# FY2012 Radioactive Material Monitoring of Aquatic Organisms

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: June 3, 2012, to July 11, 2012).

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, Niida River, Mano River

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

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

○ Survey locations and dates

| Area | | Targeted water areas | | Item | Survey dates | Remarks |
|---|---|---|---|---|---|---|
| River area | A | Abukumagawa River | Downstream part of Shinfuna Bridge, Harase River (tributaries) | Aquatic organisms sampling | June 20, 2012 | Aquatic insects, fish (Harasegawa River) |
| | | | | | July 11, 2012 | Fish (Shinfuna Bridge) |
| | | | | Water/sediment sampling | June 4, 2012 | (Water/sediment) A1 |
| | B | | Confluence with the Matsukawa River, Surikami River (tributaries) | Aquatic organisms sampling | June 19, and 29, 2012 | Fish, amphibians , etc. |
| | | | | Water/sediment sampling | June 4, 2012 | (Water) B2, (Sediment) B1, B2 |
| | C | Nittagawa River | Kayagi Bridge to Shin-Sakurai Bridge | Aquatic organisms sampling | June 8, 2012 | Fish |
| | | | | Water/sediment sampling | June 5, 2012 | (Water) C1, C3, (Sediment) C1, C2, C3 |
| | D | Mano River | Oyama Bridge to Motebashi Bridge | Aquatic organisms sampling | June 6, 2012 | Aquatic insects, fish, etc. (Miyama Bridge) |
| | | | | | June 7, 2012 | Fish (Kagitori Bridge and Motebashi Bridge) |
| | | | | | June 8, 2012 | Fish (Kagitori Bridge and Motebashi Bridge) |
| | | | | Water/sediment sampling | June 5, 2012 | (Water) D1, D2, (Sediment) D1, D2, D3 |
| Lake area | E | Hayamako Lake | | Aquatic organisms sampling | June 6, 2012 | Aquatic insects, algae, litter |
| | | | | | June 7, 2012 | Fish |
| | | | | | June 28, 2012 | Fish |
| | | | | Water/sediment sampling | June 7, 2012 | (Water) E1, (Sediment) E1, E2, E3 |
| | F | Akimotoko Lake | | Aquatic organisms sampling | June 3, 2012 | litter |
| | | | | | June 4, 2012 | Fish, amphibians , etc. |
| | | | | Water/sediment sampling | June 4, 2012 | (Water) F3, (Sediment) F1, F2, F3 |
| | G | Inawashiroko Lake | North bank | Aquatic organisms sampling | June 5, 2012 | Fish |
| | | | | Water/sediment sampling | June 5, 2012 | (Water) G1, (Sediment) G1, G2 |
| | H | | South bank | Aquatic organisms sampling | June 4, 2012 | Fish |
| | | | | | June 5, 2012 | Flora |
| | | | | Water/sediment sampling | June 5, 2012 | (Water) None , (Sediment) H1 |
| Sea area | I | Offshore of Iwakishi | Sea area around Hisanohama | Aquatic organisms sampling | July 6, 2012 | Fish, shellfish , etc. |
| | | | | Water/sediment sampling | July 6, 2012 | (Water) I2, (Sediment) I1, I2, I3 |
| | J | Offshore of Somashi | Matsukawaura | Aquatic organisms sampling | June 19, 2012 | Fish, shellfish , etc. |
| | | | | Water/sediment sampling | June 19, 2012 | (Water) J2, J3, (Sediment) J1, J2, J3 |
| | K | Off the mouth of the Abukumagawa River | Sea area in front of the mouth of the Abukumagawa River | Aquatic organisms sampling | June 28, 2012 | Fish, crustaceans , etc. |
| | | | | Water/sediment sampling | June 28, 2012 | (Water) K2, (Sediment) K1, K2, K3 |

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 radioactive cesium was conducted. Additionally, for samples of large fish higher on the food chain, organisms with structure (shellfish, etc.), and other samples for which a sufficient amount could be collected, 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. (two 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 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.

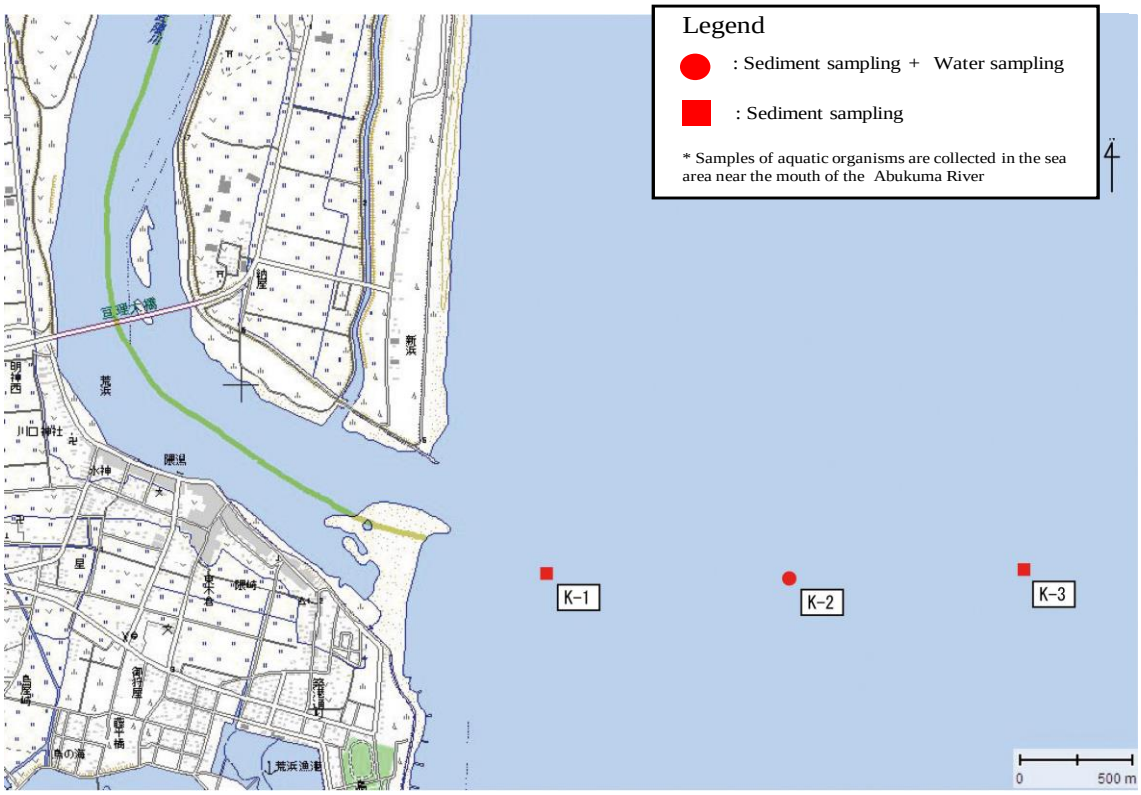
○ Survey targets and items

| Target | Measurement item | | Analyzed samples |
|---|---|---|---|
| Aquatic Organisms | Radioactive materials | Radioactive cesium (Cs-134,Cs-137) | All samples |
| | | Radioactive strontium (Sr-90) | Large fish, Shellfish, and other samples for which a sufficient amount could be collected |
| Water | Radioactive materials | Radioactive cesium (Cs-134,Cs-137) | Samples collected at two locations for each water area |
| | | Radioactive strontium (Sr-90) | Samples collected at one location for each water area |
| | General items | pH | Samples collected at two 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 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 locations for each water area |
| | | Oxidation-reduction potential | |
| | | Water content | |
| | | TOC | |
| | | Ignition loss | |
| | | Soil particle density | |
| | | Grainsize distribution | |

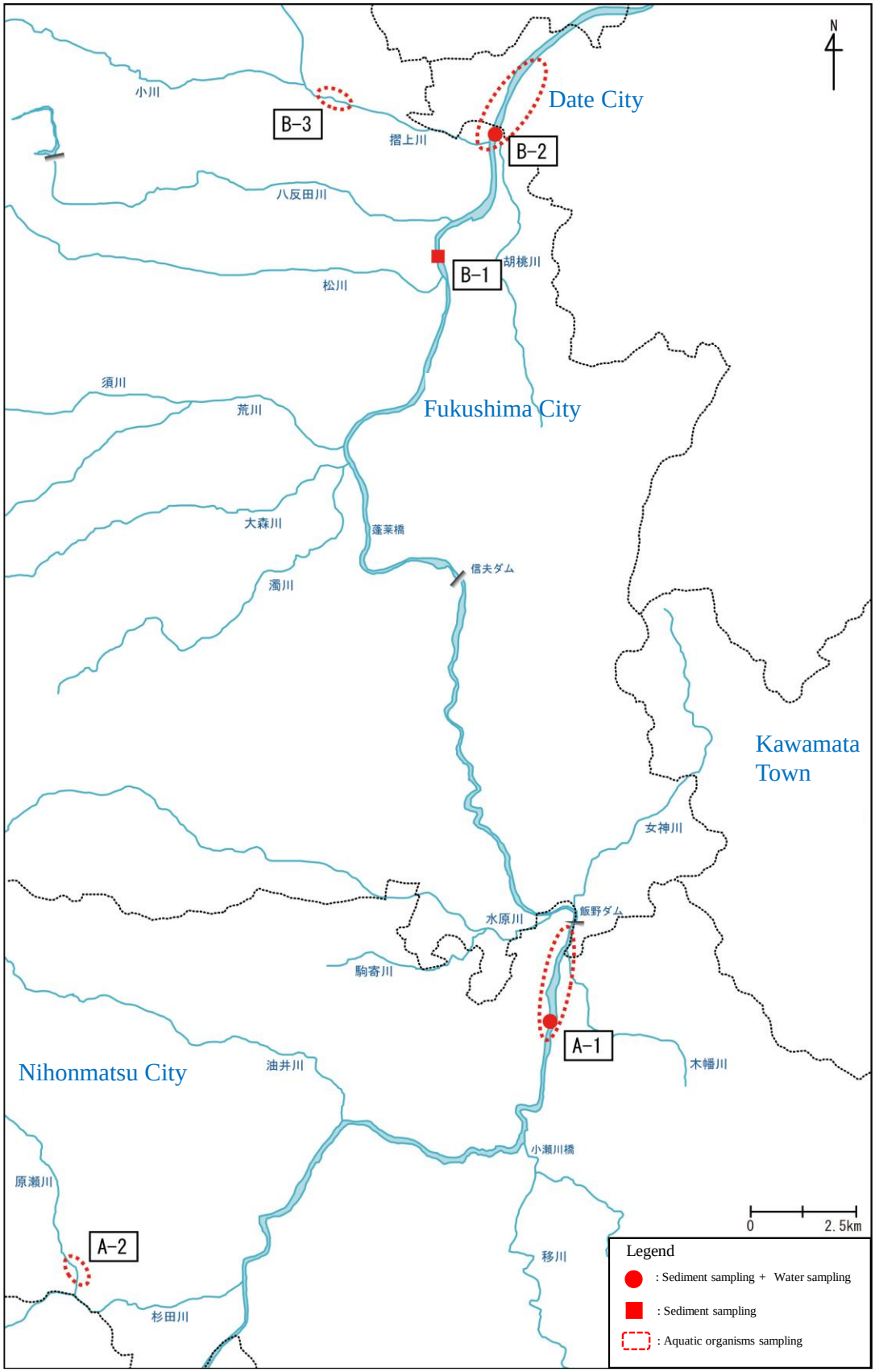
2.2 Survey Locations at Respective Water Areas

(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 Chieko-ohashi Bridge (Nihonmatsu City, Fukushima Prefecture) to the Iinoentei Dam (Horai Dam), and Location B along the Abukuma River was set from the Iinoentei Dam to Taisho Bridge (Date City, Fukushima Prefecture) as water areas containing the zone where the Nigori River, Arakawa River, 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.

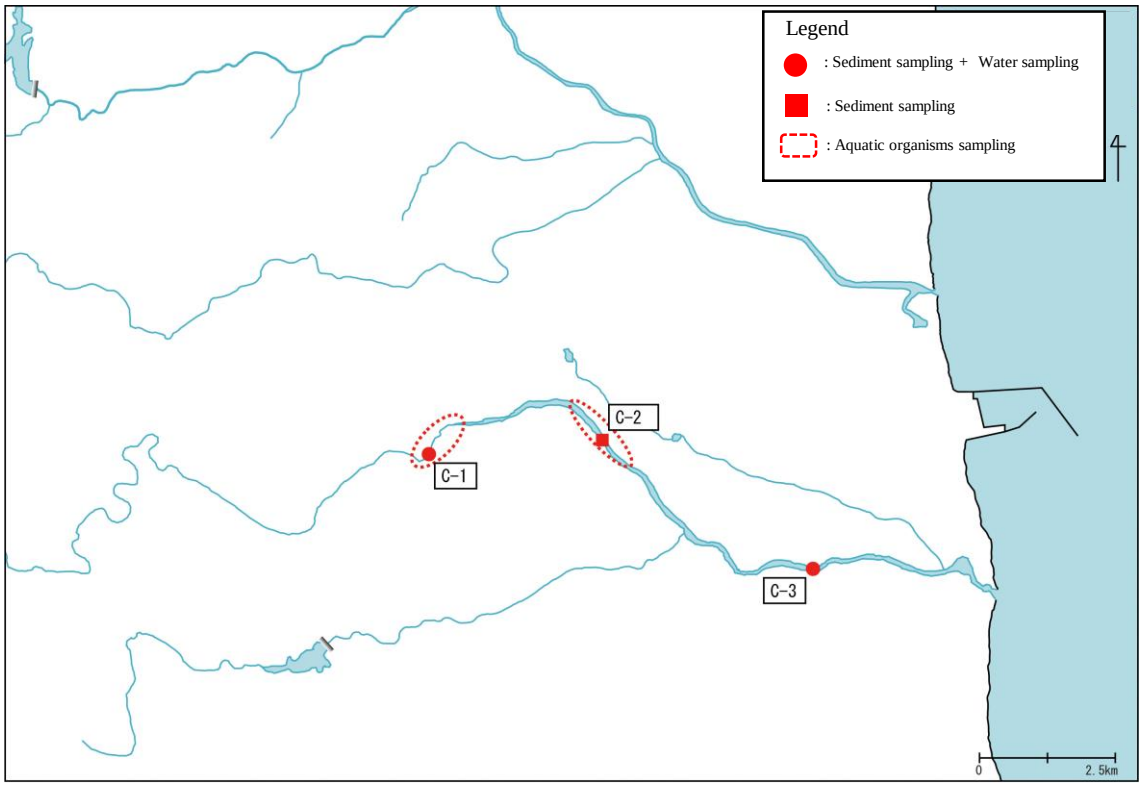



Detailed map showing Location K off the mouth of the Abukuma River




Map showing Location A and Location B along the Abukuma River

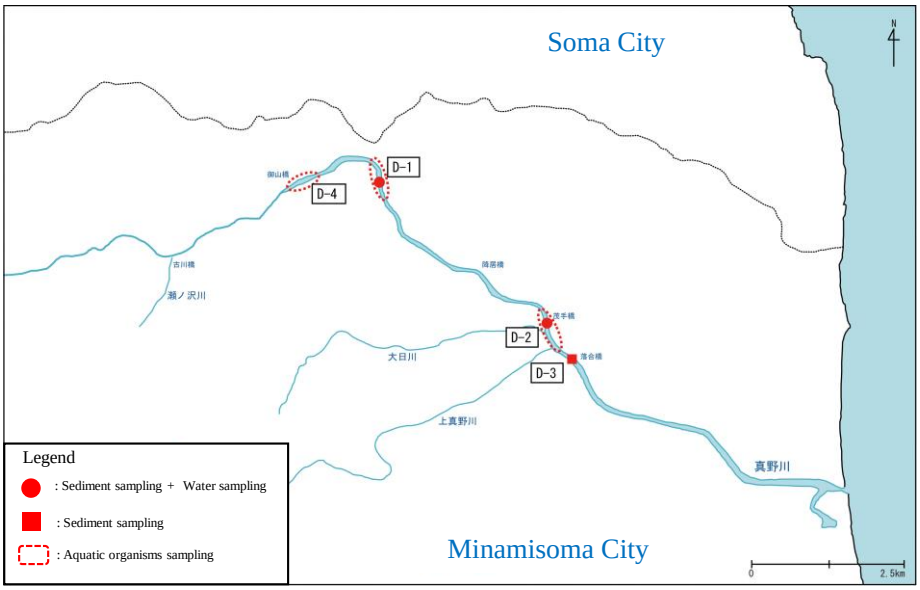
(2) Location C along the Niida River



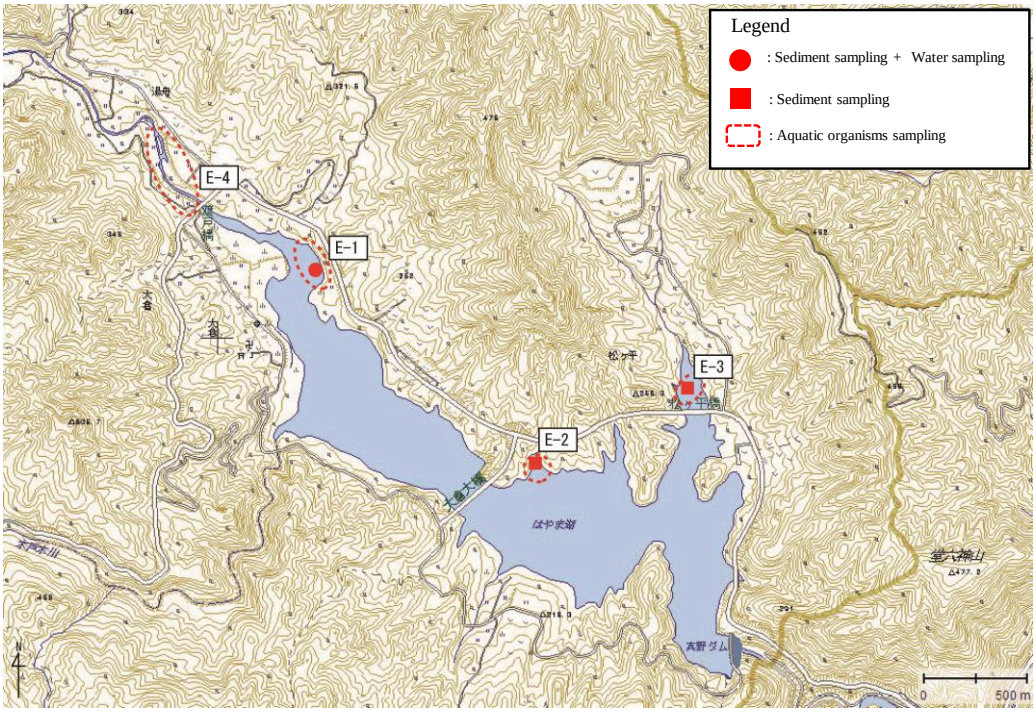

Map showing Location C along the Niida River

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

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

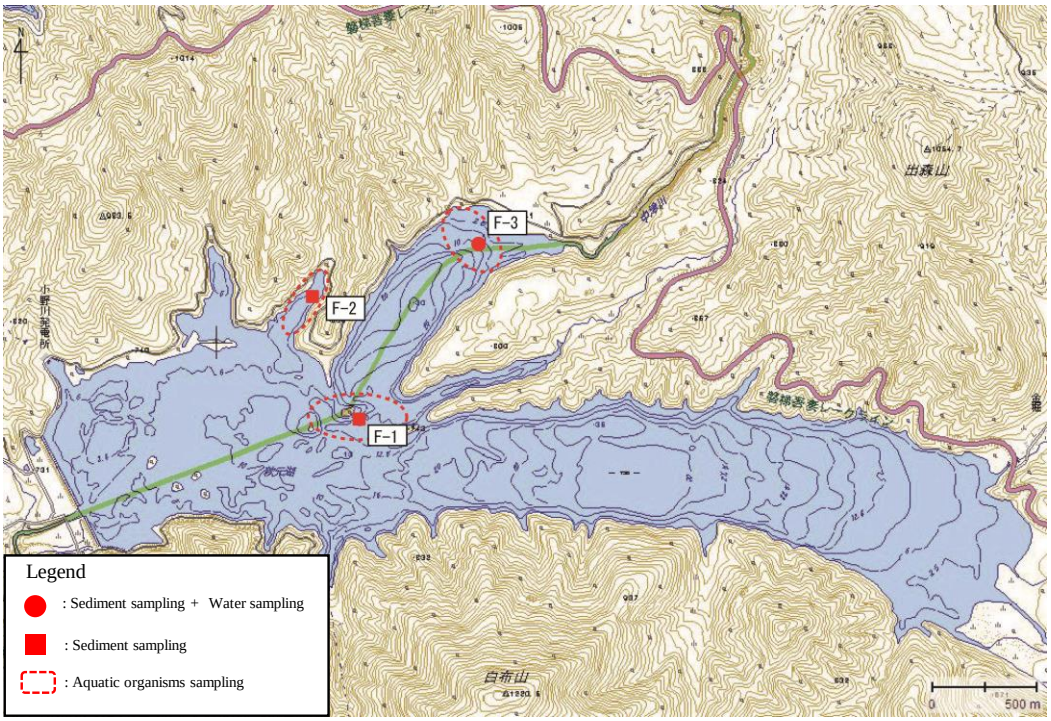



Detailed map showing Location D along the Mano River




Detailed map showing Location E in Lake Hayama

(3) Lake Akimoto (Location F in Lake Akimoto)

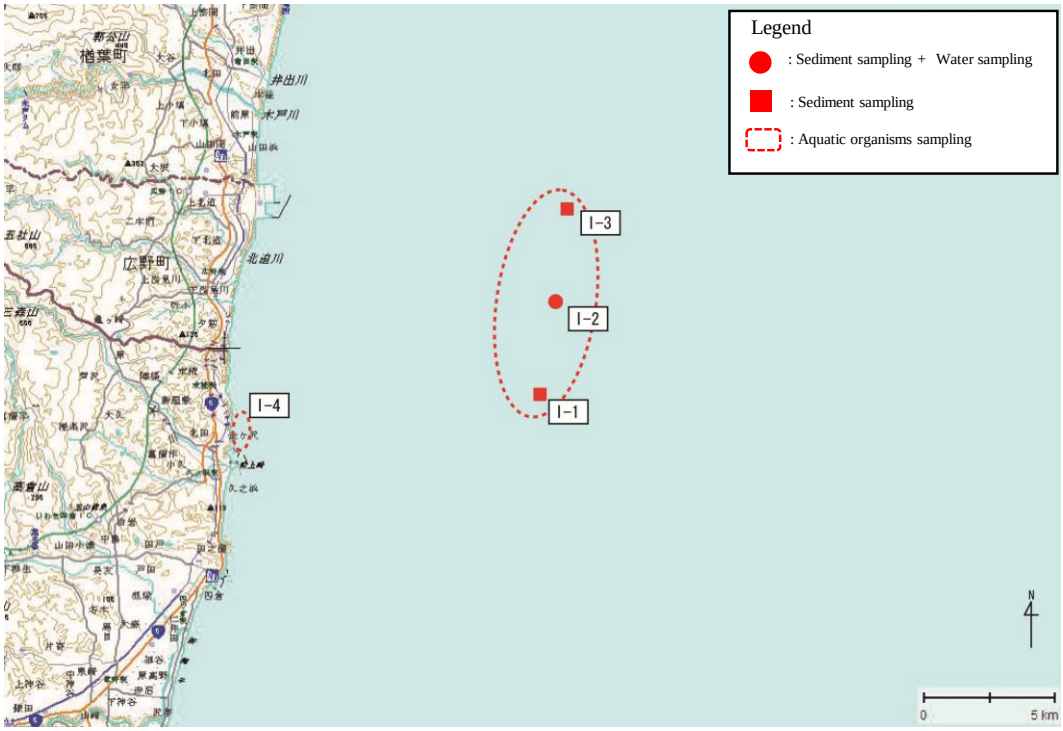



Detailed map showing Location F in Lake Akimoto

(5) Locations G and H in Lake Inawashiro

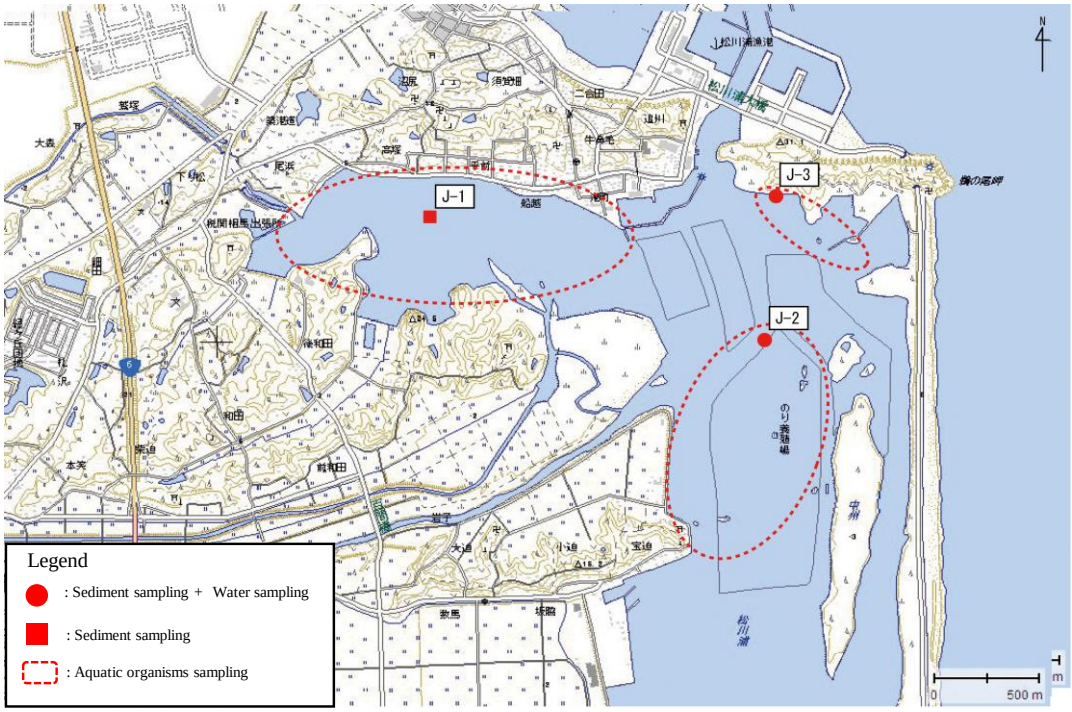

Detailed map showing Locations G and H (north lakeside and south lakeside) in Lake Inawashiro

(6) Location I off Iwaki City




Detailed map showing Location I off Iwaki City (sea area around Hisanohama)

(7) Location J off Soma City




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

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.

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.

Concentrations of radioactive strontium in sediment samples were higher for those collected in freshwater areas, as in the case of concentrations of radioactive cesium. However, no difference was observed between water samples collected in freshwater areas and those collected in seawater areas.

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

(i) Rivers and lakes

Unit: Bq/kg-wet

| | | | Flora (algae, etc.) | Aquatic insects | Crustaceans | Shellfish | Fish | Amphibia | CPOMs (dead leaves, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| Abukuma River System | Abukuma River A | 2012 Spring | 740 (algae) | 52 (4-species mixture) | 181 | 170 | 50-167 (7 species) | 290-420 (3 species) | — |
| | | 2011 Winter | — | 340 (3-species mixture) | 156 | — | 61-171 (3 species) | — | 920 |
| | Abukuma River B | 2012 Spring | 550 (algae) | — | — | — | 76-650 (10 species) | 280; 370 (2 species) | — |
| | | 2011 Winter | — | 330 (4-species mixture) | — | — | 155-680 (3 species) | — | 1,120 |
| Mano River System | Lake Hayama E (Mano Dam) | 2012 Spring | 1,870 (algae) | 510 (7-species mixture) | — | — | 280-4,400 (4 species) | — | 3,200 |
| | | 2011 Winter | — | 520 (5-species mixture) | — | — | 91-1,010 (5 species) | — | 800 |
| | Mano River D | 2012 Spring | 260 (algae) | 198 (14-species mixture) | 223 | 182 | 202-970 (4 species) | — | 1,410 |
| | | 2011 Winter | — | 670 (3-species mixture) | — | — | 190-2,600 (4 species) | — | 1,140 |
| Niida River C | | 2012 Spring | — | — | — | — | 440-11,400 (5 species) | — | — |
| Lake Akimoto F | | 2012 Spring | 46 (Spermatophyte) | — | 183 | — | 94-470 (7 species) | 540 | 250 |
| | | 2011 Winter | — | — | 180 | — | 167-510 (8 species) | — | — |
| Lake Inawashiro | Lake Inawashiro G (north lakeside) | 2012 Spring | 500 (algae) | — | — | — | 77-380 (6 species) | — | — |
| | Lake Inawashiro H (south lakeside) | 2012 Spring | 9 (Spermatophyte) | — | — | — | 46-430 (6 species) | — | — |

* As the number of aquatic insect samples was small, measurement was conducted by mixing samples for each water area and each location.

(ii) Sea areas

Unit: Bq/kg-wet

| | | Flora (algae, etc.) | Sea urchin, starfish, trepang | Crustaceans | Shellfish | | Squid, octopus | Fish |
|---|---|---|---|---|---|---|---|---|
| | | | | | Molluscan body | Shell | | |
| Location I off Iwaki City (Hisanohama) | 2012 Spring | 22; 33 (2 species (algae)) | 21; 97 (2 species (sea urchin)) | — | 13 | 24 | — | 7.6-290 (8 species) |
| | 2011 Winter | 27; 150 (2 species (algae)) | 7.1-212 (4 species (sea urchin, starfish, sea cucumber) | — | 42; 67 (2 species) | 4.7; 27 (Same as on the left) | 6.8-18.0 (5 species) | 12.2-260 (19 species) |
| Location J off Soma City (Matsukawaura Bay) | 2012 Spring | 13; 102 (2 species (algae)) 14 (Spermatophyte) | — | 12-87 (4 species) | 4.1; 5.7 (2 species) | 9; 56 (Same as on the left) | — | 11-166 (5 species) |
| Location K off the mouth of the Abukuma River | 2012 Spring | — | — | 8.4; 21 (2 species) | — | — | — | 11-42 (5 species) |
| | 2011 Winter | — | — | — | 20 | 3.6 | — | 2.15 |