be below the detection limit.

* Basically, measurement was conducted for all targeted samples, not limited to edible parts.