SPECIAL REPORT

Securing the Safety of Fish and Fishery Products of Japan

By Fisheries Agency of Japan

The most powerful earthquake that hit Japan on 11 March 2011 triggered an extremely destructive tsunami with waves as high as 40 meters and speed of about 800 km/hour, seriously affecting the coastal Prefectures of Miyagi, Iwate and Tohoku, while the waves also traveled up to 10 km inland. In addition to loss of lives and properties, infrastructures especially in the affected coastal areas were also destroyed resulting in loss of livelihoods in fishing communities. Moreover, the tsunami also caused serious nuclear accidents such as the meltdowns of the reactors in the Fukushima Dai-ichi Nuclear Power Plant (NPP) complex. As a result, the Tokyo Electric Power Company (TEPCO) which operates the Fukushima NPP had to discharge low-level radioactive stored water to the ocean to avoid further damages to the Fukushima NPP. Since then, TEPCO has been constantly monitoring the radiation level in the areas adjacent to the Fukushima NPP and at one point, TEPCO said that there had been no significant change in the sea area compared to the situation one week before the water was discharged, and that efforts are being made by TEPCO to bring down the radiation level in the sea near the Fukushima NPP to a "downward trend".

After the nuclear accidents in the Fukushima Dai-ichi Nuclear Power Plant (NPP) complex, the Government of Japan through the Fisheries Agency immediately carried out monitoring programs to measure the levels of radioactive substances contained in fish and fishery products obtained from the waters near the Fukushima NPP as well as the seawaters along the coastal areas of Japan. This was aimed at responding to the critical situation when reports indicated that radioactive substances have been detected in the seawaters near the Fukushima NPP. The radioactive substances must have originated from the discharge of contaminated water, atmospheric fallout, and precipitation washed out into the sea. The monitoring points for radioactive materials in fish and fishery products in Japan are shown in **Fig. 1**. As of 29 June 2011, the summary of the monitoring results indicated that 57 samples out of 767 fish and fishery products sampled for contents of radioactive substances **(Table 1)**, showed levels of radioactive substances that exceed the Provisional Regulatory Values (PRV). To ensure the safety of the fisheries products in the market, the Government of Japan imposed the suspension of related fishing activities and market distribution as soon as monitoring reports would indicate that the levels of radioactive substance residues in fish and fishery products are found to exceed the PRV levels (**Table 2**). The basic policy of the Government of Japan for Inspection of Radioactive Substance in Fish and Fishery Products is shown in **Box 1**.

As reported, over 99% of the discharges of radioactive substances from the Fukushima NPP into the sea occurred during the period from 28 March to 11 April 2011. Starting in mid-April 2011, discharges of radioactive substances have drastically decreased. As a matter of fact, the levels of radioactive substances in seawaters beyond the 30 km radius from the Fukushima NPP have constantly been below the detectable levels.

Nevertheless, it has also been reported that a number of trading companies still refrain from buying fish and fishery products from Japan, and that some countries maintain excessive restrictions against imports of fish and fishery products from Japan. The Government of Japan is therefore asking due consideration on the current situation since series of monitoring programs and control measures (**Box 2**) are being undertaken and enforced to ensure the safety of fish and fishery products from Japan in the market.

For more information, please visit: *http://www.jfa.maff.go.jp/e/secure/pdf/110630_summary2.pdf,* and *http://www.jfa.maff.go.jp/e/secure/pdf/110630.pdf.*

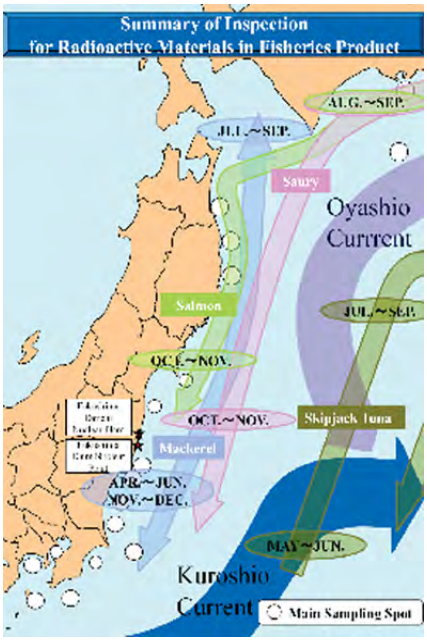

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Table 1. Results of monitoring radioactive substances in fish and fishery products in Japan (as of 29 June 2011)

Commodities	Total no of samples	Samples with levels of radioactive substance exceeding PRV level	Species with radioactive substance exceeding PRV level	
Saltwater fishes	436	22	Juvenile Japanese sand lance (*Ammodytes personatus*)	12
			White bait (Family: Salangidae)	4
			Fat greenling (*Hexagramumos otakii*)	3
			Brown Hakeling (*Physiculus fulvus*)	2
			Stone flounder (*Kareius bicoloratus*)	1
Invertebrates	113	7	Mediterranean mussel	1
			North Sea urchin	2
			Surf clam	3
			Japanese mitten crab	1
Seaweeds	34	5	Wakame seaweed	1
			Hijiki seaweed	1
			Arame seaweed	3
Processed Seafood	14	0		
Freshwater fishes	162	23	Ayu sweet fish (*Plecoglossus altivelis*)	10
			Land-locked cherry salmon (*Oncorhynchus masu*)	7
			Japanese smelt (*Hypomesus nipponensis*)	2
			Japanese dace (*Tribolodon hakonensis*)	3
			White spotted char (*Salvelinus leucomaenis*)	1
Marine mammals	8	0		
Total	**767**	**57**		**57**

Note: For more information visit: *http://www.jfa.maff.go.jp/e/inspection/index.html*

Table 2. Indices for restrictions on intake of foods (Cs-Cesium, I-Iodine; Unit: Becquerel (Bq)/kg)

Commodities	Cs-134, Cs-137					I-131			
	Drinking water	Milk, dairy products	Vegetable	Grain	Meat, Eggs, Fish, Others	Drinking water	Milk, dairy products	Vegetables (root crops, potatoes)	Others
Codex*	1,000	1,000	1,000	1,000	1,000	100	100	100	100
Japan	200	200	500	500	500	300	300	2,000	2,000
USA	1,200	1,200	1,200	1,200	1,200	170	170	170	170
EU	200	500	500	500	500	300	300	2,000	2,000
Thailand	500	500	500	500	500	100	100	100	100
Singapore	1,000	1,000	1,000	1,000	1,000	100	100	100	100
South Korea	370	370	370	370	370	300	150	300	300
Hong Kong	1,000	1,000	1,000	1,000	1,000	100	100	100	100
Chinese Taipei	370	370	370	370	370	300	55	300	300
Philippines	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Vietnam	1,000	1,000	1,000	1,000	1,000	100	100	100	100
Malaysia	1,000	1,000	1,000	1,000	1,000	100	100	100	100
China	-	330	210	260	Meat, Fish, Crustaceans: 800 Potatoes: 90	-	33	160	Meat, Fishery Products: 470 Grain: 190 Potatoes: 89

Note: Japan's index for Cesium in Fish is 500 Bq/kg which is rather conservative compared to those of other countries
Source: *Ministry of Health, Labor and Welfare, Japan*

* The Index (100) by Codex for Iodine shows a total of Sr-90, Ru-106, I-129, I-131, and U-234
The Index (1000) by Codex for Cesium shows a total of S-35, Co-60, Sr-89, Ru-103, Cs-134, Ce-144, and Ir-192
Sr-90 (Strontium-90), Ru-106 (Ruthenium-106), I-129 (Iodine-129), I-131 (Iodine-131), U-234 (Uranium-234), S-35 (Sulfur-35), Co-60 (Cobalt-60), Sr-89 (Strontium-89), Ru-103 (Ruthenium-103), Cs-134 (Cesium-134), Ce-144 (Cerium-144), Ir-192 (Iridium-192) are various radio isotopes with various "half-lives", where the "half-life" of a radioactive element is the time that it takes for one-half of the atom of that substance to disintegrate into another nuclear form, and can range from mere fractions of seconds to billion years.
Half-life of the corresponding radio isotopes: Sr-90 (29.12 years), Ru-106 (368.2 days), I-129 ($1.57xE^7$ years), I-131 (8.04 days), U-234 ($2.445xE^5$ years), S-35 (87.44 days), Co-60 (5.27 years), Sr-89 (50.5 days), Ru-103 (39.28 days), Cs-134 (2.062 years), Ce-144 (284.3 days), Ir-192 (74.02 days)

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Box 1. Basic Policy for Inspection of Radioactive Substances in Fish and Fishery Products, Japan

1. Inspection of coastal species

(a) **From Kanagawa Prefecture to Southern Part of Fukushima Prefecture:** Based on formation of fishing grounds off the coast of each Prefecture, Prefectural Governments should designate areas where inspection is necessary, and conduct sampling once a week in principle (once every two weeks in Kanagawa Prefecture and islands belonging to Tokyo Metropolis), at the main landing ports of each designated area. When sampling is conducted in markets, the area where fish was caught should be confirmed. Major species caught in each fishing season should be selected as the target species for inspection, taking the local circumstances into account. The species should be selected to cover a wide spectrum of marine habitat such as surface (*e.g.* Juvenile Japanese sand lance), middle column (*e.g.* sea bass, sea bream), and bottom (*e.g.* flounder, conger eel), taking into account the fact that larger amount of radioactive materials has so far been detected in species swimming in the surface (*e.g.* sand lance).

(b) **Northern Part of Fukushima Prefecture and to the North:** Inspection should be conducted before resumption of fishery operations. Decision on whether to resume fishery operations should be based on the analysis of the results of the inspection. When fishery operation is resumed, Prefectural Governments should designate areas where inspection is necessary, and conduct sampling once a week in principle (once every two weeks in Iwate Prefecture and to the north), at the main landing ports of each designated area. Target species for inspection should be selected based on the procedure in (a) above.

2. Migratory species (skipjack, Japanese jack mackerel, Pacific saury, among others)

Inspection should be conducted through cooperation between relevant fisheries industry organizations and the Prefectural Governments where the fish is landed.

(a) **Skipjack:** After the formulation of fishing grounds off the coast of Izu islands and Boso Peninsula (around middle of May), inspections should be conducted once a week in principle (sampling should be conducted at the fishing ports in Chiba Prefecture where landing of skipjack is expected (Chosi and Katsuura Fishing Ports)). When formation of fishing grounds off the coast of Fukushima Prefecture (usually 240-320 km off the coast) is expected (around early June), sampling by a trial fishing vessel should be conducted prior to commercial operations. Decision on whether to operate fishery in the area should be based on the analysis of the results. When fishery operation is to continue, sampling should be conducted once a week in principle at landing ports. When fishing grounds are formed off the coast of Miyagi Prefecture and to the north, inspections should be conducted once a week in principle.

(b) **Sardines and mackerel:** While fishing grounds are formed off the coast of Chiba Prefecture, sampling should continue at the fishing ports in Chiba Prefecture where landing of sardines and mackerel is expected (Choshi Fishing Port). When formation of fishing grounds off the coast of Ibaraki Prefecture is expected (in May), sampling should be conducted by the research vessel of the Ibaraki Prefectural Fisheries Experimental Station, in cooperation with the Ibaraki Prefectural Government. Decision on whether to operate fishery should be based on the analysis of the results. When fishery operation is to continue, sampling should be conducted once a week in principle at landing ports. When formation of fishing grounds off the coast of Fukushima Prefecture is expected (in June), sampling should be conducted by a research fishing vessel. The rest of the procedure will be the same as described above. When fishing grounds are formed off the coast of Miyagi Prefecture and to the north, inspections should be conducted once a week in principle.

(c) **Pacific saury and salmon migrating southward:** Starting from summer, inspections should be conducted once a week in principle.

3. Others

(a) **Amount of sample:** Sample size should be sufficient enough to be able to conduct inspection, *i.e.* 5 kg or more per species in principle. The sampling date and site should be recorded.

(b) **Additional requirements:** Due to the migratory nature of fish, and considering the varying weather conditions, sampling of target species at scheduled site and date may not always be possible. Therefore, sampling plans should be drawn up with ample flexibility to allow for these inclement weather conditions.

(c) **Publication of inspection results:** Publication and reporting of the inspection results to the Ministry of Health, Labor and Welfare should be undertaken by the Prefectural Government in whose waters the samples were caught, or in which the sampling port is located.

(d) **Response to inspection results that exceed the Provisional Regulation Value (PRV) in migratory species:** When inspection results exceed the PRV levels are detected in migratory species, the industry concerned will be requested to voluntarily refrain from relevant fishing operations around the site where the sample was obtained (generally on a prefecture by prefecture basis). Then, sampling by a research fishing vessel should be conducted once a week in principle. Fishery operations could resume only after inspection results are below the PRV levels for 3 consecutive times.

Box 2. Monitoring Programs and Control Measures Adopted by the Government of Japan to Ensure Safety of Fish and Fishery Products

1. Monitoring programs for fish and fishery products and restriction on fishing activities

(1) **Provisional Regulatory Values (PRV) in Japan:** For the purpose of food safety, the Government of Japan sets the PRV for radioactive Iodine and Cesium in fishery products at 2000 Bq/kg and 500 Bq/kg, respectively. Extensive and frequent samplings have been undertaken to ensure that no fishery products containing radioactive Iodine and/or Cesium exceeding the PRV levels are distributed to the markets. Note: As shown in **Table 2**, Japan's PRV level for radioactive Cesium of 500 Bq/kg is rather conservative compared to those of other countries (*e.g.* USA is 1200 Bq/kg).

Box 2. Monitoring Programs and Control Measures Adopted by the Government of Japan to Ensure Safety of Fish and Fishery Products *(Cont'd)*

(2) **Monitoring of fishery products:** The Fisheries Agency of Japan in coordination with relevant Prefectural Governments, has been conducting samplings to measure the levels of radioactive substances in fish and fishery products. The samplings have been carried out at major fishing ports at least once a week for each major target species. When result of a measurement detects a level exceeding the PRV, related fishing activities involving such species and its landings are immediately suspended. Note: The Basic Policy for Inspections on Radioactive Materials in Fishery products is shown in **Box 1**.

Taking into consideration the broad migration of some fish species, the Fisheries Agency in coordination with Prefectural Governments and related fisheries organizations, is undertaking samplings of fish and fishery products in wide areas from Hokkaido to Kanagawa Prefectures. Results of the sampling measurements are immediately posted on the websites of the Ministry of Health, Labor, and Welfare (MHLW) and that of the Fisheries Agency. Note: the results of the samplings as of 29 June 2011 are shown in **Table 1**. All the 57 samples except for 23 samples of freshwater fishes, found to exceed the PRV levels, were taken in the coastal areas close to the Fukushima NPP. The marine fish samples comprise limited species, *i.e.* epipelagic small fish (juvenile Japanese sand lance and juvenile anchovy), coastal bottom fish (fat greenling, brown hakeling, and stone flounder), invertebrates (Mediterranean mussel, North Sea urchin, surf clam, and Japanese mitten crab), and seaweeds (Wakame, Hijiki, and Arame seaweeds).

(3) **Restriction on fishing activities and market distribution:** In case a sampling measurement indicates radioactive substances exceeding the PRV levels, related fishing activities in a certain fishing ground and landings of that species are immediately suspended. Such suspension can only be lifted after all sampling measurements at more than three samplings in the same spot during the last one month show levels below the PRV. Through such restrictive measures, no fishery products with radioactive substances exceeding the PRV levels are distributed to the markets.

- *Situation of fishing activities in coastal areas near Fukushima and around Fukushima as of 9 June 2011:*
  - **Fukushima Area:** No fishing activities have been conducted since the occurrence of the nuclear accidents in the Fukushima NPP.
  - **Miyagi Area:** Part of fishing activities resumed in early June, after all sampling results of species caught were confirmed that their levels of radioactive substances are below the PRV.
  - **Ibaraki Area:** Fishing activities for Japanese sand lance have been suspended since sampling measurements showed that the species in this area exceeded the PRV. Trawl fishing resumed after all sampling results of the species caught were confirmed that their levels of radioactive substances are below the PRV.
- *Samplings for skipjack which is an important export marine fish species of Japan:* Skipjack migrates every June into the offshore areas of the east coast of Japan (240-320 km from the coastline). In mid-June 2011, samplings of skipjack taken in the experimental fishing offshore of Fukushima confirmed that the levels of radioactive substances were below the PRV. Therefore, fishing activities for skipjack in that area resumed since 22 June 2011. During the entire fishing season, samplings are to be continuously undertaken at major fishing ports once a week in principle.

2. Monitoring programs for seawater

The Ministry of Education, Culture, Sports, Science and Technology (MEXT) and TEPCO have been conducting monitoring programs to measure the levels of radioactive substances in seawaters and bottom sediments at over 100 sampling stations in the coastal and offshore areas in the vicinity of the Fukushima NPP. The results of the monitoring of seawaters show a decreasing trend in the levels of the radioactive substances. In particular, the results of the recent sampling measurements showed that regardless of whether the samples were taken from the surface, middle and bottom layers, the levels of radioactive substances in seawaters beyond the 30 km radius from the Fukushima NPP have been constantly below the detectable levels, *i.e.* 4 Bq/L of Iodine, 6 Bq/L for Cs-134, and 9 Bq/L for Cs-137 from the samplings by MEXT; and 7 Bq/L for Iodine, 15 Bq/L for Cs-134 and Cs-137 from the samplings by TEPCO in the area around the Fukushima NPP.

Further, MEXT also conducted simulations of future diffusion and concentration of radioactive substances in seawaters, utilizing the oceanographic prediction system JCOPE-2 with oceanographic data such as ocean currents and water temperature. The results of the recent simulation showed that the levels of radioactive substances have become and will remain below the detectable levels in the offshore areas.

3. For smooth transaction and exports

While the safety of fish and fishery products from Japan on the market is secured through the monitoring efforts and restrictive measures, any trade partners may require certificates of measurement of radioactive substances in such products. Therefore, the Government of Japan has designated 30 inspection institutes in Japan which could provide the necessary certificates for any particular consignments of fish and fishery products. In addition, relevant Prefectural Governments with the assistance of the Fisheries Agency will install simplified radiation measuring instruments at major fishing ports to introduce the screening systems for fish landings in these ports.

4. Scientific consideration: Medium- and long-terms impact on fishery products

The major radioactive substances discharged from the Fukushima NPP are radioactive Iodine-131, and Cesium-134 and Cesium-137. The impact of these radioactive substances on saltwater fish is expected to be limited, considering the following scientific facts:

(1) **Dilution and diffusion of radioactive materials in the sea:** Concentration levels of such radioactive substances are expected to rapidly and significantly decrease by dilution in the massive amount of seawaters and dispersion with seawater currents and swirls. Radioactive substances released into the sea are to fall down to the bottom sediment while being attached and absorbed into suspended particles, and in the long term, they are considered to be transported to the deep sea with average depth of 3800 meters, in this case, off the east coast of Japan.

(2) **Bio-concentration of radioactive substances in saltwater fishes:** The radioactive half-life period of Iodine is 8 days. Therefore, even if fish intakes the radioactive Iodine into its internal organs, it diminishes very shortly. For this short half-life, the transfer of radioactive iodine from seafood to human bodies is unlikely. With regards to the radioactive Cesium, although it has a longer half-life period of 30 years, Cesium behaves like Potassium in fish bodies. As such, Cesium does not remain concentrated as it is excreted through the gills and in the urine as the levels of radioactive substances in the surrounding seawater decreases.

The level of radioactive Cesium in fish has a close proportional relationship to that in the surrounding seawater, and it is known that the level of radioactive Cesium in fish would decrease to around one-half in 50 days in the surrounding seawater with low levels of radioactive substances. This implies that measurement of radioactive substances in the seawater is important in estimating the levels of radioactive substances in fish. As mentioned above, most of the recent sampling measurements show that the levels of radioactive substances in the seawater at the surface, middle and bottom layers beyond the 30 km radius from the Fukushima NPP have been constantly below the limit of the detectable levels.