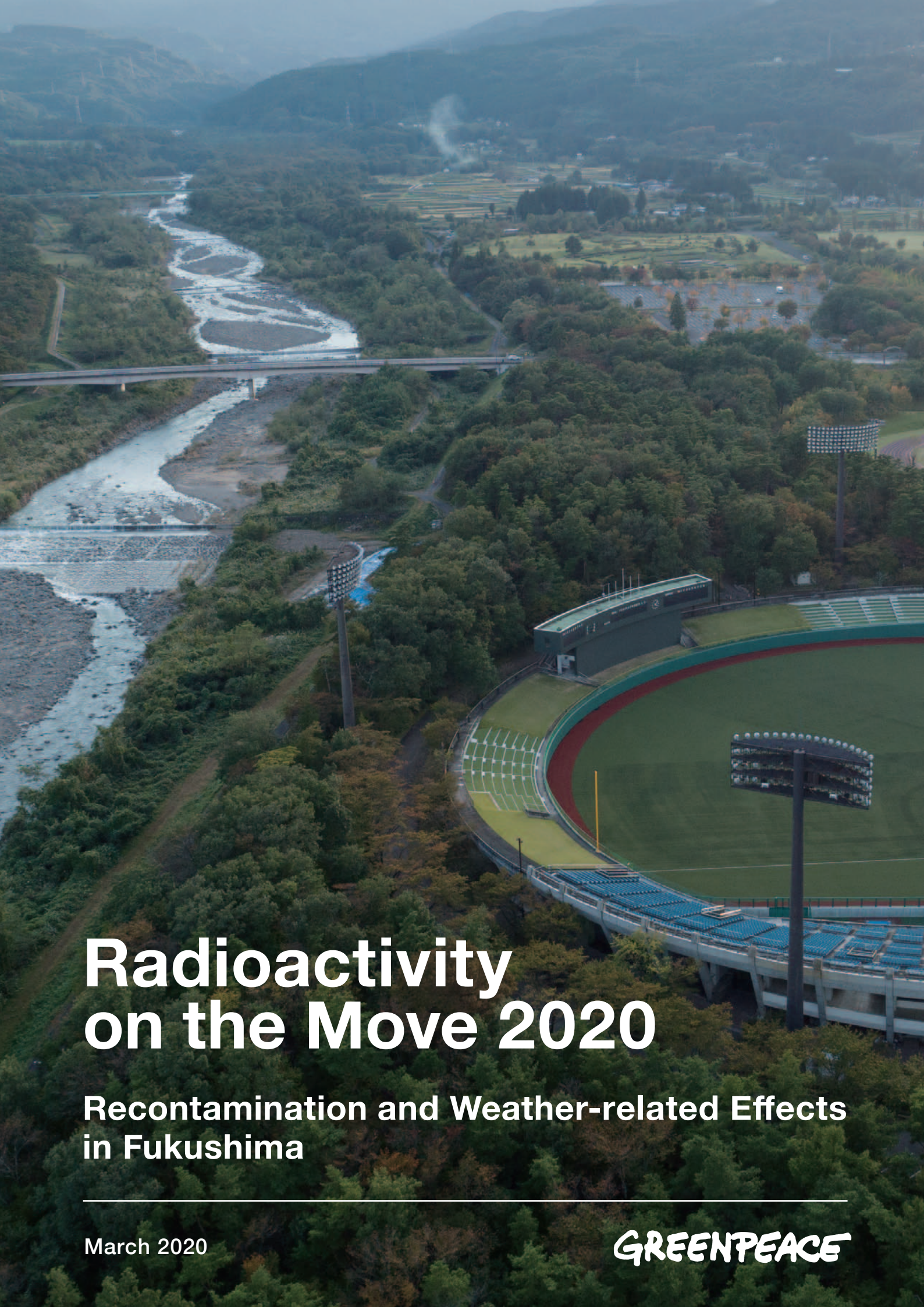


Radioactivity on the Move 2020

Recontamination and Weather-related Effects in Fukushima

March 2020

GREENPEACE

Contents

Greenpeace Japan Survey Report, March 2020

Nuclear Monitoring & Radiation Protection Survey Team:
Coordinators: Shaun Burnie, Michael Meyer-Krotz (Greenpeace Germany), and Jan Vande Putte (Greenpeace Belgium)
Radiation Protection Advisors: Mai Suzuki (Greenpeace Japan), Ray Lei (Greenpeace East Asia), Heinz Smital (Greenpeace Germany) and Mathieu Soete (Greenpeace Belgium)
Team members: Mari Chang (Greenpeace East Asia), Kazue Suzuki, Mitsuhisa Kawase and Maia Baconguis (Greenpeace Japan)
UAV technology development: Steve Wallace
Survey data compilation: Mai Suzuki and Jan Vande Putte

Report and analysis written by Shaun Burnie and Kazue Suzuki

Editing by Aniello Alioto and Maia Baconguis (Greenpeace Japan)

Photographs: © Christian Åslund / Greenpeace, Shaun Burnie / Greenpeace

A very special thanks to all house owners in Namie, Iitate, and Okuma and in particular Fukushima evacuees Ms. Kanno and Mr. Anzai who were so very generous with their time and much appreciated and necessary guidance during our survey work. We also would like to express our deep appreciation to Japanese citizens who kindly donated to this project. Their critical support made this survey project possible.

Cover: Aerial view of Azuma baseball stadium in Fukushima city which will host baseball and softball games during the 2020 Olympic (October, 2019)
Page 2-3: Radiation survey team along Abukuma river in Fukushima prefecture (October, 2019)

1 Executive summary

Greenpeace Japan's latest extensive radiation survey has found evidence of recontamination caused by Typhoon Hagibis, which released radioactive cesium from the forested mountains of Fukushima prefecture which make up 70% of the region, and which cannot feasibly be decontaminated. The Greenpeace Nuclear Monitoring and Radiation Protection survey team observed concentrated radiation levels throughout Fukushima Prefecture, including significant radiation hotspots, localized areas where radioactivity has been observed at higher levels than in previous years, a reduction in radiation levels in some areas, and recontamination elsewhere. This ongoing radiological emergency in parts of Fukushima prefecture runs directly counter to the narrative of the Japanese government which continues to push its propaganda of normalization in Fukushima.

The survey, which was conducted during three weeks of October and November 2019 by Greenpeace's survey team, also identified high-level radiation hotspots, including within Fukushima City. The complexity of the radiological situation in Fukushima prefecture, specifically in both the open and exclusion zones of Namie, Iitate, and Okuma, leads Greenpeace Japan to conclude that levels remain too high for the safe return of thousands of evacuees to these areas.

The survey took place in the immediate aftermath of Typhoon Hagibis during which heavy rainfall fell across Japan. The survey team found significant variation in radiation levels at specific locations when compared with previous years, suggesting that the radiation levels were affected by the weather. The Greenpeace survey team extended its survey to locations related to the upcoming Olympic Games in Fukushima. Radiation levels were measured at both the Azuma stadium and in central Fukushima City, where two Olympic events will be held in summer 2020, as well as at the J-Village in Iwaki, where the Olympic Torch Relay will start.

The survey team discovered the widespread presence of radioactive hotspots in Fukushima City and the J-Village. Over a period of four hours, the Greenpeace survey team identified 45 hotspots in the streets of Fukushima City in the area around the central station. The fact that these hotspots are located in public areas along the pavements and streets of central Fukushima City, including tens of meters from the entrance to the Shinkansen train line to Tokyo, highlights the ongoing scale of the nuclear disaster in 2011 and the continuing need for decontamination.

In the case of the J-Village, our conclusion is that radioactive contamination is not under control. The situation remains complex, with high levels of radiation in the area having the potential to spread and re-concentrate with additional amounts of heavy rainfall. The highest radiation hotspot identified by Greenpeace at J-Village on 26 October was 71 micro-Sieverts per hour (μSv/h) close to the surface and 32 μSv/h at 10 cm (i.e. over 1,750 times above pre-2011 background levels). This prompted Greenpeace Japan to provide details to the Japanese government, as well as the domestic and international Olympic committees and Fukushima prefecture, calling for:

1. an immediate extensive radiation survey of the public area in and around the J-Village and nearby Olympic/Paralympic venues;
2. decontamination of the identified hotspots in particular, but also of a wider area of soil (grass, forests, etc.) near the public area; and
3. regular screening of the radiation levels in J-Village to monitor possible re-contamination of public areas.

Whilst the Japanese government generally chooses to ignore the presence of radiation hotspots even after notification from Greenpeace Japan, the government issued instructions to Tokyo Electric Power Company (TEPCO) on 3 December 2019 to decontaminate the three highest contaminated spots specifically identified in the **communique by Greenpeace Japan on 18 November 2019**.

On 13 December our survey team returned to the J-Village and found additional radiation hotspots. Remarkably, we also found that standard procedures for decontamination, including removal of contamination up to 20 meters from public roads, had not been followed by TEPCO. In this case, only the few specific 1 square meter hotspots were removed, despite the fact that the wider surroundings also showed high levels of radiation. As a high profile location for the start of the Olympic

Torch Route one would have expected the authorities to have made all possible efforts to remove high concentrations of radiation upon specific notification by Greenpeace Japan. The fact that this has not been done, raises many questions and uncertainties, including how such high levels of radiation (71 μSv/h at close to surface) were not detected during the earlier decontamination work by TEPCO.

Through the support of local citizens, Greenpeace was able to continue its survey work in Iitate and Namie as well as in the highly contaminated exclusion zone of Namie and Okuma.

The complex conditions in Fukushima resulting from the 2011 Daiichi triple reactor meltdown cannot be ignored to suit the propaganda objectives of the Japanese government. Neither can this complexity be explained in absolutist, simplistic slogans – for example, neither "all is under control" nor "all of Fukushima is radioactive and dangerous" reflect the reality. Such an approach is an enormous disservice to the people of Fukushima.

The complexity of the radiation situation in Fukushima needs to be further studied, explained, and understood by the wider Japanese society and international community. The attention Japan, including Fukushima prefecture, will receive in 2020 as a result of the Olympic games is an opportunity for attaining a deeper understanding of the consequences of the Fukushima Daiichi disaster.

Recommendations to the Japanese government and Fukushima Prefecture

- Suspend the current return policy which ignores Fukushima citizens and ignores science-based analysis, including potential lifetime exposure risks;
- Immediately clarify its long-term decontamination target of 0.23 μSv/h, equal to 1 mSv/y exposure based on the government's calculation, including setting a date for when 0.23 μSv/h is to be attained, and halt any plans to revise the target level to a higher limit;
- Urgently assess the risks posed by radioactive hotspots, including the presence of cesium-rich microparticles, including the long-term consequences for public health;
- Abandon plans to lift evacuation orders in the six municipalities of Futaba, Okuma, Namie, Tomioka, Iitate and Katsurao, including the Namie districts of Tsushima, Murohara, Suenomori and Obori;
- In the interests of worker protection, suspend current decontamination programs in the "Difficult to Return" zones;
- Establish a fully transparent process to reflect and consider residents' opinions on evacuation policy, including opening a council of citizens including all evacuees;
- Provide full compensation and financial support to evacuees, and take measures to reduce radiation exposure based on science and the precautionary principle to protect public health and allow citizens to decide whether to return or relocate free from duress and financial coercion; and,
- Respond in full to the offer of dialogue and guidance from UN Special Rapporteurs, including accepting outstanding requests for Special Rapporteurs to visit Japan.

2 Introduction

Complexity of radiological situation

The results of Greenpeace Japan's latest survey in areas of Fukushima prefecture continue to reveal the highly complex nature of radioactive contamination, with evidence that recontamination and levels of radiation exposure remain too high for the safe return of populations to Iitate, Namie and Okuma.

The survey was conducted from 17th October to 4th November 2019, in both the open and closed areas of Namie and Okuma municipalities, as well as the open area in the village of Iitate. While the survey schedule had been planned months in advance, the Greenpeace survey team found itself in Fukushima in the immediate aftermath of Typhoon Hagibis, also known as Typhoon No.19. This exceptional typhoon deposited large volumes of rain across Japan, including in Fukushima Prefecture. In recent years, scientists have been reporting the effect of heavy rainfall leading to increased migration of radioactivity from mountainous forests through the river systems. When flooding occurs, this leads to increased radionuclide deposition and recontamination of land downstream. Greenpeace Japan documented this occurrence in 2016 in its report *Radiation Reloaded*, and highlighted the issue that due to the impossibility of decontamination throughout the mountainous forests of Fukushima, which make up 70% of the region, high amounts of rainfall had the potential to lead to significant land contamination (including recontamination) as well as an influx of radioactivity into the Pacific Ocean.

Greenpeace used the opportunity of being in Fukushima immediately following Typhoon Hagibis's heavy rainfall to determine if it was possible to identify specific radiological impacts. As we explain in this report, we found strong indications of weather-related effects where radioactivity levels were significantly different from past years in patterns that could not be explained by radioactive decay. The Greenpeace Nuclear Monitoring and Radiation Protection survey team observed concentrated radiation levels throughout Fukushima Prefecture, including significant radiation hotspots, localized areas where radioactivity has been observed at higher levels than in previous years, a reduction in radiation levels in some areas, and recontamination elsewhere. These examples are further evidence of the complex reality that remains in Fukushima despite the Japanese government's propaganda of "normalization".

Radiation, Human Rights and the Olympics

In the last two years, there have been multiple and sustained interventions from United Nations Human Rights Special Rapporteurs (SRs) and other United Nations (UN) Human Rights bodies which have exposed and challenged Japanese government Fukushima Reconstruction policies as they relate to the rights of children, women, and the wider community of evacuees from Fukushima Prefecture (see Appendix). The rights of tens of thousands of nuclear and decontamination workers have also been raised by UN SRs. Despite the extensively documented failure of the Japanese government to comply with its international obligations to protect human rights, including the setting of unacceptable and hazardous public radiation exposure limits, the Japanese government remains committed to policies which aim to pressure tens of thousands of Japanese Internally Displaced Persons (IDPs) to return to their former homes.

Radiation levels remain one, but not the only factor, in determining whether people return to Fukushima. As the latest population figures show, in the most contaminated areas of Fukushima the Japanese government has largely failed in its aim of convincing people that radiation dose rates are at a level where it is safe to return. It is therefore important to understand that in 2020 the Abe government is extending its efforts to convince the people of Japan, including Fukushima citizens, that nine years after the beginning of the Fukushima Daiichi accident, radiation levels pose no risk, and that the situation is 'under control'. The platform for this attempt to distort the complex reality in Fukushima will be the XXXII Olympiad, better known as the 2020 Tokyo Summer Olympics and Paralympics. For the Japanese government these are labeled as the 'Reconstruction Olympics', a branding that attempts to change the perception of the region of Japan devastated by the tragic events of 11 March 2011.

Greenpeace Japan takes no formal position on the decision to host the 2020 Olympics in Japan.

However, the decision to host two sporting events in Fukushima City raises genuine and important questions about radiation risks. Of great concern is the route of the Olympic Torch Relay through all the municipalities of Fukushima prefecture, including the districts of Iitate, Namie, and Okuma. Greenpeace has measured radiation levels in both the open areas of these municipalities and, in the remaining exclusion zones, and it is clear that radiation levels are too high for the safe return of the population.

What does all this mean for the hosting of Olympic events, including for athletes and visitors, and, most importantly, for residents? By conducting extensive radiation investigations, Greenpeace Japan attempts to explain the complex radiological environment, where nothing is straightforward.

Survey in Namie exclusion zone, Fukushima prefecture. Novermber 1, 2019

3 Radiation survey methodology

© Shaun Burnie / Greenpeace

The Greenpeace radiation team used different methods for survey work. Radio-cesiums (Cs-137 and Cs-134) contribute almost all (98%) of the long-term cumulative exposure. During the Fukushima nuclear disaster, equal amounts of Cs-137 and of Cs-134 were released.

Scanning

Systematic measurements:

- Ambient dose rate measured at one meter (m) with a highly-efficient and calibrated NaI scintillator (Georadis RT30: 2000 cps / µSv.h-1 (Cs-137) with one measurement each second.
- Walking in a systematic way, without searching for hotspots, where possible in a grid pattern.
- We took measurements around individual houses (with permission of the owners of the houses). The area around each house was divided into zones (typically: a field, path, and forests around the house) and each zone was measured separately. We defined around 5-10 zones around each house, with a minimum of 100 measurement points per zone, and a median range of 200 - 300 points per zone. The overall total of radiation measurement points for each house and land area typically ranged between 3,000 - > 5,000 points.
- In line with scientific standards, statistics are collected for each of these zones (average, minimum, and maximum for each zone). The average of all the zones of one house and land area is then calculated as a weighted average, with the same weight for each zone. This also allows a comparison between different years (as the number of measurement points for each year is not identical).

Hotspots

In addition, radiation hotspots, which are areas with concentrated radioactivity, as well as other points of interest around the houses, were identified and measured as follows:

- Ambient dose rate at 10 / 50 / 100 cm using a NaI scintillator (Radeye PRD- ER) and GPS position from handheld Garmin Montana 650 were used.
- These points were collected for each of the defined zones.

Car Scanning

To cover a wider area, we also measured radiation levels from a vehicle, with the Georadis RT30 mounted outside the vehicle opposite the driver's

side of the vehicle at 1 meter above the street level, recording one measurement every second.

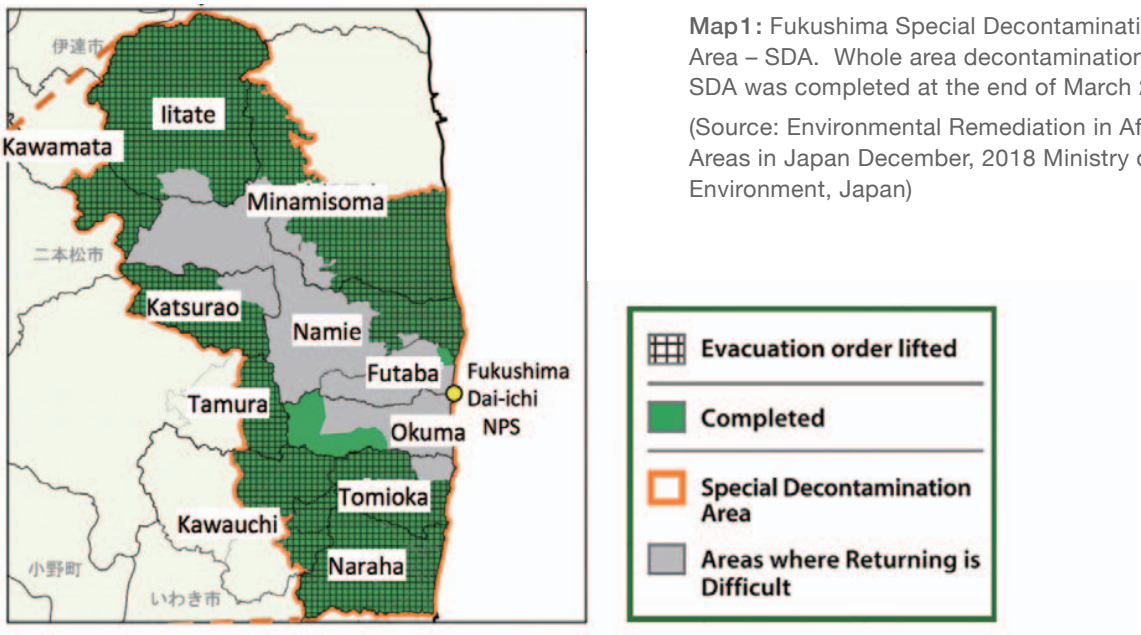
Unmanned Aerial Vehicle Scanning

The systematic measurements with the Georadis and precise Global Navigation Satellite System (GPS) have proven to be highly accurate and reliable. As mentioned later in this report and in earlier Fukushima reports from Greenpeace Japan in 2018, the measurements collected since 2015 allow us to compare trends in radiation levels. However, there are some limitations to this approach. As 70% of Fukushima prefecture is mountainous forest there is a physical challenge to accessing on foot, including areas where vegetation is becoming more dense each year. Precise replication between one year and the next under such conditions is difficult. Given the growth of vegetation in evacuated areas such as in the “Difficult to Return” Namie areas, access has been particularly problematic around houses and in the surrounding forests.

In order to surmount these limitations, in 2018 we developed a highly sensitive Unmanned Aerial Vehicle (UAV) measurement system (i.e. drone). The availability of technology that is both light and very sensitive allowed us to demonstrate, in October 2018, the feasibility of precise measurements from the air. From the technology point of view, we deployed the DJI Matrice 200 UAV. More importantly, we used a very light but sensitive CsI(Tl) thallium activated caesium iodide scintillator Kromek (Sigma-50), a LIDAR system to measure the altitude, a precise GPS system for locating the measurements, and a radio transmission to have real-time readings on the ground. The data was recorded and synchronized on a Raspberry Pi mini-computer mounted under the UAV, with one reading (GPS coordinates, altitude, and radiation measurements) every second.

Our new monitoring system is performing extremely well. We tested the use of the UAV monitor at different altitudes and found multiple applications starting from low altitude at 2 meter up to more than 100 meter. Even at 100 m, which enables virtually all obstacles to be avoided (but still well below the Japanese regulatory limit of 150 m for UAV permissible altitudes), the sensitivity of the Kromek Sigma-50 is sufficient with a count rate mostly between 500-4000 cps in the areas we measured, including the more highly contaminated areas in the “Difficult to Return” area in Namie.

After a successful demonstration of the concept in 2018 and 2019, in 2020 Greenpeace will further calibrate the UAV monitor. A detailed explanation of the methodology and results will be given once the system is fully operational.



Map1: Fukushima Special Decontamination Area – SDA. Whole area decontamination in the SDA was completed at the end of March 2017.

(Source: Environmental Remediation in Affected Areas in Japan December, 2018 Ministry of the Environment, Japan)

4

Namie and Okuma exclusion zone survey results

The global standard for radiation exposure is set by the International Commission for Radiation Protection (ICRP). The maximum recommended exposure for the general public was one milliSievert per year (mSv/y), and this was applied by the Japanese government until 2012. However, as result of the contamination of Fukushima prefecture by the nuclear disaster, these levels were exceeded. As part of its strategy to lift evacuation orders, the Japanese government in April 2012 increased the maximum recommended annual exposure to twenty (20) mSv/y.[1]

Before the March 2011 Fukushima Daiichi nuclear disaster, the average radiation levels in Fukushima prefecture were 0.04 µSv/h. In March 2012, the Japanese government set a long-term decontamination target of 0.23 µSv/h, which they calculate (if attained) would lead to a maximum annual exposure of 1 mSv. However, as this survey report and earlier Greenpeace Japan surveys have shown, in many areas of Fukushima, in particular in Iitate, Namie, and Okuma, the levels far exceed 0.23 µSv/h. The government, nine years after the start of the disaster and after 2.8 trillion yen assigned to its decontamination program, has still failed to provide any timeframe for when it thinks it will reach the 0.23 µSv/h target. As our 2018 report detailed, in some cases it will be well into the 22nd century and beyond when levels in some areas will reach 0.23 µSv/h, which remains nearly six (6) times higher than background levels pre-March 2011.

Namie exclusion zone House of Ms. Kanno

The home of Ms. Kanno is located in Shimo-Tsushima in the district of Namie, 30 km west-northwest of the Fukushima Daiichi nuclear plant. It was subjected to significant radiation contamination resulting from the March 2011 nuclear accident. The government selected Ms. Kanno's house for demonstrating its decontamination techniques and her home was subjected to considerable effort during December 2011 and February 2012. Greenpeace conducted its first radiation survey at the home of Ms. Kanno in September 2017, with a follow up survey in October 2018. In October 2019, we returned to Ms. Kanno's home with a focus on the immediate area around the house, as well as on the family's farmland and forest.

Overall, the weighted average recorded in October 2019 was 0.9 µSv/h for the seven zones measured, compared with 1.3 µSv/h for the four zones measured in 2018 (Table 1). Maximum levels in October 2019 were 2.2 µSv/h compared with 5.9 µSv/h in 2018, and 5.8 µSv/h in 2017.

There are significant variations that cannot be explained either by radioactive decay or by further official decontamination. Overall, the four zones for which we have data from 2018 and 2019, show a reduction of 31% on the average levels in a year, which is significant, compared with a zero reduction between 2017 and 2018. One plausible explanation for this contrast may be the absence of major rainfall comparable with Typhoon Hagibis, which struck Japan in October 2019, during the year preceding our 2018 survey. An explanation for the significant reduction in both the average and maximum levels for all zones can be found in zone 9, the path to the rice field. Here the average radiation measurement declined from 1.6 µSv/h in 2018 to 1.1 µSv/h in 2019, and the maximum declined from 5.9 µSv/h to 2.1 µSv/h in the respective years. The question is: why this reduction in this zone? Greenpeace Japan's analysis indicates that the lower radiation levels measured in 2019 very possibly could be the result of the very high rainfall experienced during Typhoon Hagibis.

Annual radiation dose rates for 30% of the areas measured at Ms. Kanno's house (Table 2) could lead to an exposure between 5-10 mSv/y based on Japanese government methodology and between 8-17 mSv/y based on sustained exposure over one full year.[2] The International Commission on Radiological Protection (ICRP) recommendation for the public sets the maximum additional recommended dose at 1 mSv/y.[3] 100% of the 3,722 measuring points exceeded the government's current long-term radiation target level of 0.23 µSv/h. In zone 1, which is in the immediate vicinity of the house (within 5-10 meters) and where workers had conducted decontamination, radiation levels were on average 0.5 µSv/h in 2019, compared to 0.6 µSv/h in 2018.

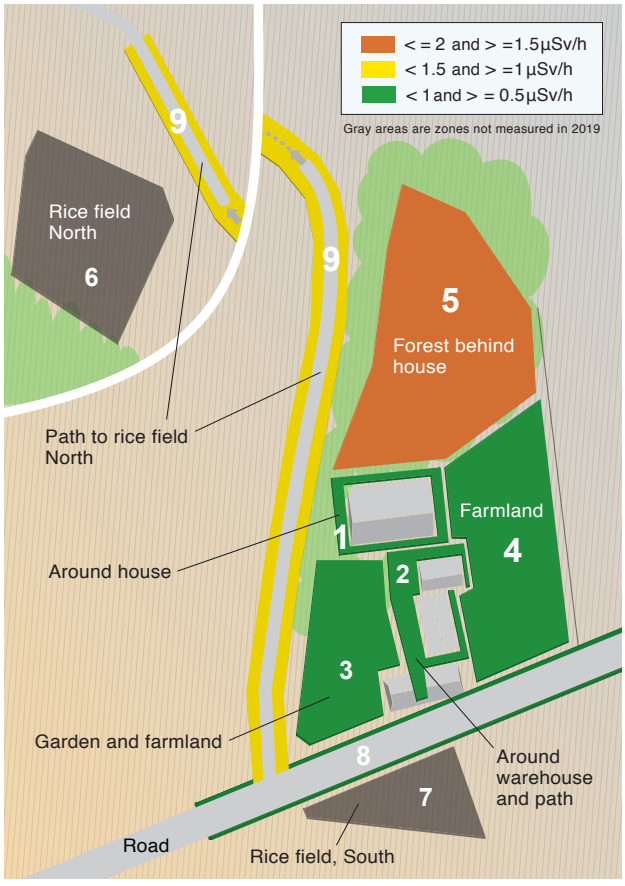


Diagram1: Schematic of Ms. Kanno's house in Shimo-Tsushima, Namie exclusion zone, Fukushima prefecture, showing the designated Zones for the Greenpeace radiation survey team.

The house itself is surrounded on three sides by forest which has grown extensively since 2011. The survey results in zone 5 (see Table 1), a forest area just behind the house, reveal the limited impact of decontamination as well as variations in radiation levels for which there are no obvious explanations. The average of the radiation levels measured in zone 5 were 1.5 µSv/h, with peak levels of 2.2 µSv/h in 2019 (compared with 2.0 µSv/h and 2.4 µSv/h in 2018 respectively). The 25% reduction in the average level in zone 5 cannot be explained either by radiation decay or decontamination. The possibility of a heavy rainfall effect due to Typhoon Hagibis requires further analysis by Greenpeace and other scientific bodies.

Table 1 : Breakdown of doserate in all Zones at Ms. Kanno house (walking on- and off-road, height 1m), 2017 - 2019.

Zone name		Max (µSv/h)			Average (µSv/h)			Number of points			Above 0.23 µSv/h			Above 1 µSv/h		
		2019	2018	2017	2019	2018	2017	2019	2018	2017	2019	2018	2017	2019	2018	2017
Zone 1	Around house	0.8	0.9	1.3	0.5	0.6	0.7	248	394	238	100%	100%	100%	0%	0%	9%
Zone 2	Around warehouse and path	1.1	n/a	2.1	0.7	n/a	1.1	479	n/a	550	100%	n/a	100%	3%	n/a	58%
Zone 3	Garden and farmland	1.5	n/a	1.8	0.9	n/a	0.8	537	n/a	383	100%	n/a	100%	39%	n/a	13%
Zone 4	Farmland	0.9	1.3	1.2	0.6	0.8	0.9	669	597	447	100%	100%	100%	0%	12%	24%
Zone 5	Forest behind house	2.2	2.4	2.8	1.5	2.0	1.9	504	330	902	100%	100%	100%	85%	100%	95%
Zone 6	Rice field, North	n/a	n/a	2.4	n/a	n/a	1.9	n/a	n/a	761	n/a	n/a	100%	n/a	n/a	100%
Zone 7	Rice field, South	n/a	n/a	1.9	n/a	n/a	1.5	n/a	n/a	403	n/a	n/a	100%	n/a	n/a	95%
Zone 8	Road	1.3	n/a	1.6	0.6	n/a	0.7	536	n/a	470	100%	n/a	100%	6%	n/a	100%
Zone 9	Path to rice field North	2.1	5.9	5.8	1.1	1.6	1.7	749	996	951	100%	100%	100%	54%	81%	91%
ALL	**Weighted average of all zones**	**2.2**	**5.9**	**5.8**	**0.9**	**1.3**	**1.3**	**3,722**	**2,317**	**5,105**	**100%**	**100%**	**100%**	**29%**	**52%**	**67%**

Table 2 : Radiation in all Zones at Ms. Kanno's house (walking on- and off-road, height 1m), October 24, 2019.

Intervals	No. of points	% of points	mSv/y (Japan govt)(*)	mSv/y if 8760h/y (*)
>= 5µSv/h	0	0%	>= 26 mSv/y	>= 43 mSv/y
< 5 and >=3.8µSv/h	0	0%	>= 20 mSv/y	>= 33 mSv/y
< 3.8 and >=2µSv/h	30	1%	>= 10 mSv/y	>= 17 mSv/y
< 2 and >=1.5µSv/h	508	14%	>= 8 mSv/y	>= 13 mSv/y
< 1.5 and >=1µSv/h	551	15%	>= 5 mSv/y	>= 8 mSv/y
< 1 and >=0.5µSv/h	2,008	54%	>= 3 mSv/y	>= 4 mSv/y
< 0.5 and >=0.23µSv/h	625	17%	>= 1 mSv/y	>= 2 mSv/y
< 0.23µSv/h	0	0%	< 1 mSv/y	< 2 mSv/y
Total number of points	**3,722**	**100%**	(*) av. Dose rate of 40nSv/h before March 2011 subtracted	

µSv/h	No. of points	% of points	mSv/y (Japan govt)(*)	mSv/y if 8760h/y (*)
no. points <0.23	0	0%	< 1 mSv/y	< 2 mSv/y
no. points >=0.23	3,722	100%	>= 1 mSv/y	>= 2 mSv/y
no. points >=0.5	3,097	83%	>= 3 mSv/y	>= 4 mSv/y
no. points >=1	1,089	29%	>= 5 mSv/y	>= 8 mSv/y
no. points >=1.5	538	14%	>= 8 mSv/y	>= 13 mSv/y
no. points >=2	30	1%	>= 10 mSv/y	>= 17 mSv/y
no. points >=3.8	0	0%	>= 20 mSv/y	>= 33 mSv/y
no. points >=5	0	0%	>= 26 mSv/y	>= 43 mSv/y
Total number of points	**3,722**	**100%**	(*) av. Dose rate of 40nSv/h before March 2011 subtracted	

House Z

Located 25 km northwest of the Fukushima Daiichi plant, the survey of House Z in October 2019 revealed, as in earlier years, very high levels of contamination, including hotspots. Greenpeace Japan did not conduct a survey at House Z in 2018, so this was our first return to this site since 2017. The overall average for all zones shows a decline from 3.3 µSv/h in 2017 to 2.4 µSv/h in 2019, with a similar decline from the maximum in 2017 of 8.2 µSv/h to 6.8 µSv/h in 2019. The average levels in zone 2 of House Z, which is in front of the house, were 3.0 µSv/h; with a maximum level of 6.1 µSv/h. 6% of annual radiation dose rates in Zone 2 would be in excess of 20 mSv/y (based on Japanese governmental methodology), and 33 mSv/y based on sustained exposure over one full year. For 70% of the whole area around House Z, the dose rates were in excess of 10 mSv/y (based on Japanese governmental methodology), and 17 mSv/y based on sustained exposure over one full year.

In zone 5, around a warehouse of House Z, the average 2019 readings were 2.5 µSv/h compared with 3.4 µSv/h in 2017, with a 2019 maximum level of 6.8 µSv/h compared with 8.2 µSv/h in 2017.

In zone 6, along Route 114, an average of 2.1 µSv/h was measured in 2019 compared with 2.71 µSv/h in 2017, and a 2019 maximum level of 5.3 µSv/h compared with 7.3 µSv/h in 2017. It should be noted that this is a higher maximum reading than the road scanning conducted both by the Japanese government and by Greenpeace Japan, due to the fact that this is based on a walking scan at an altitude closer to ground.

Table 3: Breakdown of doserate in all Zones at House Z (walking on- and off-road, height 1m), 2017 and 2019.

Zone name		Max (µSv/h)		Average (µSv/h)		Number of points		Above 0.23 µSv/h		Above 1 µSv/h	
		2019	2017	2019	2017	2019	2017	2019	2017	2019	2017
Zone 1	Path	3.2	4.3	2.3	3.2	140	180	100%	100%	100%	100%
Zone 2	In front of house	6.1	7.6	3.0	3.8	297	407	100%	100%	100%	100%
Zone 3	Around house	n/a	5.1	n/a	3.3	n/a	261	n/a	100%	n/a	100%
Zone 4	Greenhouse-garden	n/a	4.9	n/a	3.3	n/a	794	n/a	100%	n/a	100%
Zone 5	Front warehouse	6.8	8.2	2.5	3.4	262	195	100%	100%	100%	100%
Zone 6	Main road	5.3	7.3	2.1	2.7	483	875	100%	100%	100%	100%
Zone 7	Orchard	n/a	5.2	n/a	3.4	n/a	339	n/a	100%	n/a	100%
ALL	**Weighted average of all zones**	**6.8**	**8.2**	**2.4**	**3.3**	**1,182**	**3,051**	**100%**	**100%**	**100%**	**100%**

Walking scan in Namie exclusion zone. Novermber 1, 2019

Table 4 : Radiation in all Zones at House Z (walking on- and off-road, height 1m), November 1, 2019.

Intervals	No. of points	% of points	mSv/y (Japan govt)(*)	mSv/y if 8760h/y (*)
>= 5µSv/h	13	1%	>= 26 mSv/y	>= 43 mSv/y
< 5 and >=3.8µSv/h	56	5%	>= 20 mSv/y	>= 33 mSv/y
< 3.8 and >=2µSv/h	759	64%	>= 10 mSv/y	>= 17 mSv/y
< 2 and >=1.5µSv/h	296	25%	>= 8 mSv/y	>= 13 mSv/y
< 1.5 and >=1µSv/h	58	5%	>= 5 mSv/y	>= 8 mSv/y
< 1 and >=0.5µSv/h	0	0%	>= 3 mSv/y	>= 4 mSv/y
< 0.5 and >=0.23µSv/h	0	0%	>= 1 mSv/y	>= 2 mSv/y
< 0.23µSv/h	0	0%	< 1 mSv/y	< 2 mSv/y
Total number of points	**1,182**	**100%**	(*) av. Dose rate of 40nSv/h before March 2011 subtracted	

µSv/h	No. of points	% of points	mSv/y (Japan govt)(*)	mSv/y if 8760h/y (*)
no. points <0.23	0	0%	< 1 mSv/y	< 2 mSv/y
no. points >=0.23	1,182	100%	>= 1 mSv/y	>= 2 mSv/y
no. points >=0.5	1,182	100%	>= 3 mSv/y	>= 4 mSv/y
no. points >=1	1,182	100%	>= 5 mSv/y	>= 8 mSv/y
no. points >=1.5	1,124	95%	>= 8 mSv/y	>= 13 mSv/y
no. points >=2	828	70%	>= 10 mSv/y	>= 17 mSv/y
no. points >=3.8	69	6%	>= 20 mSv/y	>= 33 mSv/y
no. points >=5	13	1%	>= 26 mSv/y	>= 43 mSv/y
Total number of points	**1,182**	**100%**	(*) av. Dose rate of 40nSv/h before March 2011 subtracted	

Okuma exclusion zone

The Japanese government has opened a small area of Okuma following decontamination, but much of the area remains within the exclusion zone.

A citizen of Okuma requested that Greenpeace survey their family home, which lies in the exclusion zone of Okuma at a distance of 7.5 km from Fukushima Daiichi. This is our first review at this location, with the intention of returning in 2020. The average dose rate for the 3,263 points at House X was measured at 1.1 µSv/h with a maximum of 4.2 µSv/h. 56% of points were over 1 µSv/h and 100% of the 3,263 points measured were above the government decontamination target of 0.23 µSv/h. These were not the highest levels of contamination measured in Okuma.

Within meters of the new Ono train station, which was under construction during the time of our 2019 measurements in Okuma, we found radiation hotspots of 6 µSv/h at 1 m and 41 µSv/h at 10 cm. In the newly opened area of Okuma, near the new town hall and within a few hundred meters of the planned route for the Olympic torch, we measured radiation hotspots of 1.5 µSv/h at 1 m and 2.5 µSv/h at 10 cm in the small forest.

Image 1: Aerial image of hotspots in Okuma, near Ono station (November 2, 2019)
Made from Google Maps

Table 5: Breakdown of doserate in all Zones in Okuma (walking on- and off-road, height 1m), 2019.

Zone name		2019				
		Max (μSv/h)	Average (μSv/h)	Number of points	Above 0.23 μSv/h	Above 1 μSv/h
Zone 1	Path to house	1.8	0.9	129	100%	39%
Zone 2	Field West	1.5	1.1	309	100%	67%
Zone 3	Field East	1.8	1.1	291	100%	69%
Zone 4	Around house	4.2	1.1	579	100%	58%
Zone 5	Forest behind house	1.9	1.5	683	100%	100%
Zone 6	Garden	3.4	1.4	301	100%	83%
Zone 7	Road	2.3	0.7	971	100%	11%
ALL	**Weighted average of all zones**	**4.2**	**1.1**	**3,263**	**100%**	**56%**

Table 6: Radiation in all Zones in Okuma (walking on- and off-road, height 1m), November 2, 2019.

Intervals	No. of points	% of points	mSv/y (Japan govt)(*)	mSv/y if 8760h/y (*)
>= 5μSv/h	0	0%	>= 26 mSv/y	>= 43 mSv/y
< 5 and >=3.8μSv/h	3	0%	>= 20 mSv/y	>= 33 mSv/y
< 3.8 and >=2μSv/h	30	1%	>= 10 mSv/y	>= 17 mSv/y
< 2 and >=1.5μSv/h	576	18%	>= 8 mSv/y	>= 13 mSv/y
< 1.5 and >=1μSv/h	1,229	38%	>= 5 mSv/y	>= 8 mSv/y
< 1 and >=0.5μSv/h	1,261	39%	>= 3 mSv/y	>= 4 mSv/y
< 0.5 and >=0.23μSv/h	164	5%	>= 1 mSv/y	>= 2 mSv/y
< 0.23μSv/h	0	0%	< 1 mSv/y	< 2 mSv/y
Total number of points	**3,263**	**100%**	(*) av. Dose rate of 40nSv/h before March 2011 subtracted	

μSv/h	No. of points	% of points	mSv/y (Japan govt)(*)	mSv/y if 8760h/y (*)
no. points <0.23	0	0%	< 1 mSv/y	< 2 mSv/y
no. points >=0.23	3,263	100%	>= 1 mSv/y	>= 2 mSv/y
no. points >=0.5	3,099	95%	>= 3 mSv/y	>= 4 mSv/y
no. points >=1	1,838	56%	>= 5 mSv/y	>= 8 mSv/y
no. points >=1.5	609	19%	>= 8 mSv/y	>= 13 mSv/y
no. points >=2	33	1%	>= 10 mSv/y	>= 17 mSv/y
no. points >=3.8	3	0%	>= 20 mSv/y	>= 33 mSv/y
no. points >=5	0	0%	>= 26 mSv/y	>= 43 mSv/y
Total number of points	**3,263**	**100%**	(*) av. Dose rate of 40nSv/h before March 2011 subtracted	

Aerial view of Okuma exclusion zone, Fukushima prefecture.
November 2, 2019

5

Lifted evacuation areas - Namie and Iitate

On 31 March 2017, the Japanese government lifted the evacuation orders for areas in Namie Town and Iitate Village, which lie north and northwest of the Fukushima Daiichi nuclear plant, and are not in the "Difficult to Return" zone. In March 2011, the populations of Iitate and Namie districts were 6,509 and 21,434 respectively.[4] As of 31 January 2020, the population of Namie was 1189 (compared with 896 in 2019), and the population of Iitate, as of 1 January 2020, was 1,392 (compared with 1,003 as of 1 February 2019).

Greenpeace Japan conducted radiation surveys in Namie and Iitate in 2011; we resumed survey work in Iitate in 2015 and have revisited each year subsequently. In September 2017, Greenpeace Japan extended its survey to the central area of Namie Town where the majority of the population formerly lived. As with the results of our surveys in Iitate conducted in 2015, 2016, and 2017, we found that as of October 2019 radiation levels in the area of Namie where the evacuation order has been lifted are still significantly higher than the government's current long-term target level of 0.23 μSv/h.

As confirmed in our survey of these open areas, radiation exposure for people returning to Namie and Iitate would, in some cases, be well in excess of the recommended maximum of 1 mSv/y. The Japanese government maintains that exposure up to 20 mSv/y is acceptable in these lifted evacuation order areas. This is despite clear scientific evidence of the cancer risks from low dose radiation exposure in the 1-5 mSv/y range, which the Japanese government continues to disregard.[5]

Namie Town

The town of Namie lies 10 km north-northwest of the Fukushima Daiichi nuclear plant, and has clearly undergone extensive decontamination between 2014 and 2017. However, in areas surveyed by Greenpeace Japan in 2019, this decontamination has clearly failed to reduce radiation levels to the government's current long-term target of 0.23 μSv/h.

The Takase river, which flows through Namie, acts as a crossing point between the publicly open area and "Difficult to Return" zone of Namie.

Takase river

At the Takase river, near the hamlet of Tawatsuda, we extended our survey further than in previous years. This is in an area of Namie where the evacuation order was lifted in March 2017. Radiation levels in this area are consistently above the Japanese government's 0.23 μSv/h long-term target. Along the river bank and road where we measured 5,581 data points, levels averaged 0.8 μSv/h with maximum of 1.7 μSv/h, with 99% exceeding the government's long term decontamination target. These average levels are twenty (20) times higher than the pre-2011 background level of 0.04 μSv/h.

For Zone 1 of the Takase river survey (the path along the river), levels in 2019 matched those of 2018, with an average of 0.7 μSv/h and maximum of 1.5 μSv/h. It was not possible to accurately measure zone 2 as in 2018, due to deforestation work underway. Instead, we proceeded to measure along a slope by the bank of the river. Measurements along the river showed higher levels than on the higher roadway above, and there were indications of hotspots due to possible recontamination. The Takase river, like all the rivers of Fukushima, experienced major flooding in October 2019, leading to a major flux of radioactivity moving through the waters of Fukushima Prefecture. It is worth noting that directly upstream from this area lies one of the most contaminated areas in the Namie exclusion zone, Obori Village. The Takase river passes directly through Obori Village.

In 47% of the area along the river bank slope, in the publicly accessible area of Namie Town surveyed in October 2019, radiation levels would give an annual radiation dose between 5-8 mSv/year (based on the revised Japanese government methodology) and between 8-13 mSv based on full exposure over one year.

Survey along Takase river, Fukushima prefecture. October 24, 2019

Table 7 : Breakdown of doserate in all Zones in Takase river (walking on- and off-road, height 1m), 2019.

Location	Max (µSv/h)	Average (µSv/h)	Number of points	Above 0.23 µSv/h	Above 1 µSv/h
Path along river (Zone 1)	1.5	0.7	2,263	97%	7%
River bank slope	1.7	1.0	3,318	100%	47%
ALL	**1.7**	**0.8**	**5,581**	**99%**	**31%**

Table 8 : Radiation in all Zones in Takase river (walking on- and off-road, height 1m), October 29, 2019.

Intervals	No. of points	% of points	mSv/y (Japan govt)(*)	mSv/y if 8760h/y (*)
>= 5µSv/h	0	0%	>= 26 mSv/y	>= 43 mSv/y
< 5 and >=3.8µSv/h	0	0%	>= 20 mSv/y	>= 33 mSv/y
< 3.8 and >=2µSv/h	0	0%	>= 10 mSv/y	>= 17 mSv/y
< 2 and >=1.5µSv/h	24	1%	>= 8 mSv/y	>= 13 mSv/y
< 1.5 and >=1µSv/h	1,550	47%	>= 5 mSv/y	>= 8 mSv/y
< 1 and >=0.5µSv/h	1,739	52%	>= 3 mSv/y	>= 4 mSv/y
< 0.5 and >=0.23µSv/h	5	0%	>= 1 mSv/y	>= 2 mSv/y
< 0.23µSv/h	0	0%	< 1 mSv/y	< 2 mSv/y
Total number of points	**3,318**	**100%**	(*) av. Dose rate of 40nSv/h before March 2011 subtracted	

µSv/h	No. of points	% of points	mSv/y (Japan govt)(*)	mSv/y if 8760h/y (*)
no. points <0.23	0	0%	< 1 mSv/y	< 2 mSv/y
no. points >=0.23	3,318	100%	>= 1 mSv/y	>= 2 mSv/y
no. points >=0.5	3,313	100%	>= 3 mSv/y	>= 4 mSv/y
no. points >=1	1,574	47%	>= 5 mSv/y	>= 8 mSv/y
no. points >=1.5	24	1%	>= 8 mSv/y	>= 13 mSv/y
no. points >=2	0	0%	>= 10 mSv/y	>= 17 mSv/y
no. points >=3.8	0	0%	>= 20 mSv/y	>= 33 mSv/y
no. points >=5	0	0%	>= 26 mSv/y	>= 43 mSv/y
Total number of points	**3,318**	**100%**	(*) av. Dose rate of 40nSv/h before March 2011 subtracted	

Namie kindergarten and school

Greenpeace Japan first surveyed a kindergarten and school in Namie in 2017 when we investigated radiation levels, including in a small forested area adjacent to the school.

In our October 2019 survey the average radiation level in the forested area adjacent to the school, was 1.6 µSv/h, compared to 1.8 µSv/h in 2018; and with a maximum of 2.3 µSv/h compared to 2.9 µSv/h in 2018. These radiation levels remain much too high or any area that has been declared open for human settlement, let alone a place where children are likely to gather.

In 45% of the recently surveyed area around the school, the annual dose would be between 8-10 mSv based on the Japanese government methodology and between 13-17 mSv based on sustained exposure over a full year. For 8% of the forested area, the annual dose would be between 10-20 mSv based on the Japanese government methodology and between 17-33 mSv based on sustained exposure over a full year. 100% of the 2,190 points measured in 2019 exceeded the Japanese government's long-term decontamination target of 0.23 µSv/h.

Table 9: Breakdown of doserate in Namie school (walking on- and off-road, height 1m), 2019.

Location	Max (µSv/h)	Average (µSv/h)	Number of points	Above 0.23 µSv/h	Above 1 µSv/h
Forest in front of school	2.3	1.6	2,190	100%	97%

Table 10: Radiation in Namie school (walking on- and off-road, height 1m), October 29, 2019.

Intervals	No. of points	% of points	mSv/y (Japan govt)(*)	mSv/y if 8760h/y (*)
>= 5µSv/h	0	0%	>= 26 mSv/y	>= 43 mSv/y
< 5 and >=3.8µSv/h	0	0%	>= 20 mSv/y	>= 33 mSv/y
< 3.8 and >=2µSv/h	167	8%	>= 10 mSv/y	>= 17 mSv/y
< 2 and >=1.5µSv/h	994	45%	>= 8 mSv/y	>= 13 mSv/y
< 1.5 and >=1µSv/h	965	44%	>= 5 mSv/y	>= 8 mSv/y
< 1 and >=0.5µSv/h	60	3%	>= 3 mSv/y	>= 4 mSv/y
< 0.5 and >=0.23µSv/h	4	0%	>= 1 mSv/y	>= 2 mSv/y
< 0.23µSv/h	0	0%	< 1 mSv/y	< 2 mSv/y
Total number of points	**2,190**	**100%**	(*) av. Dose rate of 40nSv/h before March 2011 subtracted	

µSv/h	No. of points	% of points	mSv/y (Japan govt)(*)	mSv/y if 8760h/y (*)
no. points <0.23	0	0%	< 1 mSv/y	< 2 mSv/y
no. points >=0.23	2,190	100%	>= 1 mSv/y	>= 2 mSv/y
no. points >=0.5	2,186	100%	>= 3 mSv/y	>= 4 mSv/y
no. points >=1	2,126	97%	>= 5 mSv/y	>= 8 mSv/y
no. points >=1.5	1,161	53%	>= 8 mSv/y	>= 13 mSv/y
no. points >=2	167	8%	>= 10 mSv/y	>= 17 mSv/y
no. points >=3.8	0	0%	>= 20 mSv/y	>= 33 mSv/y
no. points >=5	0	0%	>= 26 mSv/y	>= 43 mSv/y
Total number of points	**2,190**	**100%**	(*) av. Dose rate of 40nSv/h before March 2011 subtracted	

Mr. Anzai's house in Iitate village

Since 2015, Greenpeace Japan has been conducting radiation surveys at the house of Mr. Toru Anzai, which is located in the south-east of Iitate, 35 km from the Fukushima Daiichi nuclear power plant. Mr. Anzai was evacuated from his home on 24 June 2011. Mr. Anzai's house and the surrounding area were subjected to extensive decontamination by the authorities during the 2014-2015 period. This involved scraping away a layer of more than 5 cm of topsoil, which was then removed from the site and stored as radioactive waste. In some cases, the surface was covered with uncontaminated soil. The survey results from Mr. Anzai's house in 2015-2019 are shown in Tables 11 and 12.

Readings at Mr. Anzai's house were taken at a total of 3,651 measurement points in October 2019. When conducting the survey in October 2015, decontamination work was still in progress, which led us to conclude in 2016 that the measured decrease was a combined effect of further decontamination, decay, and erosion.

In October 2019, while there has been a noticeable decline in the overall average radiation level for all zones, 100% of all measurements in seven of the ten zones still exceeded the government target of 0.23 µSv/h. In 2018,

the average was 0.7 µSv/h whereas the level measured in 2019 was 0.5 µSv/h, a 29% reduction. For the maximum levels of radiation observed, there was an even wider variation with levels measured at 1.3 µSv/h in 2019 compared with 1.7 µSv/h in 2018, a 24% decline. Levels recorded in 2016 and 2017, after the completion of decontamination in 2015, had mostly remained stable. The decline in radiation levels cannot be explained by radioactive decay alone, and indicates a weathering effect perhaps due to the heavy rainfall of Typhoon Hagibis.

In earlier years we noted that decontamination efforts had been much less effective in zone 5. A similar problem was experienced by houses in Iitate which are also located in close proximity to hillside forests, where decontamination is not possible. As is standard practice throughout the contaminated regions, an area up to 20 meters from Mr. Anzai's house into the forest has been 'decontaminated'. In 2019, we measured the levels in Zone 5 at an average of 0.9 µSv/h and a maximum of 1.3 µSv/h compared to 1.0 µSv/h and 1.7 µSv/h, respectively, in 2018. The radiation levels on the steep slopes close to houses are crucial as they have a direct impact on the radiation levels inside houses. We can also expect that radioactivity from the non-decontaminated forest might re-contaminate the already decontaminated area below and closer to houses. In the case of Mr. Anzai, his house was demolished in 2018 and there are currently no plans to rebuild at this location.

The most noticeable variation in levels between 2018 and 2019 were in zone 4 and zone 7, both are agricultural fields that were subjected to decontamination in 2015. Average radiation levels in 2019 were 68% and 58% of the previous year (see Table 11). This cannot be explained by radioactive decay alone, and suggests resuspension and weather related effects resulting from heavy rainfall. These significant changes are particularly evident when examined across the five year period for which we have data. Our return to Mr. Anzai's land in October 2020, in the absence of further heavy rainfall, will provide us a means to confirm the cause of these significant variations in dose rates.

For 57% of the area at Mr. Anzai's land, dose rates would be in excess of 3 mSv/y based on Japanese government methodology, and 4 mSv/y based on sustained exposure over one full year. For 4% of the area, radiation exposure would be in excess of 5 µSv/y based on Japanese government methodology, and 8 mSv/y based on sustained exposure over one full year.

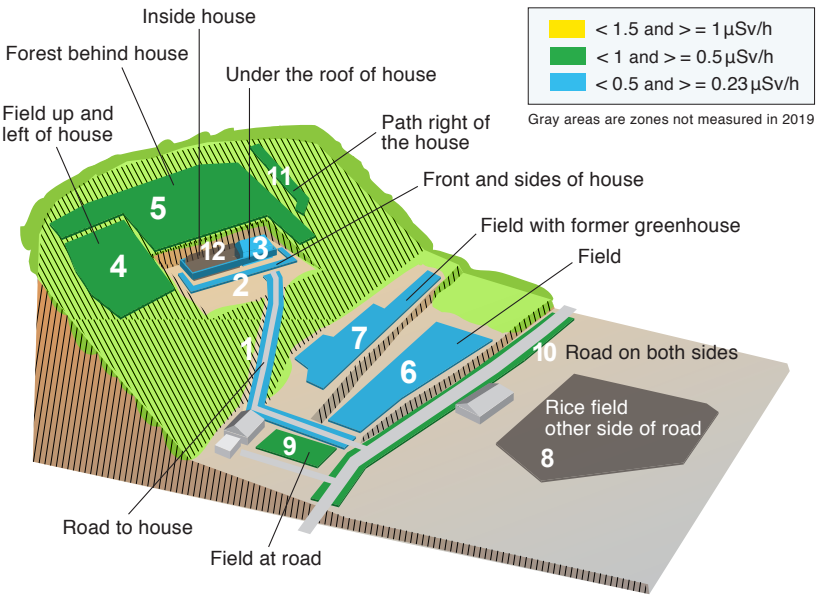


Diagram 2: Schematic of Mr. Anzai's house in Iitate, showing the designated Zones for the Greenpeace radiation survey team.

Table 11: Breakdown of doserate in all Zones in Mr. Anzai's house (walking on- and off-road, height 1m), 2015 - 2019.

Zone name		Max (µSv/h)					Average (µSv/h)					Average % of previous year				
		2019	2018	2017	2016	2015	2019	2018	2017	2016	2015	2019	2018	2017	2016	2015
Zone 1	Road to house	0.6	1.0	0.9	0.8	1.4	0.4	0.5	0.6	0.6	1.1	87%	83%	105%	58%	n/a
Zone 2	Front and sides of house	0.5	0.9	0.8	0.7	1.3	0.3	0.4	0.4	0.3	0.6	64%	102%	116%	60%	n/a
Zone 3	Under the roof of house	0.5	0.9	0.6	0.7	1.2	0.3	0.4	0.4	0.4	0.7	75%	105%	101%	57%	n/a
Zone 4	Field up and left of house	1.0	1.3	1.4	1.5	2.3	0.7	1.0	1.1	1.1	1.9	68%	88%	99%	61%	n/a
Zone 5	Forest behind house	1.3	1.7	1.6	1.5	2.2	0.9	1.0	0.9	1.0	1.4	87%	113%	90%	75%	n/a
Zone 6	Field	0.7	1.1	1.1	1.1	2.0	0.5	0.6	0.8	0.8	1.2	76%	75%	105%	69%	n/a
Zone 7	Field with former greenhouses	0.7	1.4	1.4	1.6	n/a	0.4	0.7	0.8	0.8	n/a	58%	84%	105%	n/a	n/a
Zone 8	Rice field other side of road	n/a	n/a	1.2	0.6	1.7	n/a	n/a	0.5	0.3	1.4	n/a	n/a	145%	23%	n/a
Zone 9	Field at road	1.0	n/a	2.0	1.5	n/a	0.6	n/a	0.9	1.0	n/a	n/a	n/a	96%	n/a	n/a
Zone 10	Road on both sides	1.1	n/a	1.4	1.0	2.6	0.5	n/a	0.7	0.6	1.3	n/a	n/a	115%	48%	n/a
Zone 11	Path right of the house	1.0	n/a	1.6	1.5	n/a	0.7	n/a	1.1	1.0	n/a	n/a	n/a	111%	n/a	n/a
Zone 12	Inside house	n/a	n/a	0.7	n/a	0.9	n/a	n/a	0.3	n/a	0.5	n/a	n/a	n/a	n/a	n/a
ALL	**Weighted average of all zones**	**1.3**	**1.7**	**2**	**1.6**	**2.6**	**0.5**	**0.7**	**0.8**	**0.7**	**1.1**	**73%**	**89%**	**101%**	**68%**	**n/a**

Zone name		Number of points					Above 0.23 µSv/h					Above 1 µSv/h				
		2019	2018	2017	2016	2015	2019	2018	2017	2016	2015	2019	2018	2017	2016	2015
Zone 1	Road to house	184	447	255	264	481	100%	100%	100%	100%	100%	0%	0%	0%	0%	78%
Zone 2	Front and sides of house	241	464	372	301	234	70%	98%	98%	87%	100%	0%	0%	0%	0%	4%
Zone 3	Under the roof of house	170	629	186	169	573	76%	99%	98%	98%	100%	0%	0%	0%	0%	11%
Zone 4	Field up and left of house	405	542	365	283	524	100%	100%	100%	100%	100%	0%	62%	88%	88%	100%
Zone 5	Forest behind house	732	952	644	358	814	100%	100%	100%	100%	100%	21%	65%	48%	53%	71%
Zone 6	Field	285	1,018	370	327	1,126	100%	100%	100%	100%	100%	0%	1%	8%	2%	73%
Zone 7	Field with former greenhouses	515	695	607	578	n/a	93%	100%	100%	100%	n/a	0%	10%	16%	18%	n/a
Zone 8	Rice field other side of road	n/a	n/a	510	239	332	n/a	n/a	100%	98%	100%	n/a	n/a	3%	0%	100%
Zone 9	Field at road	178	n/a	183	103	n/a	100%	n/a	100%	100%	n/a	0%	n/a	22%	30%	n/a
Zone 10	Road on both sides	694	n/a	857	194	592	100%	n/a	100%	100%	100%	0%	n/a	4%	1%	95%
Zone 11	Path right of the house	247	n/a	339	245	n/a	100%	n/a	100%	100%	n/a	0%	n/a	65%	50%	n/a
Zone 12	Inside house	n/a	n/a	215	n/a	817	n/a	n/a	100%	n/a	100%	n/a	n/a	0%	n/a	0%
ALL	**Weighted average of all zones**	**3,651**	**4,747**	**4,903**	**3,061**	**5,493**	**96%**	**100%**	**100%**	**98%**	**100%**	**4%**	**22%**	**22%**	**23%**	**58%**

Table 12: Radiation in all Zones in Mr. Anzai's house (walking on- and off-road, height 1m), October 28, 2019.

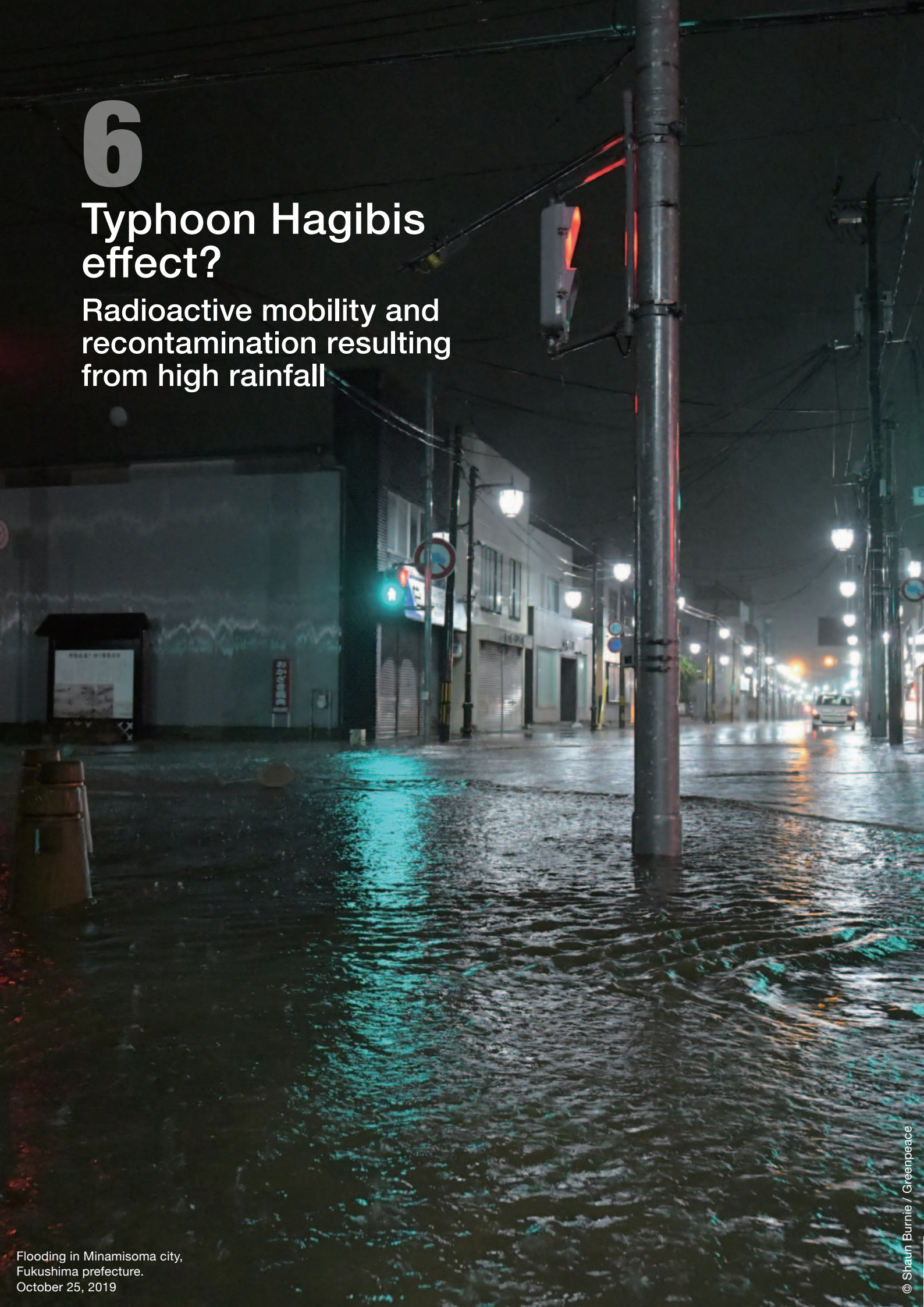
Intervals	No. of points	% of points	mSv/y (Japan govt)(*)	mSv/y if 8760h/y (*)
>= 5µSv/h	0	0%	>= 26 mSv/y	>= 43 mSv/y
< 5 and >=3.8µSv/h	0	0%	>= 20 mSv/y	>= 33 mSv/y
< 3.8 and >=2µSv/h	0	0%	>= 10 mSv/y	>= 17 mSv/y
< 2 and >=1.5µSv/h	0	0%	>= 8 mSv/y	>= 13 mSv/y
< 1.5 and >=1µSv/h	160	4%	>= 5 mSv/y	>= 8 mSv/y
< 1 and >=0.5µSv/h	1,924	53%	>= 3 mSv/y	>= 4 mSv/y
< 0.5 and >=0.23µSv/h	1,418	39%	>= 1 mSv/y	>= 2 mSv/y
< 0.23µSv/h	149	4%	< 1 mSv/y	< 2 mSv/y
Total number of points	**3,651**	**100%**	(*) av. Dose rate of 40nSv/h before March 2011 subtracted	

µSv/h	No. of points	% of points	mSv/y (Japan govt)(*)	mSv/y if 8760h/y (*)
no. points <0.23	149	4%	< 1 mSv/y	< 2 mSv/y
no. points >=0.23	3,502	96%	>= 1 mSv/y	>= 2 mSv/y
no. points >=0.5	2,084	57%	>= 3 mSv/y	>= 4 mSv/y
no. points >=1	160	4%	>= 5 mSv/y	>= 8 mSv/y
no. points >=1.5	0	0%	>= 8 mSv/y	>= 13 mSv/y
no. points >=2	0	0%	>= 10 mSv/y	>= 17 mSv/y
no. points >=3.8	0	0%	>= 20 mSv/y	>= 33 mSv/y
no. points >=5	0	0%	>= 26 mSv/y	>= 43 mSv/y
Total number of points	**3,651**	**100%**	(*) av. Dose rate of 40nSv/h before March 2011 subtracted	

6

Typhoon Hagibis effect?

Radioactive mobility and recontamination resulting from high rainfall



Flooding in Minamisoma city, Fukushima prefecture.
October 25, 2019

Greenpeace Japan's annual radiation survey in areas of Fukushima coincided with the region being struck by one of the most powerful typhoons of the last 100 years, Typhoon Hagibis. The resulting heavy rainfall caused localized flooding and landslides, as well as tragic loss of life. A lesser known fact is that flooding is one of the major factors increasing downstream migration of radioactivity.

Heavy rains – such as typhoons – can further increase cesium (Cs) discharge rates from Fukushima forests by one or two orders of magnitude. The radioactivity, principally radio-cesium, that was deposited in the mountainous forests of Fukushima in March 2011 is a long-term source of downstream contamination. As Greenpeace Japan reported in its 2016 report *Radiation Reloaded*,[6] the stocks of radio-cesium in forests, hill slopes, and floodplains can be remobilized and contaminate areas downstream by significant rainfall events, typhoons, and spring snowmelt. That would include areas that did not receive fallout from the radioactive plumes in 2011, as well as areas that have already been decontaminated, as increased water flows resulting from typhoons can re-suspend or mobilize contaminated sediment and organic matter – i.e. rather than cesium simply being buried under newer sediments, it can be mechanically remixed, creating secondary contamination. In addition, the contaminated particulates and organic matter brought down from forests and fields with heavy rains and typhoons will create continuing, subsequent influxes of radiocesium into lakes and coastal ecosystems for years and decades to come. Whether radio-cesium is transported via particulate matter (i.e. bound to minerals) or dissolved in water is a critical factor in understanding both its movement and its bioavailability – this is expressed as the 'Kd factor' which is the distribution coefficient for cesium. Kd is one of the most important parameters used in estimating the migration of contaminants. Fukushima discharges have been documented to have a Kd factor 1-2 orders of magnitude higher than those found in Chernobyl watersheds in the initial years after the disaster. This means that the ratio of particulate-bound cesium transported in Fukushima river catchments in relation to dissolved (bioavailable) cesium was an order of magnitude or two higher than that in Chernobyl.

This has been attributed to several factors, including higher precipitation levels in Fukushima compared to Chernobyl, the high clay content of Fukushima soils, and that fine clay particles, to which cesium has a particular affinity, are also eroded soil particles. The fine particles to which most of the mineral-bound cesium is attached are also the most likely to be carried into forest streams by rain and over long distances in rivers. Some of this particulate cesium in rivers is not mineral-bound, but rather a wash-down of the hot glassy particles that were also released in the most acute phases of the radioactive releases.

The effect of heavy rainfall on radioactive concentrations of Fukushima's river systems, and releases into the Pacific Ocean, were studied in the initial years after the Fukushima Daiichi disaster. According to one study,[7] an estimated 84-92% of the radiocesium transported in the Abukuma watershed was carried in the form of suspended solids between August 10, 2011 and May 11, 2012.

The authors of that same study further stated that "The total flux of radiocesium into the Pacific Ocean estimated at the outlet station (basin area 5,172 km^2) was 5.34 terabecquerels (TBq) for 137Cs, and 4.74 TBq for 134Cs, corresponding to 1.13% of the total estimated radiocesium fallout over the basin catchment (890 TBq). This was equivalent to the estimated amount of direct leakage from the Fukushima Daiichi Nuclear Power Plant to the ocean during June 2011 to September 2012 of 17 TBq and the Level 3 Scale Leakage on 21 August 2013 (24 TBq)."[8]

In particular, typhoons cause significant increases in cesium discharges into the Pacific Ocean. This study estimated that storm-mobilized cesium discharges were at 6.18 TBq, accounting for 61.4% of the total cesium discharges to the coastal areas during the observation period. Another study of the Natsui River and the Same River in 2011 reported that heavy rain and Typhoon Roke were responsible for 30-50% of the total annual radio-cesium flux to coastal regions for these rivers.[9] Further, during base-flow conditions, the particulate fraction of the total radio-cesium inventory was between 21–56%, but increased to nearly 100% after Typhoon Roke which struck Japan in September 2011, six months after the triple reactor meltdown, and spread radio-cesium deposits widely across the region.

Eight years after Typhoon Roke, 2019's Typhoon Hagibis, traversed Japan on 12 October 2019. Rainfall totals exceeding 400-500 mm fell over east central Honshu, with many areas receiving at least 200 mm. Locally, over 900 mm (0.9 meters) was reported over a 24 hour period southwest of Tokyo. A few weeks later, Typhoon 21 (Bualoi) struck parts of Japan on 25 October, including Namie in Fukushima prefecture, where 245 mm of rain was recorded in 12 hours.

Without comprehensive data of the cesium concentrations of river water prior, during, and after the October 2019 typhoons, it is not possible to say with absolute certainty that they brought about much higher radiation releases from the mountainous forests of Fukushima. But the evidence from earlier typhoons and resulting data strongly suggests that there was a substantial increase in downstream contamination from October 2019. Greenpeace Japan's measurements showing major variations in radiation levels over previous year(s) are indicative of these weather related effects. The example of Ms. Kanno's house, for which we have data sets covering three years (2017-2019), show that while both the maximum and average radiation levels between 2017 and 2018 remained relatively constant, in October 2019, there was a 63% reduction in the maximum measured (and 31% in average). Greenpeace Japan proposes that such a reduction could be a direct result of the very heavy rainfall washing out radioactive cesium from the concrete surface.

The location of the highest hotspot in Zone 9 at Ms. Kanno's house, on the path to the rice field, was first measured in 2017. The levels measured in 2019 show almost no change from 2017. The specific topography creates a small stream of water, carrying radioactive material out of the forest and across the path. The highest concentrations of observed radiation at this site are at the point where the water flows from the concrete path into the immediate vegetation, before it carries on into a ditch. The conclusion of Greenpeace Japan is that this is an example of recontamination. One trigger for this appears to be high rainfall and flooding resulting from that rainfall. Our 2019 survey at Mr. Anzai's house in Iitate also provided evidence of probable typhoon effects. Average radiation levels in zones 4 and 7 in 2019 were 68% and 58% of the previous year. This cannot be explained by radioactive decay alone, and suggests resuspension and weather related effects resulting from heavy rainfall. These significant changes are particularly evident when taken across the five year period from 2015-2019 for which we have data sets.

A clear example of how radioactivity relocates from contaminated forests was observed along Route 114 in the exclusion zone of Namie. While the road was opened to the public in September 2017, the land on either side remains closed to visitors and habitation. Along Route 114, from the junction opposite the TEPCO Kakura screening station, Greenpeace measured (by road scanning) 2,511 points with an average of 0.4 μSv/h, and a maximum of up to 3.7 μSv/h. At the highest spots, which were measured by handheld Radeye, we witnessed clear water flows from the forest to the north of the screening station across the side road and across Route 114, indicating the pathway for radio-cesium migration. During our survey work in October 2020, we will seek to verify this hypothesis and to observe, in the absence of additional occurrences of heavy rain, whether the major fluctuations in radiation levels measured in the environment are confirmation of the effect of heavy rain induced mobilization of radioactivity.

The results of our 2019 survey demonstrate the complex and persistent nature of radionuclide contamination in areas of Fukushima prefecture. We hypothesize that the significant reduction of radioactivity in certain zones, as measured around Ms. Kanno's and Mr. Anzai's homes, results in downstream contamination and eventual release to the Pacific Ocean. The fact is that the radioactivity does not disappear but relocates.

While there have been some changes in radio-cesium in the forests of Fukushima, including the rapid decay of Cs-134 and how cesium is located in the soil structures/forest canopy, it can be speculated that there was a significant increase in the radioactivity of Fukushima rivers during the October 2019 period. That increased radioactivity in rivers results in deposition of radio-cesium in areas flooded downstream, including floodplains, and eventually higher deposition into the Pacific Ocean.

© Shaun Burnie / Greenpeace

7 The 2020 Olympics

Radiation risks (including hotspots) and Human rights

The decision by the Japanese government to host 2020 Summer Olympics and Paralympics events in Fukushima prefecture, as well as the opening of the Olympic Torch relay at the J-Village (20km south of the Fukushima Daiichi nuclear plant), has highlighted both Japanese government propaganda and important questions concerning the current radiological conditions in the region. The Abe government is seeking to use the Olympics/Paralympics as a global media platform to communicate that the entirety of Fukushima prefecture has returned to 'normal' and that the devastating effects of exploding reactors and radioactive fallout plumes across Fukushima are all in the past and no longer relevant. The answer is, of course, far more complicated and nuanced. Many areas of Fukushima have returned to a sort of normality. At the same time, areas of Fukushima including Namie, Iitate, Okuma and Futaba remain highly contaminated. Since 70% of Fukushima prefecture is mountainous forest, as a result of the contamination in 2011 these uphill forests serve a long-term source of radioactivity for the areas below. The principle radioactive source, Cesium-137 has a half life of 30 years, and therefore will remain a hazard for around ten half lives, or 300 years. The forested mountains of Fukushima cannot be decontaminated and pose a radioactivity recontamination risk to all areas downstream after heavy rainfall.

Greenpeace Japan surveyed the area around the Azuma sports complex stadium, which lies to the west of Fukushima City. Two Olympic events will be hosted at this location in July 2020 – baseball and softball. The sporting site lies around 80 km to the northwest of the Fukushima Daiichi nuclear plant and outside the Japanese government evacuation and exclusion zones. The area was subjected to radioactive contamination in 2011 and as such, levels of radio cesium can still be detected. Greenpeace Japan, measuring data in October 2019, showed for 2,965 points average levels were 0.1 μSv/h,

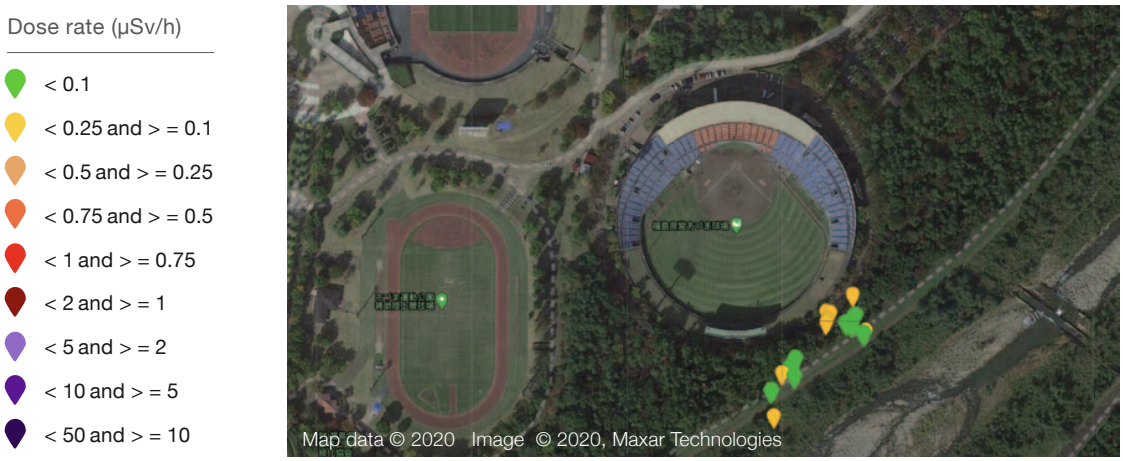


Image 2: Aerial image of hotspots at the Azuma stadium, path in the South (October 18, 2019)
Made from Google Maps

with all points below the government long-term decontamination target of 0.23 μSv/h. Nonetheless, these levels are 2.5 times higher than the average background levels prior to the Fukushima Daiichi accident in March 2011, which was 0.04 μSv/h.

For Fukushima City, where many visitors attending the Olympic events will arrive from Tokyo, the radiation situation is more complex than at the Azuma stadium. Greenpeace Japan measured 7,284 points in the area around the central train station (see map). Average levels were 0.1 μSv/h with a maximum of 0.2 μSv/h. These are 2.5 times higher than before the accident March 2011, and the maximum is 5 times higher. The principal concern from a human health perspective with these radiation levels relates to long-term residents, and not so much short term visitors, including competing athletes and spectators.

However, the presence of large numbers of radiation hotspots in Fukushima City (as detailed below), and other areas of Fukushima, including the J-Village, is not normal. They raise important questions of radiation health risks, the answers to which are not simple.

Survey team walking beside Azuma stadium, Fukushima city.
October 18, 2019

Radiation hotspots - J village

On 18 November 2019, Greenpeace Japan provided results of its October survey at the J-Village to the Japanese Minister of the Environment, as well as the domestic and international Olympic Committees Chairpersons and Fukushima Governor. The October survey had identified significant levels of radiation in so-called hotspots. We decided at that time to give the authorities one full month to respond to our request for urgent intervention and to put in place a decontamination program at the J-Village. During the following weeks, in our oral communication with the Ministry of the Environment and J-Village management there was little indication that action was being planned. However, on 12 December, the Japanese Ministry of Environment publicly confirmed the presence of the highest radioactive hotspot identified by Greenpeace Japan, as well as a newly-identified hotspot. Under instructions from the government, these specific hotspots had been removed by the Tokyo Electric Power Company (TEPCO). However, on 13-14 December, a small Greenpeace survey team returned to J-Village where we measured public areas in and around the sports complex and where we detected additional radioactive contamination, and observed the results of decontamination efforts that did not follow established decontamination protocols.

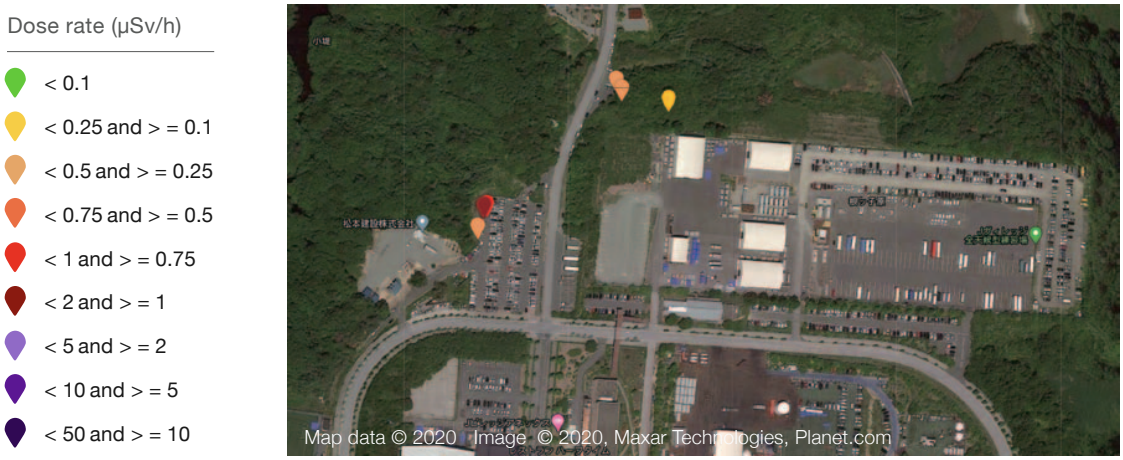


Image 3: Aerial image of hotspots in J village area (October 26, 2019)
Made from Google Maps

Remarkably, after TEPCO removed just two of the hotspots identified by Greenpeace Japan on 3 December, we observed that the standard procedures for decontamination had not been followed by TEPCO. The standard practice for Fukushima decontamination is to remove vegetation and soil up to 20 meters from the public road. In this case, only the specific hotspots were removed over an area of about 1 square meter, despite the fact that the wider surroundings of the hotspots also showed high levels of radiation as well.

Our conclusion, at the time of our second radiation survey of 2019 around J-Village, was that radioactive contamination at J-Village is not under control. The original location of the highest radiation hotspot identified by Greenpeace Japan on 26 October was 71 μSv/h close to the surface and 32 μSv/h at 10 cm. On 13 December, Greenpeace's radiation survey team found the radiation levels of the same location to be lower than 1 μSv/h at 10 cm during the re-test. However, just to the north of this hotspot, Greenpeace Japan identified a patch of ground adjacent to the parking lot where levels were up to 2.2 μSv/h at 10 cm. Near the entrance of this same parking lot, Greenpeace measured 2.6 μSv/h at 10 cm and 1 μSv/h at 1 m. Additionally, at the edge of a forest north of the car park, radiation hotspots of 2.6 μSv/h at 10 cm were identified. A second forest, 300 meters north showed consistent levels of 0.6 μSv/h at 10 cm, and 0.4 μSv/h at 1 m, which is almost double the government's decontamination target.

As is well known, the J-Village is the location for the start of the Japanese leg of the Olympic Torch Relay. As such, one would have expected the authorities to have made all possible efforts to remove high concentrations of radiation. The fact that this has not been done, raises many questions and uncertainties, including how such high levels of radiation (71 μSv/h at close to surface) were not detected during the earlier decontamination by TEPCO. Why were only the most alarming hotspots, which were identified by Greenpeace Japan, removed and not the wider areas following the standard decontamination procedures? Given these apparent failures to ensure public safety, the ability of the authorities to accurately and consistently identify radiation hotspots appears to be seriously in doubt.

J-Village soccer facility in Naraha town, Fukushima prefecture, the starting point of the 2020 Tokyo Olympic torch relay. October 26, 2019

Radiation hotspots - Fukushima City

During October 2019 we also measured radioactive hotspots in Fukushima city. Over a period of four hours our survey team identified forty-five (45) hotspots in the streets of Fukushima City in the area around the central station. Eleven of these hotspots equaled or exceeded the Japanese government decontamination long term target of 0.23 µSv/h measured at 1 m. 100% of them exceeded 0.23 µSv/h at 0.1 m. Four of these hotspots exceeded 3 µSv/h at 0.1 m. The highest measured hotspot was 0.7 µSv/h at 1 m, 1.6 µSv/h at 0.5 meters, and 5.5 µSv/h at 0.1 m. This is 137 times higher than the background radiation levels measured in the Fukushima environment prior to the 2011 nuclear disaster. The fact that these hotspots are located in public areas along the pavements and streets of central Fukushima City, including tens of meters from the entrance to the Shinkansen (bullet train) line to Tokyo, highlights the scale of the nuclear disaster in 2011. Again the principal radiation hazard is to the resident population in Fukushima City, who statistically have a higher chance of being exposed to these hotspots. But it cannot be said that the risk to short term visitors is non-existent.

The Japanese government does not want to acknowledge that these levels of radioactivity are a hazard to public health. And generally the levels measured by Greenpeace Japan in Fukushima City in October/November 2019 are much lower than in Namie, Iitate, and Okuma. However, that does not mean they are not a hazard. Under International Atomic Energy Agency (IAEA) guidelines, the hotspots of Cesium-137 which exceed a dose rate of 0.3 to 0.5 µSv/h at 10 cm, would contain an amount of radioactive Cs-137 that would require it to be declared as dangerous goods – or Radioactive Material Class 7. This would mean that it would require classification under IAEA Safety Standards if some of this soil would be shipped or moved. Under certain circumstances a dose rate of 0.14 µSv/h could contain the amount of Cs-137 required to meet the IAEA definition of a dangerous material. All forty-five (45) hotspots found by Greenpeace Japan (in less than four hours of survey work by a small team) in central Fukushima City exceed the radiation limit of 0.3 µSv/h at 10 cm that classifies the material as a dangerous good. The Japanese government has failed to address the fact that this level of contamination can be found easily in Fukushima City.

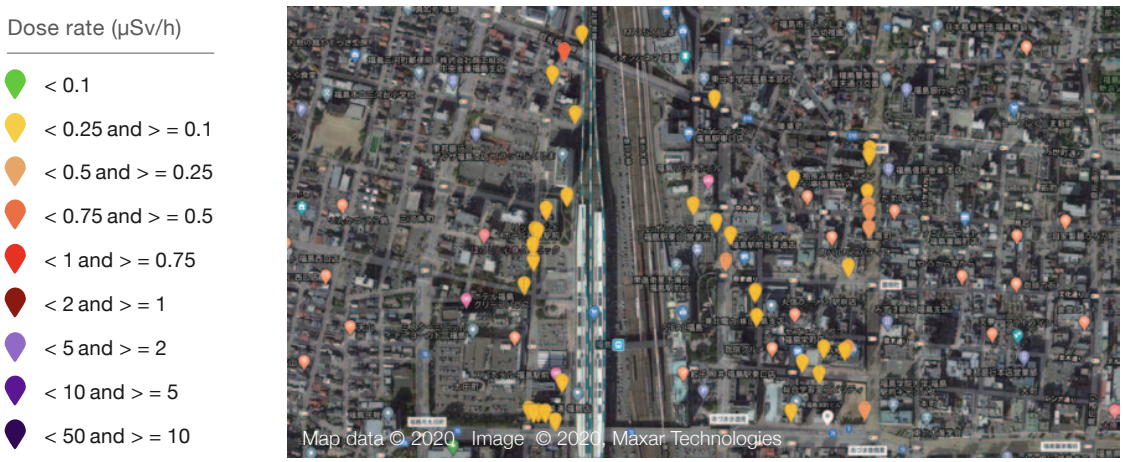
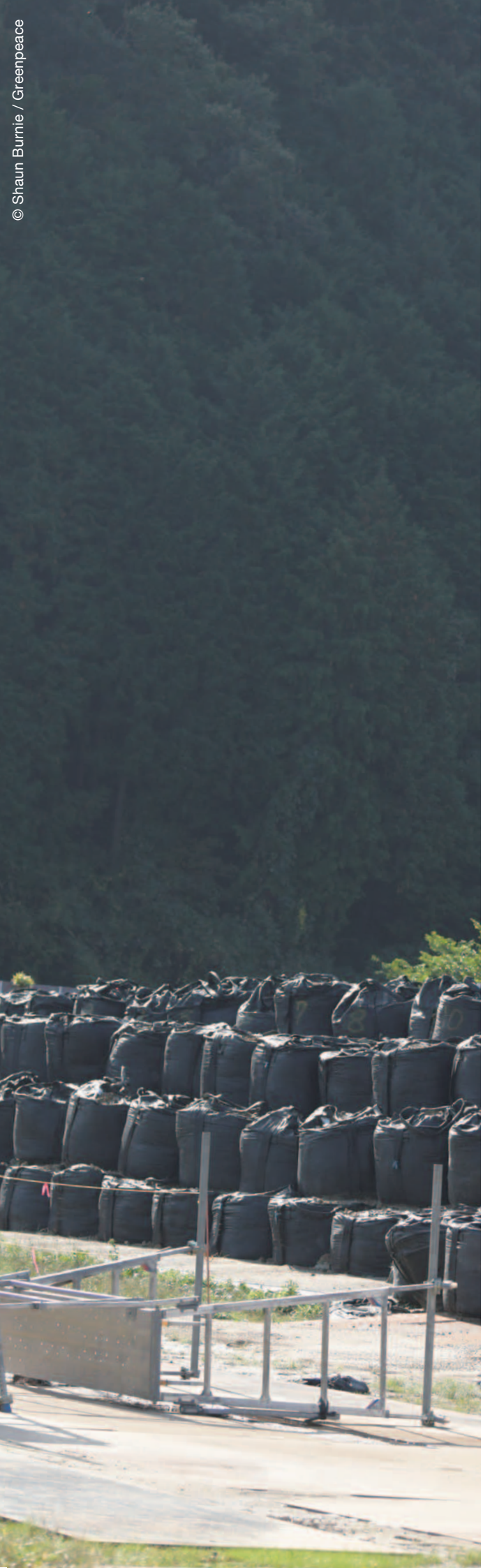


Image 4: Aerial image of hotspots in Fukushima city near Fukushima station (November 4, 2019) Made from Google Maps



© Shaun Burnie / Greenpeace

Hotspots and Cesium-rich MicroParticles

One factor that has concerned Greenpeace for a number of years has been the discovery of small particles containing high levels of radioactivity. These so-called Cesium-rich MicroParticles (CsMPs) are on average a few millimeters in diameter and have been found several hundred kilometers away from Fukushima Daiichi. Scientific studies have reported on the chemical and isotopic compositions of the CsMPs, providing information on the likely sources of the CsMPs and the reactions that occurred inside the damaged Fukushima Daiichi reactor units during the nuclear disaster. As reported by scientific literature, including most recently in 2019, "*Due to the small size and high Cs specific activity, CsMPs have the potential to penetrate deep into the human respiratory system and remain for decades, which may lead to high localized radiation doses. Nevertheless, there are currently no epidemiological studies of the health effects caused by these particles. Furthermore, the number and distribution of CsMPs in the environment is not precisely known... CsMPs in residential areas at present have experienced varying environmental conditions, such as being surrounded by vegetation, concrete, and buildings, and this may profoundly increase CsMP mobility by being washed out from the surfaces.*" [10]

From a soil sample collected in Watari, which lies on eastern outskirts of Fukushima city, analysis showed that there were 24 cesium-rich microparticles per gram of soil, and where activity was 3.10 Becquerels/gram (Bq/g).[11] The presence of these microparticles, and the potential that radioactive hotspots measured throughout Fukushima prefecture, including Fukushima city, are the location of CsMPs, raise important issues over the health risks to the local population. As a recent 2019 study observed, *"a comprehensive understanding of CsMP distribution has not been completed, hence health risks cannot be properly evaluated."* [12] Once again, the simplistic communication of the Abe government that there are no radiation risks in Fukushima and that life has returned to normal does not match with the complex reality in Fukushima prefecture.

8 Conclusion and recommendations

The results of the 2019 Greenpeace Japan's radiation survey highlight the complexity of the radiological conditions in Fukushima prefecture. There are strong indications that the very heavy rainfall generated by 2019's Typhoon Hagibis and Typhoon 21 (Bualoi) had a major impact on the mobilization of radioactive cesium. The mountainous forests of Fukushima prefecture remain an enormous stock of radioactivity and evidence from the latest survey indicates that this radioactivity was significantly disturbed and mobilized in October 2019.

As we have measured certain areas repeatedly over a number of years, we observed in our 2019 surveys that radiation levels remained stable in certain areas whilst in others there were significant variations, including reductions. These reductions cannot be explained by radioactive decay. At the same time, Greenpeace identified areas of high concentrations, including hotspots. There was clear visual evidence of recontamination caused by water remobilizing radioactivity from the contaminated forests. This was witnessed in both the closed area of the Namie exclusion zone and the open area of Namie Town. As in 2018, average and maximum radiation levels in the lifted evacuation areas (i.e. areas determined by the Japanese government to be safe for return) of Namie and Iitate remain too high for normal life to be considered possible without increased health risks to returning citizens.

The Japanese government continues to defy United Nations human rights specialists who have challenged the policy of lifting evacuation orders, exposing citizens, in particular women, children, and workers, to unsafe radiation levels. The latest Greenpeace Japan survey results highlight the scale of the ongoing nuclear crisis in the most contaminated areas of Fukushima, and why the United Nations human rights experts are fully justified in expressing their urgent concerns.

Greenpeace's discovery of high levels of radiation and multiple hotspots, in both Fukushima City and the J-Village sports complex, directly challenges the Japanese government's propaganda narrative preceding the 2020 Summer Olympic Games. The complexity of the radiological situation is underscored by measurements in Fukushima City and around J-Village.

The risk factors for these elevated radiation levels remain unknown, and particularly relate to long term residents. At the same time, the presence of Cesium-rich MicroParticles (CsMPs) across Fukushima prefecture (which are respirable and therefore hold

the potential to deliver concentrated doses) exposes Japanese government's assurances that there are no radiation risks to be mere propaganda. The fact that every hotspot measured by Greenpeace in Fukushima City would classify it as a dangerous good or Radioactive Material Class 7 under IAEA regulations shows that the radiation situation in Fukushima is very far from normal.

The complex conditions in Fukushima resulting from the 2011 triple reactor meltdown cannot be ignored to suit the propaganda objectives of the Japanese government. Neither can this complexity be explained in simplistic slogans – neither "all is under control" nor "all of Fukushima is radioactive and dangerous" reflect the reality. Such an approach is an enormous disservice to the people of Fukushima. The complexity of the radiation situation in Fukushima needs to be studied, explained, and understood by the wider Japanese society and the international community. The attention Japan, including Fukushima Prefecture, will receive in 2020 as a result of the Olympic games is an opportunity for attaining a deeper understanding of the consequences of the Fukushima Daiichi disaster.

Recommendations to the Japanese Government and Fukushima Prefecture

- Suspend the current return policy which ignores Fukushima citizens and ignores science-based analysis, including potential lifetime exposure risks;
- Immediately clarify its long-term decontamination target of 0.23 μSv/h, equal to 1 mSv/y exposure based on the government's calculation, including setting a date for when 0.23 μSv/h is to be attained, and halt any plans to revise the target level to a higher limit;
- Urgently assess the risks posed by radioactive hotspots, including the presence of cesium-rich microparticles, including the long-term consequences for public health;
- Abandon plans to lift evacuation orders in the six municipalities of Futaba, Okuma, Namie, Tomioka, Iitate and Katsurao, including the Namie districts of Tsushima, Murohara, Suenomori and Obori;
- In the interests of worker protection, suspend current decontamination programs in the "Difficult to Return" zones;
- Establish a fully transparent process to reflect and consider residents' opinions on evacuation policy, including opening a council of citizens including all evacuees;
- Provide full compensation and financial support to evacuees, and take measures to reduce radiation exposure based on science and the precautionary principle to protect public health and allow citizens to decide whether to return or relocate free from duress and financial coercion; and,
- Respond in full to the offer of dialogue and guidance from UN Special Rapporteurs, including accepting outstanding requests for Special Rapporteurs to visit Japan.

Ms. Kanno in Tsushima (Namie exclusion zone) next to her house.
December 18, 2019.

Endnotes

1. IAEA, “Annex I of Technical Volume 5 EVOLUTION OF REFERENCE LEVELS FOR REMEDIATION AND DEVELOPMENT OF A FRAMEWORK FOR POST-ACCIDENT RECOVERY”, see https://www-pub.iaea.org/MTCD/Publications/PDF/SupplementaryMaterials/P1710/TV5/AnnexI.pdf
2. This higher estimate is on the basis that someone was in that area for 8,760 hours in one year; the Japanese government 0.23 μSv/y long-term target would give a dose of 1 mSv/y based on citizens spending an average of 8 hours per day outside and taking account of shielding from radiation while inside a house. The methodology used by the Japanese authorities for many people is an underestimation. Residents in this agriculture and forestry-dependent region mostly worked and lived outside prior to the Fukushima nuclear disaster, particularly during the spring, summer, and autumn seasons. Even during the winter period, work is conducted outside, for example in the forest. The maximum figure here is based on if a person was to spend the entire year of 8,760 hours at this location.
3. The ICRP sets a recommended public dose limit of 1 mSv in a year, with a higher value being allowed in special circumstances as in the case of the Fukushima Daiichi nuclear accident, provided the average over five years does not exceed 1 mSv per year, see ICRP 111: Protection of People Living in Long-term Contaminated Areas after a Nuclear Accident or a Radiation Emergency, available at http:// www.icrp.org. See also, OECD, Nuclear Energy Agency: Evolution of ICRP Recommendations 1977, 1990 and 2007. Changes in Underlying Science and Protection Policy and their Impact on European and UK Domestic Regulation, ISBN 978-92-64-99153- 8, 2011, see https://www.oecd-nea.org/rp/reports/2011/nea6920-ICRP-recommendations.pdf.
4. Fukushima prefecture, see http://www.pref.fukushima.lg.jp/site/portal/26-11.html (in Japanese)
5. The Lancet, “Ionizing radiation and risk of death from leukemia and lymphoma in radiation- monitored workers (INWORKS): an international cohort study”, Klervi Leuraud, David B Richardson, Elisabeth Cardis, Robert D Daniels, Michael Gillies, Jacqueline A O’Hagan, Ghassan B Hamra, Richard Haylock, Dominique Laurier, Monika Moissonnier, Mary K Schubauer-Berigan, Isabelle Thierry-Chef, Ausrele Kesminiene, National Institute for Occupational Safety and Health (NIOSH) Public Health England’s Centre for Radiation, Chemical and Environmental Hazards (PHE-CRCE), University of North Carolina (UNC), Center for Research in Environmental Epidemiology (CREAL), Drexel University - School of Public Health, Pompeu Fabra University (UPF), CIBER- BBN, IRSN laboratory Ionizing Radiation Epidemiology Laboratory (LEPID), Lancet Haematol, 22 June, 2015 see http:// dx.doi.org/10.1016/S2352-3026(15)00094-0. Funding for the study was provided by Funding – Centers for Disease Control and Prevention, Ministry of Health, Labour and Welfare of Japan, Institut de Radioprotection et de Sûreté Nucléaire, AREVA, Electricité de France, National Institute for Occupational Safety and Health, US Department of Energy, US Department of Health and Human Services, University of North Carolina, Public Health England, as well as the Centers for Disease Control and Prevention (5R030H010056-02) and the Ministry of Health, Labour and Welfare of Japan (GA No 2012-02-21-01)
6. Greenpeace Japan, “Radiation Reloaded: Ecological Impacts of the Fukushima Daiichi Nuclear Accident 5 years later”, February 2016, see https://www.greenpeace.org/archive-japan/Global/japan/pdf/GPJ-Fukushima-Radiation-Reloaded-Report.pdf
7. Yamashiki, Y., et al. (2014). “Initial flux of sediment-associated radiocesium to the ocean from the largest river impacted by Fukushima Daiichi Nuclear Power Plant.” Scientific Reports 4, Article: 3714. http://www.nature.com/articles/srep03714
8. Ibid.
9. Nagao, S., et al. (2013). “Export of 134Cs and 137Cs in the Fukushima river systems at heavy rains by Typhoon Roke in September 2011.” Biogeosciences. 10: 6215–6223. https://www.researchgate.net/publication/258758074_Export_of_134Cs_and_137Cs_ in_the_Fukushima_river_systems_at_heavy_rains_by_Typhoon_Roke_in_ September_2011
10. Chemosphere, “Abundance and distribution of radioactive cesium-rich microparticles released from the Fukushima Daiichi Nuclear Power Plant into the environment”, Ryohei Ikehara a, 1, Kazuya Morooka a, 1, Mizuki Suetake a, Tatsuki Komiya a, Eitaro Kurihara a, Masato Takehara a, Ryu Takami a, Chiaki Kino b, Kenji Horie c, d, Mami Takehara c, Shinya Yamasaki e, Toshihiko Ohnuki f, Gareth T.W. Law g, William Bower g, Bernd Grambow h, Rodney C. Ewing i, Satoshi Utsunomiya a, *a Department of Chemistry, Kyushu University, 744 Motooka, Nishi-ku, Fukuoka, 819-0395, Japan b The Institute of Applied Energy, 1-14-2 Nishi-shimbashi, Minato-ku, Tokyo, 105-0003, Japan c National Institute of Polar Research, 10-3 Midori-cho, Tachikawa-shi, Tokyo, 190-8518, Japan d Department of Polar Science, The Graduate University for Advanced Studies (SOKENDAI), Shonan Village, Hayama, Kanagawa, 240-0193, Japan e Faculty of Pure and Applied Sciences and Center for Research in Isotopes and Environmental Dynamics, University of Tsukuba, 1-1-1 Tennodai, Tsukuba, Ibaraki, 305-8577, Japan f Laboratory for Advanced Nuclear Energy, Institute of Innovative Research, Tokyo Institute of Technology, 2-12-1 Ookayama, Meguro-ku, Tokyo, 152-8550, Japan g Radiochemistry Unit, Department of Chemistry, The University of Helsinki, Helsinki, 00014, Finland h SUBATECH, IMT Atlantique, CNRS-IN2P3, the University of Nantes, Nantes, 44307, France i Department of Geological Sciences and Center for International Security and Cooperation, Stanford University, October 2019, see https://doi.org/10.1016/j.chemosphere.2019.125019
11. Ibid.
12. Ibid.

Appendix

United Nations Human Rights and Fukushima Evacuees, Workers and Children 2018 - 2019

Ever since the start of the Fukushima Daiichi nuclear disaster in March 2011, many of the issues concerning the rights of evacuees (particularly women and children), citizens, and workers have been raised by United Nations human rights bodies and experts. The most significant of these was the 2012 Mission **Report of Special** Rapporteur Anand Grover.

During the past 12-18 months there has been an escalation of interventions by United Nations human rights bodies and Special Rapporteurs on the rights of Japanese citizens most impacted by the ongoing nuclear disaster. This document provides links to the key documents, both United Nations statements, communications, and reports, as well as the response of the Japanese government.

26 February to 23 March 2018 – Universal Periodic Review of Japan, Human Rights Council, **Decision of Working Group**. Following intervention of the Governments of Germany, Portugal, Mexico and Austria the four recommendations were made to Japan.

Extracts: “161.215 Apply the Guiding Principles on Internal Displacement to all those impacted by the Fukushima Daiichi nuclear disaster in order to ensure full and equal participation for both women and men in decision-making processes regarding their resettlement (Portugal);

161.216 Respect the rights of persons living in the area of Fukushima, in particular of pregnant women and children, to the highest level of physical and mental health, notably by restoring the allowable dose of radiation to the 1 mSv/year limit, and by a continuing support to the evacuees and residents (Germany);”

Fukushima nuclear workers 26 June 2018 – **Joint Communication From Special Procedures**, to Taro Kono Minister for Foreign Affairs, Japan - Baskut Tuncak, Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes and Dainius Pûras, Special Rapporteur on the right of everyone to the enjoyment of the highest attainable standard of physical and mental health, Urmila Bhoola Special Rapporteur on contemporary forms of slavery, including its causes and consequences.

Extract: “we would like to bring to the attention of your Excellency’s Government information we have received concerning issues faced by workers employed in the ongoing decontamination and resettlement program in the Fukushima Prefecture of Japan, more particularly, the existing and potential risks to which they are exposed to, inconsistencies in the monitoring and implementation of guidelines aimed at protecting their security and required working conditions, reported consistent violations of their labour rights and their right to physical and mental health, including unsatisfactory levels of health and security safeguards in place.”

16 August 2018, **Response** to the Joint Communication from Special Procedures from the Government of Japan, 16 August 2018.

Extract: “the claim that “decontamination workers working in this area will be subject to unjustifiable radiation risks” is not appropriate.”

16 August 2018, **Press statement** United Nations Office of the Human Rights Commissioner, Special Rapporteurs, “Japan: Fukushima clean-up workers, including homeless, at grave risk of exploitation, say UN experts”

Extract: “Japan must act urgently to protect tens of thousands of workers who are reportedly being exploited and exposed to toxic nuclear radiation in efforts to clean up the damaged Fukushima Daichi Nuclear Power Station, say three UN human rights experts.

Overall Fukushima Human Rights, 5 September, 2018 – United Nations Office of the Human Rights Commissioner, **Joint Communication** from Special Procedures from Cecilia Jimenez-Damary, Special Rapporteur on the human rights of internally displaced persons and Baskut Tuncak, Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes to Taro Kono Minister for Foreign Affairs, Japan.

Extracts: “we have to note that the concerns we had expressed previously continue to persist, in light of information and witness accounts which are conveyed to our mandates by various information sources...”

“The impact of the decontamination programme places a great number of persons, including persons belonging to vulnerable groups, under considerable constraints and could result in violations of their basic human rights... We take this opportunity to recall that those persons evacuated or self-evacuated from their homes by the Fukushima disaster constitute internally displaced persons (IDPs) and to remind your Excellency’s Government of its obligations relating to the human rights of IDPs, including those contained in the provisions of the 1998 Guiding Principles on Internal Displacement...”

“Particular concern is expressed over the impact of the terms and modalities of ongoing resettlement programmes on the enjoyment of human rights, in particular the right to life, health, physical integrity, housing, and food. The decision to not reflect the actual number of evacuees and recognizing these as internally displaced persons in the official records of the prefectural government, undermines the ability of local authorities to provide vital services and financial assistance to a number of self-evacuees...”

“...we are deeply concerned that the decision to lift evacuation orders in areas where radiation levels remain high, and withdrawing housing support previously provided to a large number of households, create significant pressures for internally displaced persons to return to their previous homes, where their life, safety or health would be at risk from exposure to hazardous levels of radiation...”

“Returning evacuees, as well as those already living in municipalities of Fukushima, face additional health risks posed by large scale, heavy transportation and storage of nuclear waste as well as the radiation that could be released by waste facilities. We remain concerned by the fact that this practice is expected to increase during the coming years, along with the long-term psychological effects associated with living in a nuclear waste industrial zone.” and “In connection with the above alleged facts and concerns, please refer to the Annex on Reference to international human rights law attached to this letter which cites international human rights instruments and standards relevant to these allegations.”

“In view of the urgency of the matter, we would appreciate a response on the steps and measures taken by your Excellency’s Government to safeguard the rights of the nuclear evacuees in compliance with international instruments.”

Evacuees, including children, 25 October 2018 - Opening **remarks** by the United Nations Special Rapporteur on human rights and hazardous substances and wastes, Baskut Tuncak at the 73rd session of the U.N. General Assembly.

25 October 2018, United Nations Office of the Human Rights Commissioner, **Press statement**, Japan must halt returns to Fukushima, radiation remains a concern, says UN rights expert.

Extracts: “The recommendation to lower acceptable levels of exposure to back to 1 mSv/yr was proposed by the Government of Germany and the Government of Japan ‘accepted to follow up’ on it, according to the UN database. However, in the expert’s view, the recommendation is not being implemented. Japan has a duty to prevent and minimise childhood exposure to radiation, added the UN expert referring to his **2016 report on childhood exposure to toxics**. The UN Convention on the Rights of the Child, to which Japan is a Party, contains a clear obligation on States to respect, protect and fulfil the right of the child to life, to maximum development and to the highest attainable standard of health, taking their best interests into account. This, the expert said, requires State parties such as Japan to prevent and minimise avoidable exposure to radiation and other hazardous substances...

The Special Rapporteur said Japan should provide full details as to how its policy decisions in relation to the Fukushima Daiichi nuclear accident, including the lifting of evacuation orders and the setting of radiation limits at 20 mSv/y, are not in contravention of the guiding principles of the Convention, including the best interests of the child."

"The combination of the Government's decision to lift evacuation orders and the prefectural authorities' decision to cease the provision of housing subsidies, places a large number of self-evacuees under immense pressure to return," Tuncak said.

"The gradual lifting of evacuation orders has created enormous strains on people whose lives have already been affected by the worst nuclear disaster of this century. Many feel they are being forced to return to areas that are unsafe, including those with radiation levels above what the Government previously considered safe."

5 November 2018, Ministry of Foreign Affairs, Government of Japan **Response** to the 5 September 2018 Joint Communication from Special Procedures.

Extracts: "Lifting of the evacuation order is a measure to make return possible for those who prefer to return, and not a measure to force evacuees to return...the decision of the evacuees as to whether to return to their original places to live or not is entirely up to them. The GoJ does not force them to return nor put any pressure on them to do so...

"..the GoJ has no clear idea of what is meant by "living in a nuclear waste industrial zone", the GoJ had already explained to the local residents about the results of the monitoring before the waste disposal facility started its operation...

"With regard to the judicial decision in the Fukushima District Court on 10 October 2017, the GoJ lodged an appeal on 23 October 2017 as a result of consideration within the government, because some of the findings of the facts and judgement by the court were at odds with the opinions of the GoJ. Therefore, this judicial decision is not final. In addition, the GoJ is of the view that there is no indication that "the district court in Fukushima Prefecture recognised self-evacuees as equal victims of the Fukushima Daiichi accident, affirming their right to compensation" in the judicial decision."

"...the Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes released a press release that contains erroneous contents based on a one-sided claim. The GoJ is seriously concerned about such claim, as it could unnecessarily inflame public anxiety, cause confusion, and further trouble people suffering from harmful rumors in disaster-hit areas."

Fukushima children – 1 February 2019, United Nations Committee on the Rights of the Child, **Concluding** observations on the combined fourth and fifth periodic reports of Japan.

Extracts: 1 "(a) Reaffirm that radiation exposure in evacuation zones is consistent with internationally accepted knowledge on risk factors for children"

"Implement the recommendations made by the Special Rapporteur on the right of everyone to the enjoyment of the highest attainable standard of physical and mental health, (A/HRC/23/41/Add.3)."

"52. The Committee recommends that the State party take all appropriate measures to ensure that the recommendations contained in the present concluding observations are fully implemented..."

Greenpeace is an independent campaigning organisation that acts to change attitudes and behavior, to protect and conserve the environment, and promote peace.

GREENPEACE

Greenpeace Japan

8-13-11 NF Bldg. 2F, Nishi-Shinjuku,
Shinjuku, Tokyo 160-0023

For further information:

Jan Vande Putte
jan.vande.putte@greenpeace.org

Heinz Smital
heinz.smital@greenpeace.org

Shaun Burnie
shaun.burnie@greenpeace.org

Kazue Suzuki
energy.jp@greenpeace.org

www.greenpeace.org/japan