

FY2013 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 3, 2013, to December 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

○ Survey locations and dates

Area	Targeted water areas	Zone	Item	Survey dates	Remarks	
River area	A	Shinfuno Bridge to the Inoentei Dam; Harase River (a tributary)	Aquatic organisms sampling	December 6, 2013	Algae, insects, crustaceans, shellfish, fish, amphibians	
			Water/sediment sampling	December 3, 2013	(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 7, and 10, 2013	Algae, insects, fish, coarse particulate organic matters
				Water/sediment sampling	December 3, 2013	(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 10, 2013	Algae, insects, crustaceans, fish, amphibians, coarse particulate organic matters
				Water/sediment sampling	December 4, 2013	(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 11, 2013	Algae, insects, crustaceans, shellfish, fish, amphibians
				Water/sediment sampling	December 9, 2013	(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 8, 2013	Algae, insects, crustaceans, fish, coarse particulate organic matters
				Water/sediment sampling	December 12, 2013	(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 12, 2013	Algae, insects, crustaceans, fish, coarse particulate organic matters
				Water/sediment sampling	December 13, 2013	(Water sampling) F-1—F-6 (Sediment sampling) F-1—F-5
	G	Lake Hayama		Aquatic organisms sampling	December 9, 2013	Algae, insects, fish, coarse particulate organic matters
				Water/sediment sampling	December 9, 2013	(Water sampling) G-1, G-3, G-5 (Sediment sampling) G-1—G-5
Lake area	H	Lake Akimoto	Aquatic organisms sampling	December 3, 2013	Algae, crustaceans, shellfish, fish, amphibians	
			Water/sediment sampling	December 3, 2013	(Water sampling) H-1, H-3, H-5 (Sediment sampling) H-1—H-5	
	I	Lake Inawashiro	North bank	Aquatic organisms sampling	December 4, 2013	Coarse particulate organic matters
			Water/sediment sampling	December 4, 2013	(Water sampling) I-1, I-3 (Sediment sampling) I-1—I-4	
	J	Lake Inawashiro	South bank	Aquatic organisms sampling	December 4, 2013	Algae, shellfish, fish, amphibian
			Water/sediment sampling	December 4, 2013	(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 13, 2013	Crustaceans, fish
			Water/sediment sampling	December 18, 2013	(Water sampling) K-2 (Sediment sampling) K-1—K-3	
	L	Offshore of Soma City	Matsukawaura	Aquatic organisms sampling	December 10, 2013	Algae, crustaceans, shellfish
Water/sediment sampling				December 10, 2013	(Water sampling) L-2, L-3 (Sediment sampling) L-1—L-3	
M	Offshore of Iwaki City	Offshore of Hisanohama	Aquatic organisms sampling	December 5, 2013	Algae, echinoderm, shellfish, fish	
			Water/sediment sampling	December 5, 2013	(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 or where clay particles and coarse particulate organic matters (CPOMs) 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.

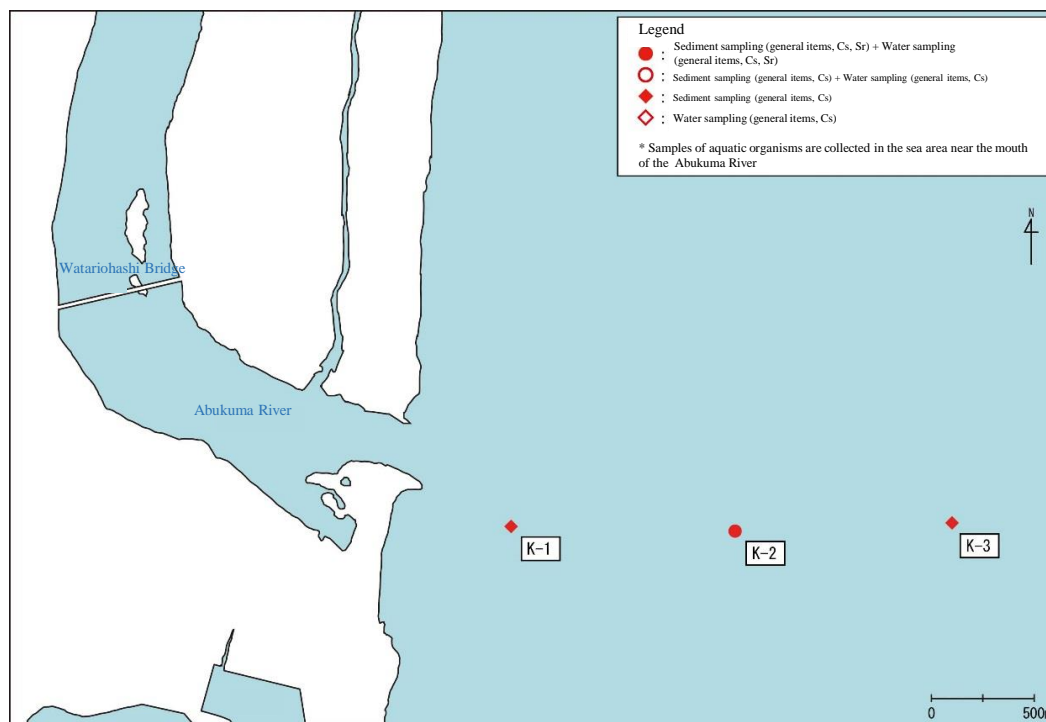
○ Survey targets and items

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			

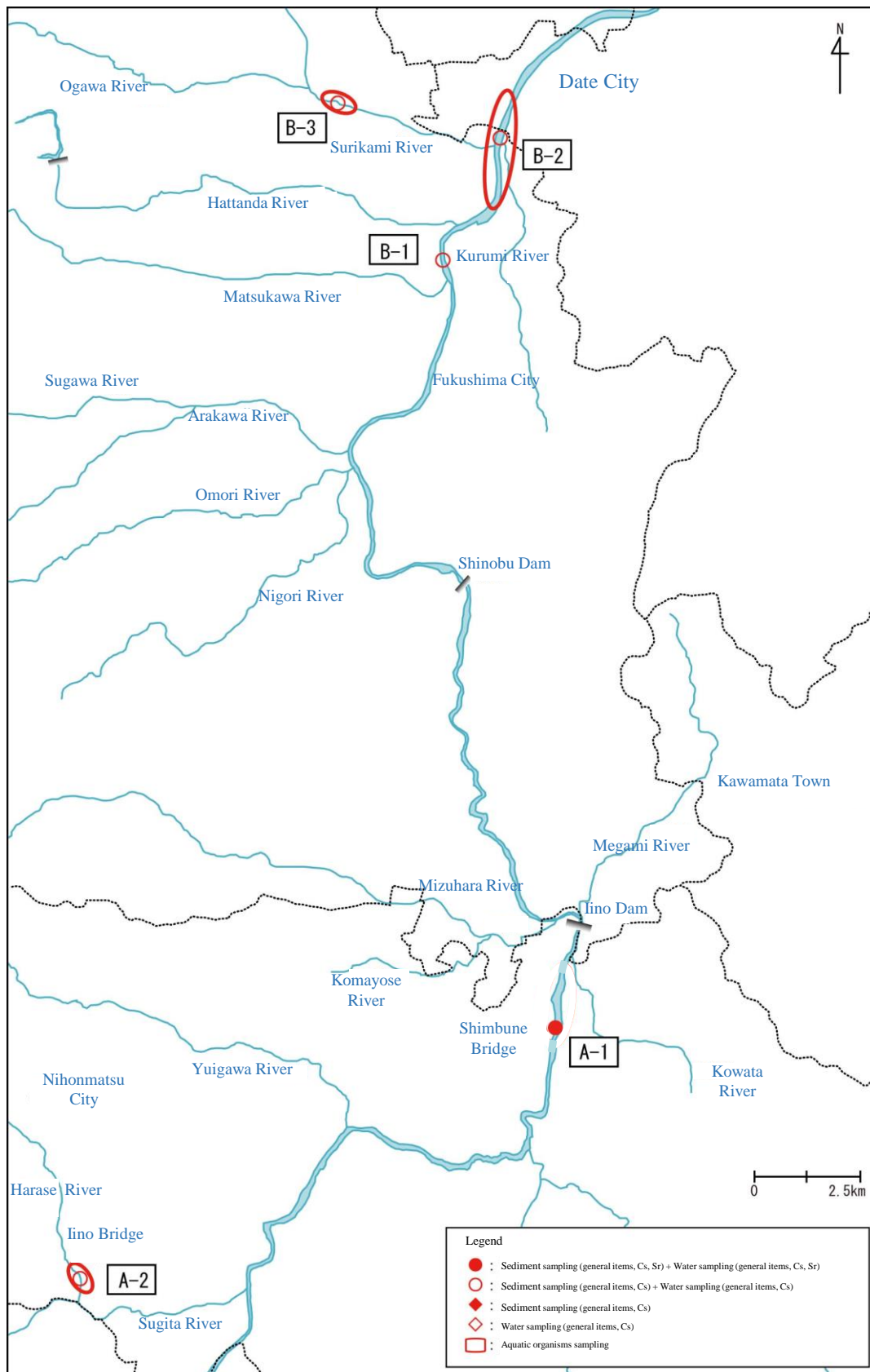
2.2 Survey Locations at Respective Water Areas

(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 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.



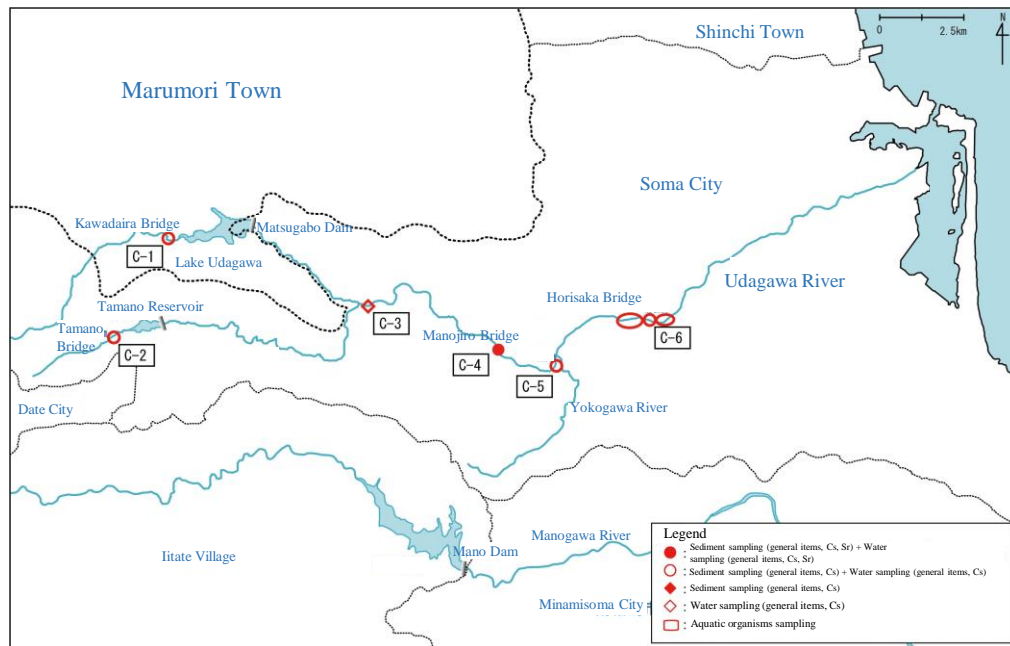
Detailed map showing Location K off the mouth of the Abukuma River



Map showing Location A and Location B along the Abukuma River

(2) Location C along the Uda River

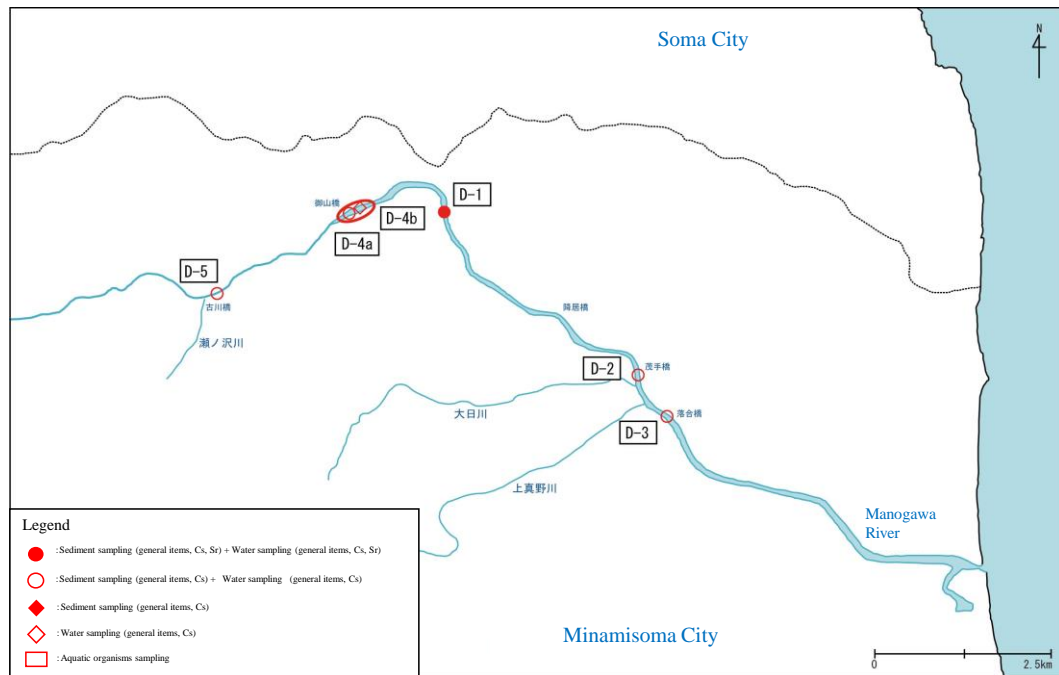
Surveys were started in the autumn term of FY2012 for the location from Kawahira Bridge to Horiita Bridge, where water flows into the Matsugafusa Dam (Lake Uda), and around Tamano Bridge, where water flows into the Tamano Reservoir (a tributary to the Tamano River).



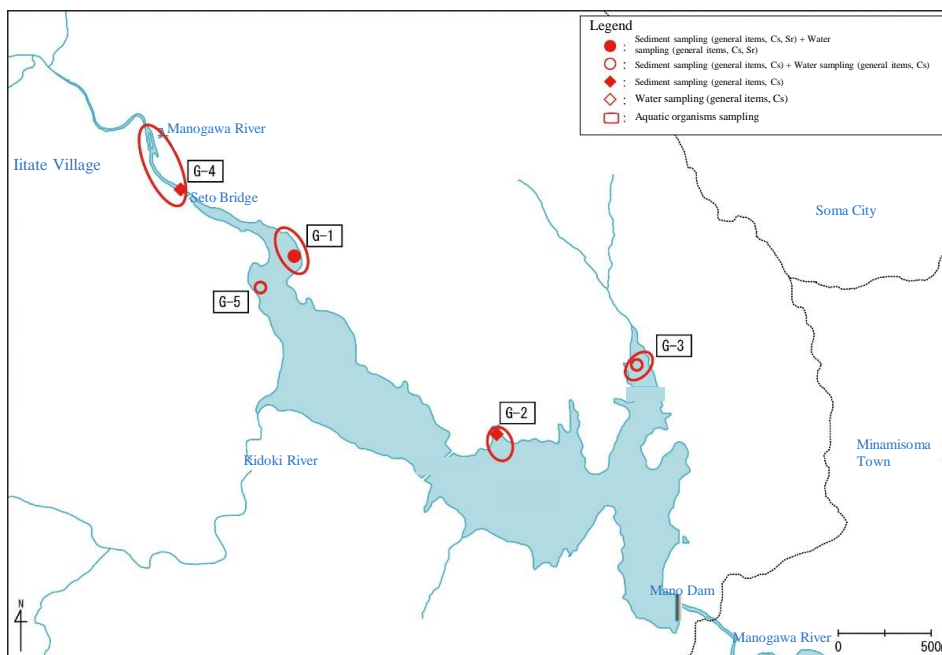
Detailed map showing Location C along the Uda River

(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.



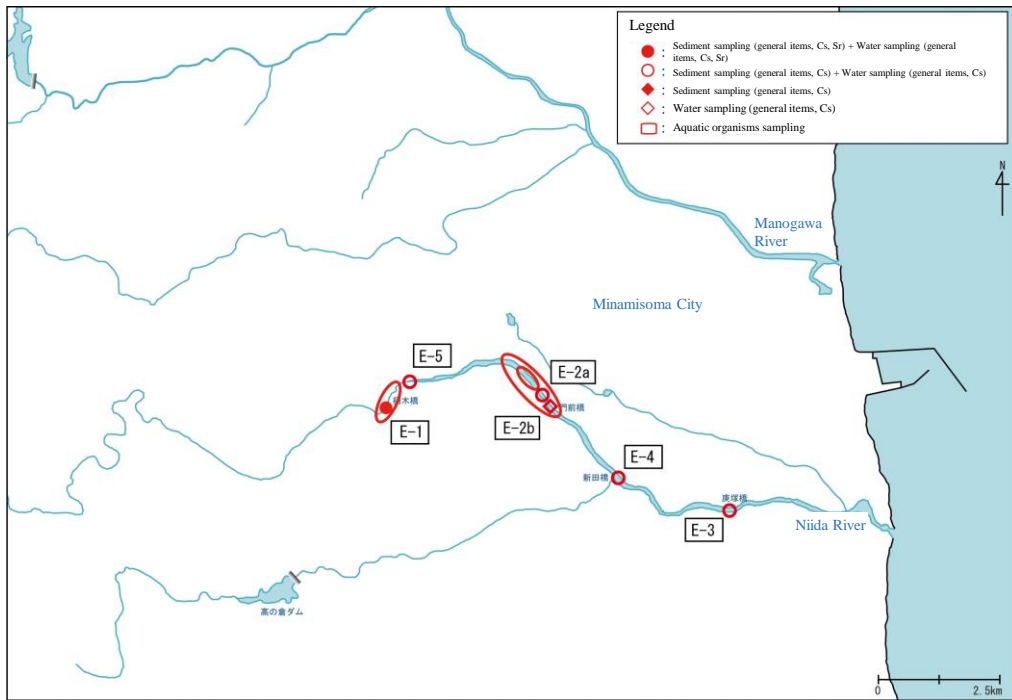
Detailed map showing Location D along the Mano River



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

(4) Location E along the Niida River

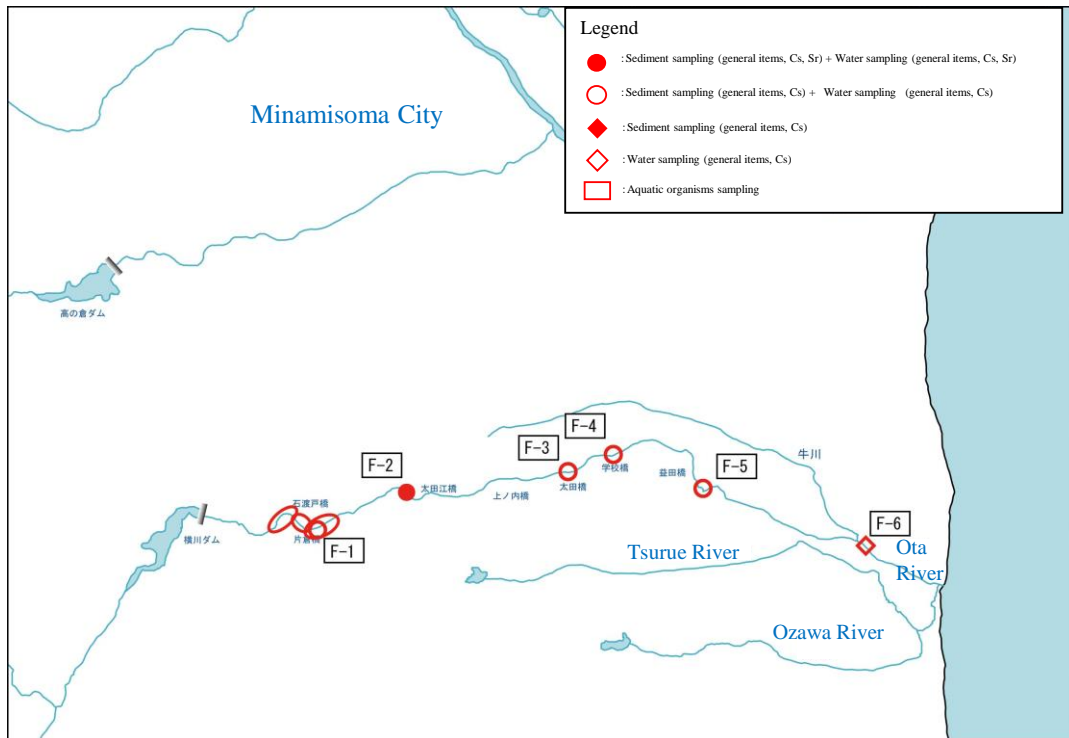
Surveys were conducted from Kayanoki Bridge to Sugauchi Bridge.



Detailed map showing Location E along the Niida River

(5) Location F along the Ota River

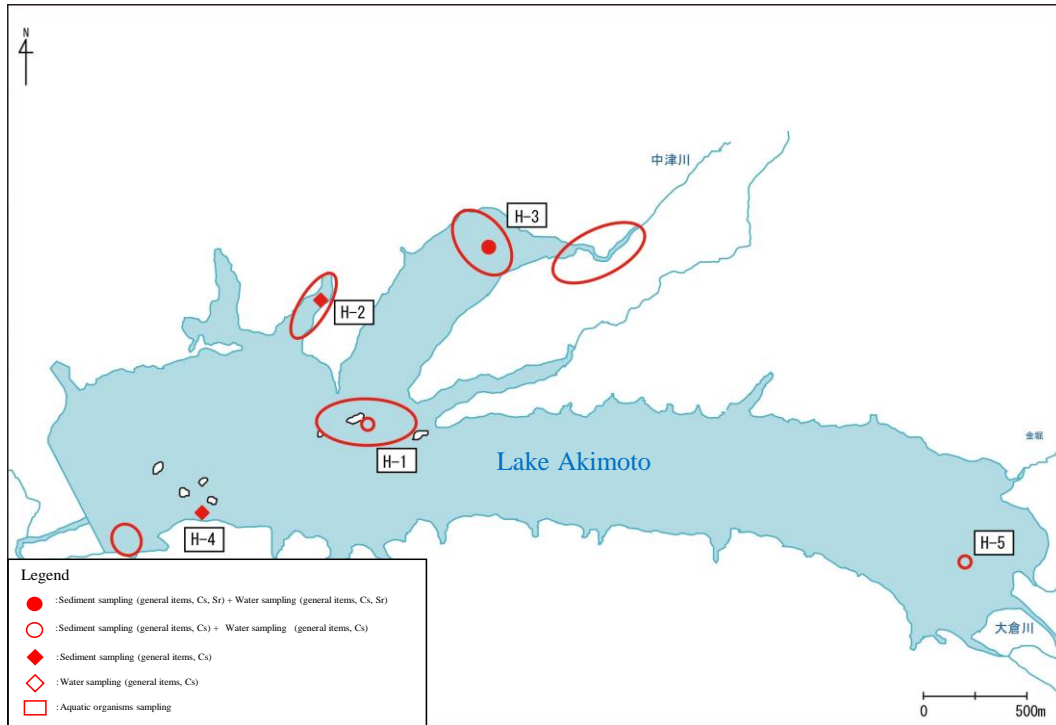
Surveys were started in the autumn term of FY2012 for the location from Yaeyonezawa Bridge to Memezawa District.



Detailed map showing Location F along the Ota River

(6) Location H in Lake Akimoto

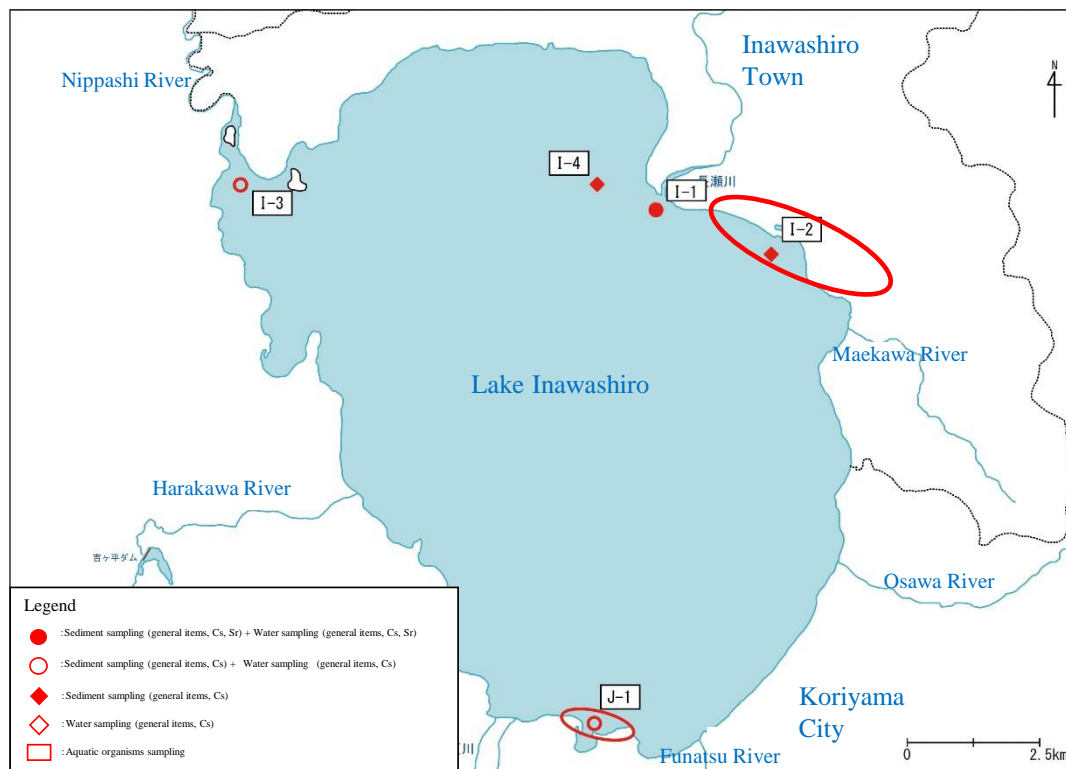
Surveys were conducted in the whole area of Lake Akimoto, the confluence with the Nakatsu River, and around Lake Akimoto.



Detailed map showing Location H in Lake Akimoto

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

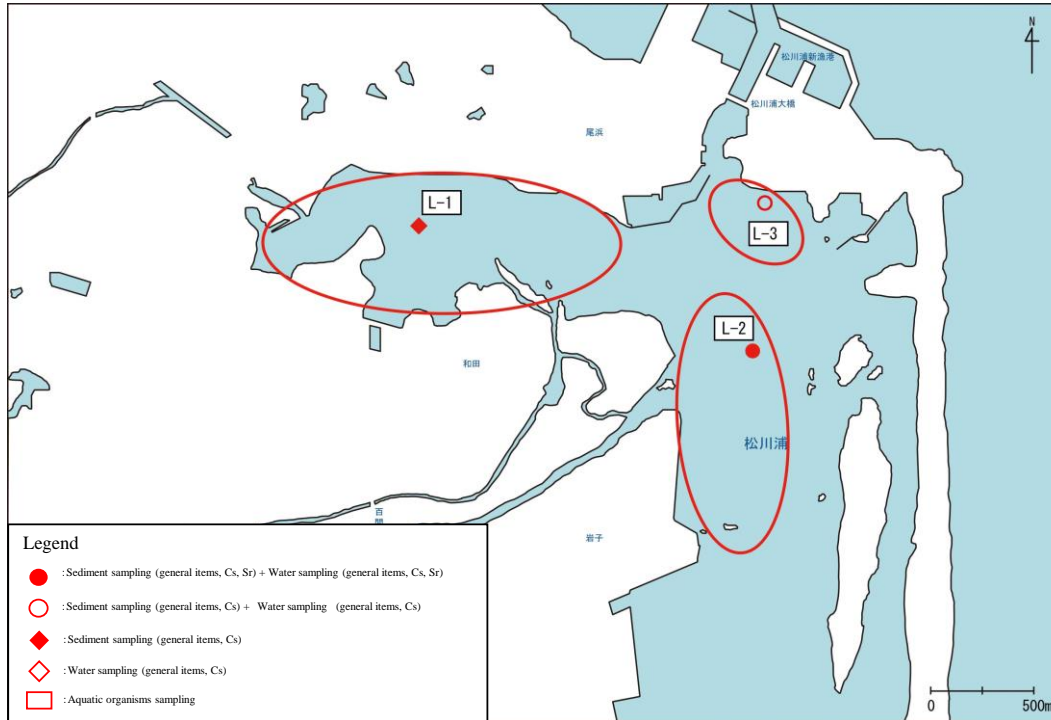
Surveys were conducted at around the point where the Nagase River inflows into Lake Inawashiro, and at around the point where lake water flows out into the Nippashi River (at the north lakeside), and at the south lakeside.



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

(8) Location L off Soma City

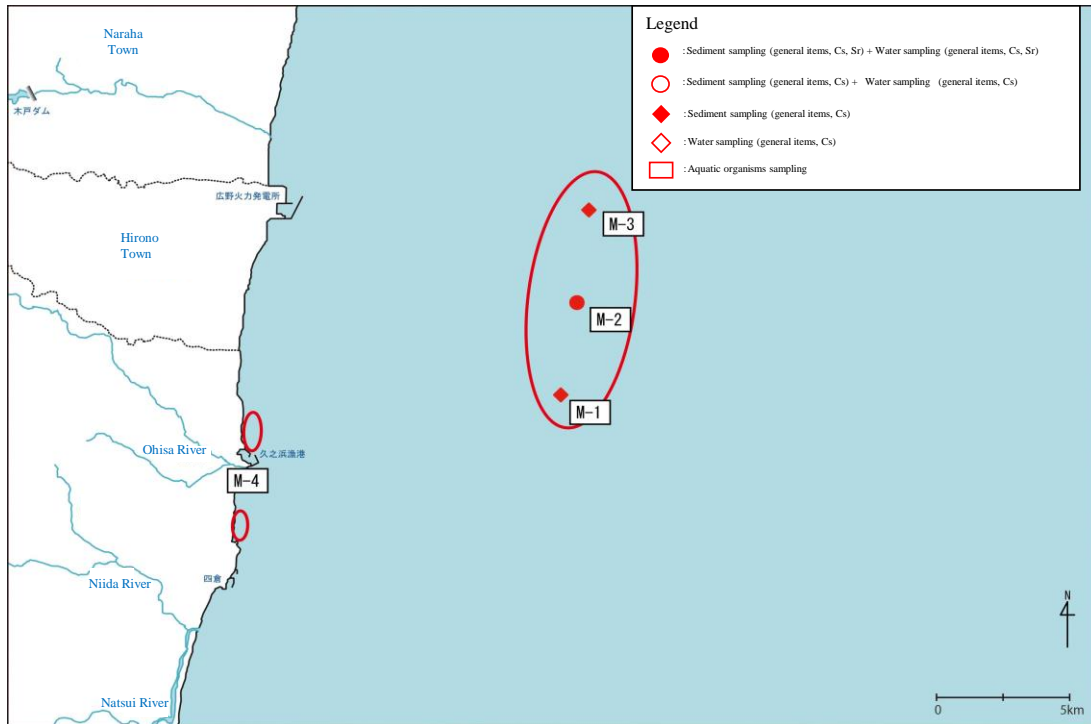
Surveys were conducted within the Matsukawaura Bay, centering on the estuary region of the Uda River.



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	Flora (algae, etc.)	Aquatic insects	Spider s	Crustaceans	Shellf ish	Fish	Amphibi a	CPOMs (fallen leaves, etc.)
Abukuma River System	Abukuma River A	FY2013 Dec.	284	41; 57 (2 species)	—	37	18	22-45 (4 species)	20; 330 (2 species)	—
		FY2013 Oct.-Nov.	340	26	—	157	19	19-41 (4 species)	20-278 (3 species)	—
		FY2013 Aug.-Sep.	460	44; 131 (2 species)	—	40	16	14-69 (7 species)	22-299 (3 species)	—
		FY2013 Jul.	730	39; 202 (2 species)	—	76	28	32-42 (3 species)	49-330 (3 species)	830
	Abukuma River B	FY2013 Dec.	134	11-152 (4 species)	—	—	—	44-109 (3 species)	—	76
		FY2013 Oct.-Nov.	144	7.8-118 (3 species)	146	33	—	5.9-55 (9 species)	40; 302 (2 species)	157
		FY2013 Aug.-Sep.	171	11-124 (3 species)	—	64	—	16-162 (15 species)	68; 296 (2 species)	204
		FY2013 Jul.	N.D.; 450 (2 species)	15-198 (4 species)	—	62	120	14-274 (10 species)	49; 550 (2 species)	165
Uda River C	FY2013 Dec.	360	27-110 (3 species)	—	34	—	27; 77 (2 species)	—	33	
	FY2013 Oct.-Nov.	307	25; 30 (2 species)	—	37-51 (3 species)	—	16-143 (5 species)	18	520	
	FY2013 Aug.-Sep.	54; 520 (2 species)	20-180 (3 species)	—	29-44 (3 species)	—	19-140 (5 species)	33	147	
	FY2013 Jul.	520	21-283 (3 species)	—	29-55 (3 species)	—	45-141 (3 species)	12; 16 (2 species)	205	
Mano River System	Lake Hayama G (Mano Dam)	FY2013 Dec.	56; 620 (2 species)	71; 86 (2 species)	—	—	—	60-1,430 (7 species)	—	243
		FY2013 Oct.-Nov.	38; 1,830 (2 species)	80; 99 (2 species)	—	216	70	145-1,580 (5 species)	—	500
		FY2013 Aug.-Sep.	22-1,470 (3 species)	97-1,430 (3 species)	—	307	—	204-770 (7 species)	—	590
		FY2013 Jul.	10-3,400 (4 species)	89; 340 (2 species)	—	—	—	225-2,650 (6 species)	—	560
	Mano River D	FY2013 Dec.	N.D-910 (3 species)	44-440 (3 species)	—	161	28	90; 205 (2 species)	610	188
		FY2013 Oct.-Nov.	N.D.; 460 (2 species)	67-410 (3 species)	—	57-340 (3 species)	69	N.D.-1,860 (6 species)	460	—
		FY2013 Aug.-Sep.	9.9-400 (4 species)	63-159 (3 species)	—	161-450 (3 species)	42	46-191 (5 species)	570	—
		FY2013 Jul.	14-1,610 (3 species)	59-222 (3 species)	—	180; 350 (2 species)	99	6-254 (7 species)	420; 1,100 (2 species)	670
Niida River E	FY2013 Dec.	1,810	32-800 (3 species)	—	306; 360 (2 species)	—	197-254 (3 species)	—	400	

	FY2013 Oct.-Nov.	1,740	221; 1,100 (2 species)	—	301-430 (3 species)	—	138-660 (8 species)	1,600	—
	FY2013 Aug.-Sep.	269; 3,200 (2 species)	221; 1,290 (2 species)	222	319	—	116-500 (9 species)	4,100	500
	FY2013 Jul.	9.3; 4,000 (2 species)	270; 1,500 (2 species)	—	400; 740 (2 species)	—	198-460 (7 species)	—	870
	FY2013 Dec.	305; 5,600 (2 species)	295-1,430 (3 species)	—	1,220	—	930; 2,250 (2 species)	—	880
Ota River F	FY2013 Oct.-Nov.	73-8,700 (4 species)	308; 660 (2 species)	—	1,390; 1,580 (2 species)	—	500-2,870 (7 species)	—	—
	FY2013 Aug.-Sep.	278-7,400 (3 species)	390-660 (3 species)	—	730-1,420 (3 species)	—	42-4,100 (8 species)	—	—
	FY2013 Jul.	70-8,000 (4 species)	150-840 (3 species)	—	970; 1,390 (2 species)	—	920-2,950 (6 species)	—	4,300

* ND means to be below the detection limit.

* Basically, measurement was conducted for all targeted samples.

* Since the autumn term of FY2012, sampling and analysis of aquatic insects have been conducted separately for four categories (Plecoptera, Trichoptera, Odonata, and Megaloptera). Emerged aquatic insects (*Luciola cruciata*) are included (**).

(i) Rivers and lakes (cont')

Unit: Bq/kg-wet

Water area		Time	Flora (algae, etc.)	Aquatic insects	Spider s	Crustaceans	Shellfi sh	Fish	Amphibi a	CPOMs (fallen leaves, etc.)
Lake Akimoto H		FY2013 Dec.	4.2-169 (3 species)	—	—	73	18	51-212 (8 species)	21	—
		FY2013 Oct.-Nov.	12; 22 (2 species)	N.D.; 15 (2 species)	—	55	—	28-93 (9 species)	58	19
		FY2013 Aug.-Sep.	19-78 (3 species)	—	—	91	163	10-187 (13 species)	19-340 (3 species)	37
		FY2013 Jul.	1.3; 7.3 (2 species)	N.D.**	—	77	60	16-264 (11 species)	24; 55 (2 species)	119; 250 (2 species)
Lake Inawashiro Lake Inawashiro J (south lakeside)		FY2013 Dec.	—	—	—	—	—	—	—	42
		FY2013 Oct.-Nov.	—	—	—	13	—	2.6-170 (7 species)	—	62
		FY2013 Aug.-Sep.	—	—	—	12	—	12-158 (11 species)	—	—
		FY2013 Jul.	—	—	—	—	—	55-165 (6 species)	—	162
		FY2013 Dec.	2.0	—	—	—	N.D.; 8.5 (2 species)	2.7	38	—
		FY2013 Oct.-Nov.	1.1-48 (3 species)	N.D.	—	6.2	4.2	1.7-215 (7 species)	5.7; 30 (2 species)	—
		FY2013 Aug.-Sep.	N.D.-4.4 (3 species)	—	—	8.7	9.8	1.8-173 (11 species)	6.4	—
		FY2013 Jul.	N.D.-2.9 (3 species)	—	—	29	7.3	44-158 (9 species)	2.8; 120 (2 species)	—

* ND means to be below the detection limit.

* Basically, measurement was conducted for all targeted samples.

* Since the autumn term of FY2012, sampling and analysis of aquatic insects have been conducted separately for four categories (Plecoptera, Trichoptera, Odonata, and Megaloptera). Emerged aquatic insects (Luciola cruciata) are included (**).

(ii) Sea areas

Unit: Bq/kg-wet

Water area	Time	Flora (algae, etc.)	Sea urchin, starfish, trepang	Crustaceans	Polychae ta	Shellfish		Squid, octopus	Fish	
						Molluscan body	Shell			
Location K off the mouth of the Abukuma River		FY2013 Dec.	—	—	2.2	—	—	—	0.99-13 (6 species)	
		FY2013 Oct.-Nov.	—	—	0.66; 1.3 (2 species)	—	—	—	1.8-3.3 (4 species)	
		FY2013 Aug.-Sep.	—	—	0.39; 1.8 (2 species)	—	—	—	—	1.6-7.0 (5 species)
		FY2013 Jul.	—	—	0.50	—	—	—	—	1.4-13 (6 species)
Location L off Soma City (Matsukawaur a Bay)		FY2013 Dec.	N.D.; N.D. (2 species)	—	5.0; 13 (2 species)	—	1.8; 4.3 (2 species)	—	—	
		FY2013 Oct.-Nov.	1.5-33 (3 species)	—	1.7-22 (3 species)	16	3.4; 5.2 (2 species)	—	—	5.7; 15 (2 species)
		FY2013	N.D.;	—	4.6-6.7	6.9	2.3; 2.4	1.6; 6.0	—	4.6-5.3

	Aug.-Sep.	0.53 (2 species)		(3 species)		(2 species)	(2 species)		(3 species)
	FY2013 Jul.	0.65-21 (3 species)	—	2.6-20 (5 species)	10	2.2; 4.0 (2 species)	3.0; 15 (2 species)	—	3.8-6.4 (3 species)
Location M off Iwaki City(Hisanohama)	FY2013 Dec.	1.1	6.7; 23 (2 species)	—	—	1.8	—	—	2.7-50 (9 species)
	2013 Oct.-Nov.	1.8	5.1	—	—	2.4	—	—	2.1-55 (6 species)
	2013 Aug.-Sep.	1.6	4.8; 23 (2 species)	—	—	1.9	16	—	4.1-84 (7 species)
	2013 Jul.	N.D.	5.0; 31 (2 species)	—	—	1.7	13	—	4.3-106 (8 species)

* ND means to be below the detection limit.

* Basically, measurement was conducted for all targeted samples.