# Outline of Offshore Marin Survey

## Offshore Marin Survey

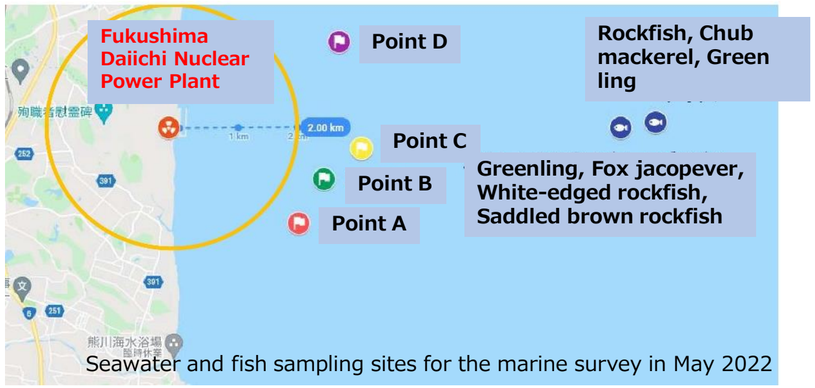
○Sample ・Seawater・Fish・Plankton

○Nuclides to measure ・Radioactive Cesium ・Strontium90 ・Tritium

○Sampling Site

・4 sites in 1.5 km offshore of the Fukushima Daiichi NPP (Point A, B, C and D)

・If no fish can be caught above the sites, the skipper may change locations to fish.



Seawater and fish sampling sites for the marine survey in May 2022

○ Sampling Seawater

・Seawater is collected from 2 depths (from the surface and the lower layer)

・The surface layer is collected using a bucket, and the lower layer is collected with a van dorn water sampler. (For cesium = 20 L, for strontium = 20 L, for tritium = 2 L)

○Sampling Fish

・Obtain fish by fishing.

・Ichthyology researcher collects blood from the fish on board.

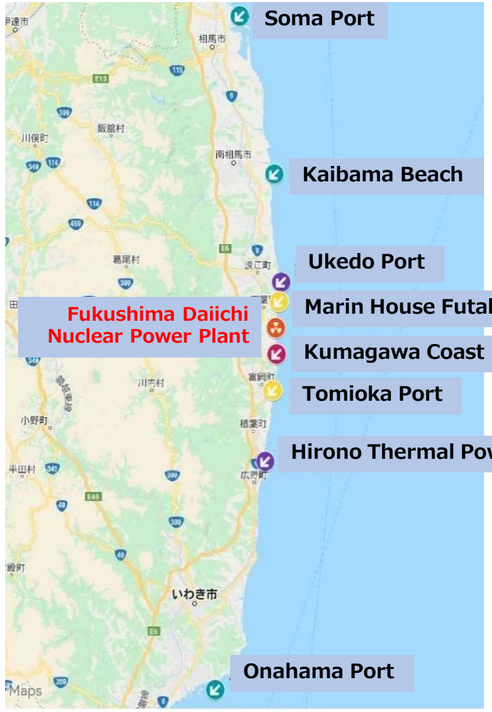
○ Sampling Plankton

・Pump seawater by the ship's large-capacity pump and pass it through a plankton net to collect.

## Coastal Marin Survey

○Sample ・Seawater

○Nuclides to measure ・Radioactive Cesium ・Strontium90 ・Tritium




○Sampling Site

・From Soma Port to Onahama Port, Twice a year

- ・Soma Port
- ・Kaibama, Murakami Beach
- ・Ukedo Port
- ・Futaba Beach
- ・Kumagawa Coast
- ・Tomioka Port
- ・Iwasawa Beach
- ・Onahama Port

○Sampling Seawater

・Sample seawater from the surface.

・Collect it with a bucket.
For Cesium = 20L, for Strontium = 20L, for Tritium = 2L

# Offshore Marine Survey

## Measurement Results: Radioactive Cesium-137 in Seawater and Fish

・Measurement data of radioactive cesium-137 in seawater and fish sampled from 1.5km offshore of Fukushima Daiichi Nuclear Power Plant in November 2022, May/August 2023 and May 2024.
・Radioactive cesium is removed from 20L of seawater by adsorption on ammonium molybdophosphate before measurement.
・Cs-137 is detected in most of the fish sample collected.

### Cs-137 Measurement Results in Seawater (Bq/L)

| | Point A Surface | Point A Lower | Point B Surface | Point B Lower | Point C Surface | Point C Lower | Point D Surface | Point D Lower | Tomioka Port Surface |
|---|---|---|---|---|---|---|---|---|---|
| 2022/11/9 | 0.004±0.0005 | 0.004±0.0006 | 0.003±0.0005 | 0.003±0.0005 | 0.002±0.0005 | 0.003±0.0005 | 0.005±0.0006 | 0.003±0.0005 | 0.012±0.0007 |
| 2023/5/31 | 0.003±0.0005 | 0.003±0.0005 | 0.004±0.0005 | 0.005±0.0005 | 0.004±0.0006 | 0.003±0.0005 | 0.004±0.0005 | 0.003±0.0006 | 0.01±0.0007 |
| 2023/8/2 | 0.002±0.0005 | 0.008±0.001 | 0.003±0.0005 | 0.003±0.0006 | 0.003±0.0005 | 0.003±0.0005 | 0.003±0.0005 | 0.004±0.0006 | 0.008±0.0006 |
| 2024/3/5 | 0.004±0.0005 | 0.005±0.0005 | 0.004±0.0005 | 0.004±0.0005 | 0.003±0.0005 | 0.004±0.0005 | 0.024±0.0008 | 0.020±0.0007 | 0.063±0.001 |

### Cs-137 Measurement Results in Fish (Bq/kg raw)

| | 2022/11/9 |
|---|---|
| Red sea bream | 1.0±0.1 |
| Flounder | 0.9±0.04 |
| Blowfish | 1.3±0.1 |
| White rockfish | 1.8±0.1 |
| Greenling | 0.9±0.1 |

| | 2023/5/31 |
|---|---|
| Goldeye rockfish | 1.3±0.1 |
| Blowfish | 0.7±0.1 |
| White rockfish | 1.0±0.1 |
| White rockfish | 1.4±0.1 |
| Fox jacopever | 0.3±0.1 |

| | 2023/8/2 |
|---|---|
| Shark | 1.7±0.1 |
| Flounder | 0.9±0.1 |
| Black sebastes | 0.3±0.1 |
| White rockfish | 0.7±0.05 |
| Fox jacopever | 0.4±0.05 |

| | 2024/3/5 |
|---|---|
| Crimson seabream | 0.4±0.1 |
| Roundnose flounder | 0.3±0.1 |
| Goldeye rockfish | 1.2±0.1 |
| White rockfish | 1.0±0.07 |
| Greenling | 1.1±0.06 |

# Offshore Marine Survey

## Measurement Results: Strontium-90 in Seawater and Fish

- Measurement data of Strontium-90 in seawater and fish sampled from 1.5km offshore of Fukushima Daiichi Nuclear Power Plant in November 2022 and May/August 2023.
- Strontium-90 was detected in the different points depending on the sampling date.
- For fish, analysis was performed mainly on the head and bones.

### Sr-90 Measurement Results in Seawater (Bq/L)

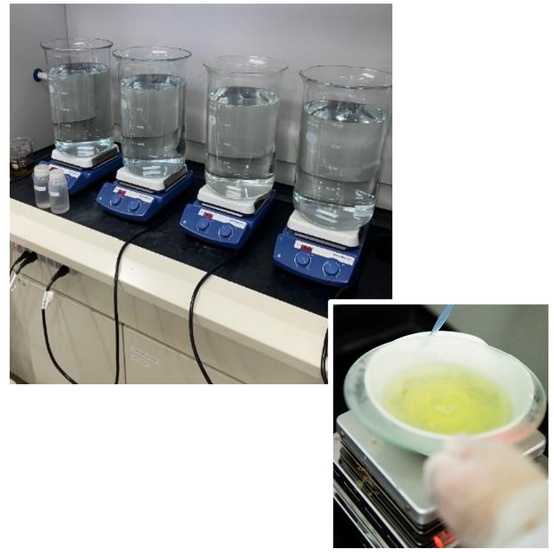
| | Point A Surface | Point A Lower | Point B Surface | Point B Lower | Point C Surface | Point C Lower | Point D Surface | Point D Lower | Tomioka Port Surface |
|---|---|---|---|---|---|---|---|---|---|
| 2022/11/9 | 0.001±0.0003 | 0.0008±0.0003 | 0.0015±0.0003 | 0.0012±0.0003 | 0.0019±0.0004 | 0.0011±0.0004 | 0.001±0.0003 | 0.0012±0.0003 | 0.0008±0.0003 |
| 2023/5/31 | 0.0005±0.0003 | 0.0006±0.0003 | 0.0009±0.0003 | 0.0006±0.0003 | 0.0008±0.0003 | 0.0009±0.0003 | 0.0009±0.0004 | ND＜0.0005 | 0.0005±0.0002 |
| 2023/8/2 | 0.0005±0.0003 | ND＜0.0004 | ND＜0.0004 | 0.0007±0.0003 | ND＜0.0004 | ND＜0.0004 | ND＜0.0004 | ND＜0.0004 | 0.0005±0.0003 |

### Sr-90 Measurement Results in Fish (Bq/kg dry)

| | 2022/11/9 |
|---|---|
| White rockfish | ND＜0.14 |
| Flounder | ND＜0.1 |
| Red sea bream | ND＜0.12 |
| Greenling | ND＜0.11 |

| | 2023/5/31 |
|---|---|
| White rockfish | ND＜0.13 |
| Blowfish | ND＜0.60 |
| White rockfish | 0.46±0.13 |
| Fox jacopever | ND＜0.12 |

| | 2023/8/2 |
|---|---|
| Flounder | ND＜0.14 |
| Black sebastes | ND＜0.12 |
| White rockfish | ND＜0.25 |



# Offshore Marine Survey　Measurement Results: Tritium in Seawater and Fish

- Measurement data of Tritium in seawater and fish sampled from 1.5km offshore of Fukushima Daiichi Nuclear Power Plant in May and August and November 2022 and May 2023.
- From August 2022 we started using liquid scintillation counters specialized to measure tritium, which allowed us to lower the detection limit.
- Free-water Tritium and Organically Bound Tritium in fish was not detected (ND) at this stage.

## Tritium Measurement Results in Seawater (Bq/L)

| | Point A Surface | Point A Lower | Point B Surface | Point B Lower | Point C Surface | Point C Lower | Point D Surface | Point D Lower | Tomioka Port Surface |
|---|---|---|---|---|---|---|---|---|---|
| 2022/5/10 | ND<0.11 | ND<0.11 | ND<0.11 | ND<0.12 | ND<0.11 | ND<0.11 | ND<0.11 | ND<0.12 | ND<0.11 |
| 2022/8/24 | ND<0.04 | ND<0.04 | ND<0.04 | ND<0.04 | ND<0.04 | ND<0.05 | ND<0.05 | ND<0.05 | ND<0.05 |
| 2022/11/9 | ND<0.04 | ND<0.05 | ND<0.05 | ND<0.04 | ND<0.04 | ND<0.04 | ND<0.04 | ND<0.04 | ND<0.04 |
| 2023/5/31 | ND<0.04 | ND<0.04 | 0.05±0.04 | 0.05±0.04 | ND<0.04 | ND<0.04 | ND<0.04 | ND<0.04 | ND<0.04 |

## Free-water Tritium Measurement Results in Fish (Bq/L )

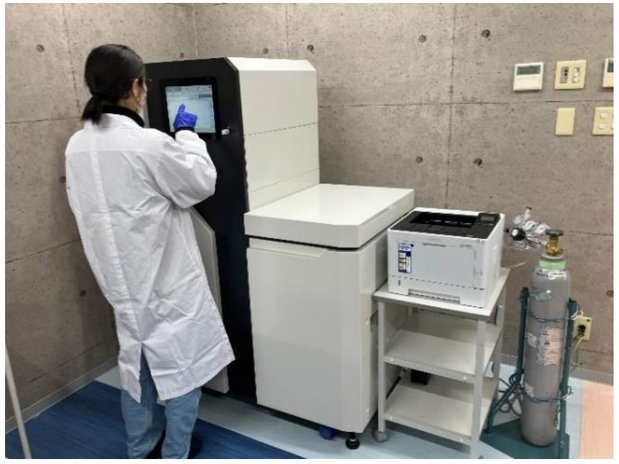
| | 2022/5 |
|---|---|
| White rockfish | ND＜0.37 |
| White rockfish | ND＜0.37 |
| White rockfish | ND＜0.37 |
| Greenling | ND＜0.36 |
| Fox jacopever | ND＜0.36 |

| | 2023/8 |
|---|---|
| Flounder | ND＜0.34 |
| Black sebastes | ND＜0.35 |

## Organically Bound Tritium Measurement Results in Fish (Bq/kg raw)

| | 2022/5 |
|---|---|
| White rockfish | ND＜0.09 |
| Fox jacopever | ND＜0.09 |

| | 2023/8 |
|---|---|
| Flounder | ND＜0.09 |
| Black sebastes | ND＜0.09 |



# Coastal Marine Survey Measurement Results for Seawater

- Seawater measurement data of Fukushima coast.
- Concentrations of radioactive cesium tend to be higher at points closer to the nuclear power plant.
- Strontium-90 in seawater was detected at different sampling sites depending on the date of sampling.
- Tritium was also detected, but at the stage before the contaminated water was discharged, there was no significant difference from the normal seawater concentration.

## Cs-137 Measurement Results in Seawater (Bq/L)

North ← → South

| | Soma Port | Murakami Beach | Ukedo Port | Futaba Beach | Kumagawa Coast | Tomioka Port | Iwasawa Beach | Onahama Port |
|---|---|---|---|---|---|---|---|---|
| 2023/5,6 | 0.005±0.0006 | 0.005±0.0005 | 0.01±0.0007 | 0.004±0.0006 | 0.02±0.0008 | 0.01±0.0007 | 0.008±0.0006 | 0.001±0.0006 |
| 2023/12 | 0.007±0.0006 | 0.005±0.0005 | 0.009±0.0006 | 0.012±0.0006 | 0.013±0.0004 | 0.010±0.0007 | 0.006±0.0006 | 0.003±0.0005 |

## Sr-90 Measurement Results in Seawater (Bq/L)

| | Soma Port | Murakami Beach | Ukedo Port | Futaba Beach | Kumagawa Coast | Tomioka Port | Iwasawa Beach | Onahama Port |
|---|---|---|---|---|---|---|---|---|
| 2023/5,6 | 0.0011±0.0003 | 0.0005±0.0003 | 0.0012±0.0003 | 0.0009±0.0003 | 0.0006±0.0003 | 0.0005±0.0002 | 0.001±0.0003 | 0.001±0.0003 |
| 2023/12 | ND<0.0003 | ND<0.0008 | ND<0.0008 | 0.0011±0.0003 | 0.0006±0.0003 | 0.0008±0.0003 | ND<0.0003 | ND<0.0005 |

## Tritium Measurement Results in Seawater (Bq/L)

| | Soma Port | Kaibama Beach | Ukedo Port | Futaba Beach | Kumagawa Coast | Tomioka Port | Iwasawa Beach | Onahama Port |
|---|---|---|---|---|---|---|---|---|
| 2022/12 | ND<0.04 | ND<0.04 | ND<0.04 | 0.07±0.04 | ND<0.04 | ND<0.04 | 0.05±0.04 | Missing data |
| 2023/5 | 0.06±0.04 | 0.06±0.04 | 0.09±0.04 | ND<0.04 | ND<0.04 | ND<0.04 | ND<0.04 | Missing data |

# Measuring Radiation levels in Ookuma Town

## TARACHINE conducted surveys on environmental radioactivity in Ookuma Town in the fall of 2022.

NPO Mothers' Radiation Lab Fukushima – TARACHINE https://tarachineiwaki.org/

【Reason for the Surveys】

- The evacuation order for the designated 860-hectare reconstruction and revitalization zone was lifted, and the standard value for returning home was set 20 millisieverts (mSv) as an annual dose limit. This standard value is the upper value recommended by International Commission on Radiological Protection ( ICRP)[*]. This means the standard value for the general population of Okuma including children and annual exposure limit for the nuclear industry workers are the same.
- "Manabiya Yumenomori" (a comprehensive school for 0~15year-olds) will be opened in Okuma Town. It's expected health concerns will arise in the future as children will be studying and living under such high radiation levels permitted as 20 mSv/y. We believe it's important to know the correct values of radiation levels in the environment in order to protect ourselves from the radiation exposure scientifically.

[*] ICRP recommended in 2007 that in the event of large-scale radioactive contamination due to a nuclear power plant accident, the standard value should be adopted from 【the lower values of 1 to 20 mSv/y】, to protect the people living in the contaminated area. However, 【the uppermost value of 1-20 mSv/y】was adopted.

【The background and reason why 20 mSv was set as the annual dose reference level for Ookuma Town】

Previously, the reference value was 1 mSv/y, or 0.23 microsieverts per hour (μSv/h). Decontamination measures were implemented accordingly. However, due to subsequent media reports and the indifference of the town residents, 20 mSv/y , or 3.8 μSv/h seemed to be accepted as the reference value which is on par with the nuclear power plant premises. It's obviously abnormal that the reference value for the area where children live, learn, and play.

＊From the minutes of the Okuma Town Decontamination Investigation Committee ＊

- "For the areas such as Oogawara and Nakayashiki where evacuation order was lifted, I think we'd been basically considering things with 0.23μSv/h as the base. But this time around 3.8μSv/h is set as the base, there are still some areas remained with a radiation dose of 2 ~ 3 μSv/h. The decontamination work is said to be done, even though the dose is still high this time. The standards for around here are quite different from that of the areas the evacuation order had already been lifted."
- " We had been discussing about 1mSv, or 0.23μSv/h for the decontamination work in Oogawara area, when I first heard that it has become 20mSv, or 3.8μSv/h, I thought 'Huh? However, after that, the media kept reporting 3.8μSv/h was the standard, so the residents probably had that image, I think the previous standard of 0.23μSv/h or 1mSv has been diminishing in our mind."

【 Regarding Air Dose Standards 】

| | Air Dose (μSv/h) | Annual Exposure Dose (mSv/y) |
|---|---|---|
| Annual dose limit for the general public | 0.23 | 1.00 |
| **Criteria for Terminating Evacuation Order of Okuma Town** | **3.80** | **19.76** |
| General dose before the nuclear accident | 0.04 | 0.00 |
| Onahama Yokomahi Park, Iwaki City as of 2023 | 0.06 | 0.11 |
| Fukushima Railway Station West Exit “Corasse Hiroba” as of 2023 | 0.12 | 0.42 |

The annual exposure dose is calculated assuming 8 hours spent outdoors and 16 hours spent indoors per day. The assumption was made that radiation would be reduced by 60% indoor. The values do not include natural background radiation.

【 Regarding Dose standards in Soil 】

| Clearance criteria | Designated Waste (after the nuclear accident) | |
|---|---|---|
| Values that were considered unnecessary to treat as radioactive waste | Values that must be handled in an appropriate manner under the governmental responsibility | Values that need to be disposed of at a disposal site with a stricter shielding structure |
| Unit: Radioactive Cesium Concentration (Bq/kg) | | |
| Less than 100 | More than 8,000 | More than 100,000 |

【 Survey Method 】

■ Using Nippon Shahei Giken's "GPS-linked air dose rate automatic recording system,  Hot Spot Finder", we carried out  measuring at  a point 1 m above the ground.

■ Detail measurement of the soil.  Collecting 5 cm of top soil from the ground surface and dried it, and the concentration of radioactive cesium was measured. Strontium-90 was measured in the half of the 12 locations. In addition, the air dose rate of the ground surface at those locations were also measured.

■ The survey points were not special hotspots such as under rain gutters or deep in the forests where people wouldn't usually go in, but the points were roadside and shrubbery where there is a good possibility that children would walk or stay in their daily lives.

【 Consideration on TARACHINE's Measuring Survey Results 】

We detected over 8,000 Bq/kg radioactive cesium in the soil at 19 out of 24 locations, and 6 locations out of them exceeded 50,000 Bq/kg. Furthermore, over 100,000 Bq/kg was detected in 3 locations.
The highest radiation dose was 200,818 Bq/kg in the hill behind the planned construction site for the school "Manabiya Yume no mori" in the Oogawara area.

As for cesium levels in the soil, the result shows there are observation points with highly contaminated soil and also with less contaminated soil in both Oogawara area and the designated reconstruction and revitalization zone.  We collected samples from several locations that were thought to have been decontaminated by stripping or adding soil, however, all but one location exceeded thousands of Bq/kg.

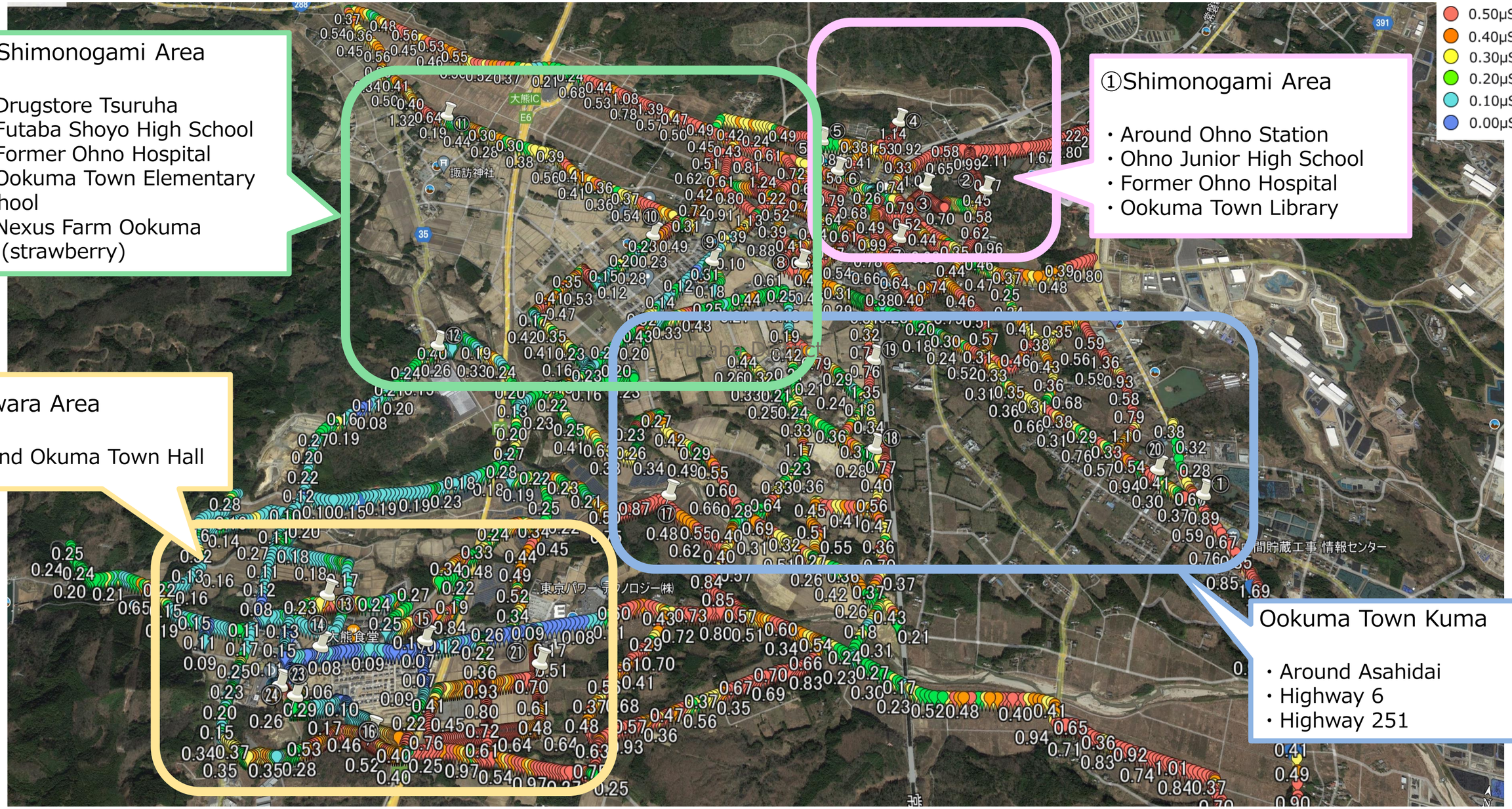
On the other hand, the air dose rate on the ground surface exceeded 3.8 μSv/h at 5 out of 24 locations.
We were unable to find such spots by the vehicle-borne survey.
We'd like to emphasis that these surveys were not aimed at particularly concentrated hotspots.

It is noteworthy that several thousands to several hundreds of thousands of contaminated soils still remains in the places such as the hills behind the school and the rice paddies of Oogawara Minaidaira area where children pass by to go to school or play around.

# Ookuma Town
# Futaba District

## ■ Sampling Points of Measuring Soil

The sampling points were not known hotspots such as under rain gutters or deep in the forests where people don't usually go in, but **the points were along roadside and shrubbery where there was a good possibility children would walk or stay in their daily lives.**




### ②Shimonogami Area

- Drugstore Tsuruha
- Futaba Shoyo High School
- Former Ohno Hospital
- Ookuma Town Elementary School
- Nexus Farm Ookuma (strawberry)

### ①Shimonogami Area

- Around Ohno Station
- Ohno Junior High School
- Former Ohno Hospital
- Ookuma Town Library

### Oogawara Area

- Around Okuma Town Hall

### Ookuma Town Kuma

- Around Asahidai
- Highway 6
- Highway 251

Air dose measured 1m above soil surface　Measured with a hotspot finder (unit: μSv/h)
① Air dose on the ground surface　Measured with a survey meter (unit: μSv/h)
② Soil: Total Value of Cs-137and Cs-134　Measured with a germanium semiconductor detector (unit: Bq/kg dry)
③ Soil:　Strontium-90　Measured with a liquid scintillation counter (unit: Bq/kg dry)

# Survey in November and December 2022 Around Okuma Town Hall

# Survey in November and December 2022

# Shimonogami① Okuma Town


Air dose measured 1m above soil surface
Measured with a hotspot finder (unit: μSv/h)

① Air dose on the ground surface Measured with a survey meter (unit: μSv/h)

② Soil: Total Value of Cs-137and Cs-134 Measured with a germanium semiconductor detector (unit: Bq/kg dry)

③ Soil: Strontium-90 Measured with a liquid scintillation counter (unit: Bq/kg dry)


# Survey in November and December 2022

# Shimonogami② Okuma Town

Air dose measured 1m above soil surface
Measured with a hotspot finder (unit: μSv/h)

① Air dose on the ground surface Measured with a survey meter (unit: μSv/h)

② Soil: Total Value of Cs-137and Cs-134 Measured with a germanium semiconductor detector (unit: Bq/kg dry)

③ Soil: Strontium-90 Measured with a liquid scintillation counter (unit: Bq/kg dry)

Air dose measured 1m above soil surface　Measured with a hotspot finder (unit: μSv/h)
① Air dose on the ground surface　Measured with a survey meter (unit: μSv/h)
② Soil: Total Value of Cs-137and Cs-134　Measured with a germanium semiconductor detector (unit: Bq/kg dry)
③ Soil:　Strontium-90　Measured with a liquid scintillation counter (unit: Bq/kg dry)

# Survey in November and December 2022 Around Kuma, Ookuma Town

0.50μSv/h～
0.40μSv/h～
0.30μSv/h～
0.20μSv/h～
0.10μSv/h～
0.00μSv/h～

常磐線

**21**

①2.21 μSv/h
②8,874 Bq/kg

**23**

①1.23 μSv/h
②19,477 Bq/kg

**22**

①1.15 μSv/h
②4,354 Bq/kg

**24**

①5.00 μSv/h
②150,490 Bq/kg
③20.82　Bq/kg

**20**

①3.85 μSv/h
②57,460 Bq/kg
③7.04　Bq/kg

| Area | Sampling Site | Air Dose Rates (uSv/h) | Cesium Total of 137 and 134(Bq/kg-dry) | Strontium-90 (Bq/kg-dry) |
|---|---|---|---|---|
| Oogawara Area | ①Wooded area in Oogawara Minamidaira | 1.00 | 11,528 | |
| | ②Near Ookuma Post Office | 0.31 | 3,772 | |
| | ③Near Oogawara Minamidaira Garbage Dump | 0.13 | 191 | |
| | ④The mountain behind Manabiya Yumenomori school | 4.29 | 200,818 | 23.22 |
| | ⑤North side of Oogawara Minamidaira rice field | 2.55 | 32,451 | 7.87 |
| | ⑥South side of Oogawara Minamidaira rice field | 6.16 | 63,728 | 8.59 |
| | ⑦Behind the Ookuma Town Office | 1.07 | 15,440 | |
| | ⑧Forest southeast of Ookuma Town Hall | 1.35 | 19,644 | 6.37 |
| Shimonogami Area① | ⑨Across from Former Ono Junior High School | 2.96 | 27,795 | |
| | ⑩In front of Shotoku Taishi Hall | 2.75 | 49,523 | 2.66 |
| | ⑪North side of former Ono Hospital | 4.18 | 3,384 | |
| | ⑫West side of former Ono Hospital | 3.04 | 47,710 | 5.41 |
| | ⑬South side of former Ono Hospital | 1.04 | 6,984 | |
| | ⑭Shrubbery in front of Ookuma Library | 2.44 | 101,372 | 11.74 |
| Shimonogami Area② | ⑮In front of Tsuruha drug store | 2.22 | 56,620 | 5.19 |
| | ⑯Near Futaba Shoyo High School | 0.74 | 10,981 | |
| | ⑰Near former Ono Elementary School | 2.70 | 23,742 | ND<1.51 |
| | ⑱Shimonogami, near the newly built garage | 1.83 | 24,206 | 2.73 |
| | ⑲Near the strawberry factory | 0.38 | 8,792 | |
| Ookuma Kuma neighborhood | ⑳Near the Highway 6 Central Storage Center | 3.85 | 57,460 | 7.04 |
| | ㉑Hill behind Tokyo Power Technology | 2.21 | 8,874 | |
| | ㉒Next to Asahidai Sekisui Heim | 1.15 | 4,354 | |
| | ㉓West side of Joban Line, next to Asahidai private house | 1.23 | 19,477 | |
| | ㉔Field next to Prefectural road 251 | 5.00 | 150,490 | 20.82 |

# List of Measurement Results

## Ookuma Town, Futaba District, Fukushima Prefecture

## Environmental Radioactivity Survey

## List of Measurement Results