



Contamination: From Minamata to Fukushima

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A Slowly Emerging Picture

On 22 March 2011, an exhausting court battle finally ended for over 2000 victims of mercury poisoning in Kumamoto and Kagoshima prefectures. In sum, the agreement, decades in the making, was as follows as outlines in the Japan Times (31 March): "Chisso will provide some 90 percent of the plaintiffs with a ¥2.1 million lump sum each as well as a ¥2.29 billion fund, and the central and prefectural governments will shoulder part of their medical costs." Chisso Corporation's dumping of methyl-mercury in nearby waters caused Minamata disease, as the painful ailment came to be known after it was first recognized in 1956. Half a century later, time is running out for these victims to receive the official recognition they deserve, as their bodies are growing increasingly frail. The mercury that poisoned their bodies was carried through the fish they ate and accumulated as it moved up the trophic tiers in a process called biomagnifications. In this process persistent poisons, such as mercury, concentrate in the upper echelons of the food chain. In biomagnification, organisms at the top of the chain carry higher levels of toxicity in their fatty tissues.



Fishing in Minamata Bay

Since 11 March 2011, a different kind of toxin began making its way through the veins of common food sources after TEPCO (Tokyo Electric Power Company) completed a planned dumping of radioactive water into the Pacific Ocean at the site of Fukushima Daiichi nuclear power plant. Spinach and other green leafy vegetables, milk, and water have been found to have iodine-131. Fish, cows' milk, and water have been contaminated with cesium-137.

TEPCO, Japan's largest power company, offered an apology along with a veritable shoulder shrug. Their Faustian explanation: to avoid releasing water of even higher levels of radiation into the ocean, we must first dump water with less radioactivity.



Photomontage: Outside the TEPCO plant in Fukushima

While numerical data is occasionally released detailing the amounts of iodine-131 and cesium-137 in the soil of Fukushima, in the sea water off of the Fukushima plant, in the drinking water in Tokyo pipes, in the leafy greens of Miyagi Prefecture, in the milk from Iwate, or on the sides of planes flying across

the Pacific, the short and long term environmental consequences of these radioisotopes is far from clear. As with methyl-mercury a half century ago, Japan is once again threatened by a new persistent toxin accumulating in its food and water. But unlike the early days of the discovery of mercury poisoning, Japan's government has quickly launched responses to this contamination, even far beyond the local site of contamination. After the government banned the sale of numerous greens from Fukushima and six other prefectures and after the concomitant discovery of radioactivity in Tokyo water, fears of food and water contamination quickly ignited in Tokyo (and nearby countries that import food from Japan). Long lines for bottled water formed in grocery stores, ration cards for water for infants were introduced, and some Tokyo denizens experimented with buying food on-line. Then, when the government eased the sale ban on a few greens, a new, more nationalistic response to the contamination blossomed. Enthusiastic supporters of Fukushima farmers attended farmers' markets in Tokyo and elsewhere to buy previously banned produce in order to counter the "unfounded rumors" that have caused such financial hardship for farmers on the eastern side of Japan. Various groups and individuals have shown their solidarity by publicly eating, promoting, or buying produce from Fukushima and six nearby prefectures. Television talents, sports heroes, and popular singers have encouraged Japanese to follow the Chief Cabinet Secretary Edano's example and eat strawberries and greens (irresistible when down to 100 yen a bag) from Fukushima and outlying prefectures. In a show of support for the economic recovery of the region and its farmers, American ambassador John Roos bought Fukushima sake at a Tokyo shop, though it is likely the sake had been brewed before 11 March. There were the sacrifices of Tokyo urbanites: questions of contamination were answered by the consumption of bargain basement sale prices.

Food Absorption and Leafy Greens

On 23 March 2011, the Japanese government restricted the consumption of various greens from Fukushima prefecture including *kakina*, broccoli, cabbage, *komatsuna*, *kukitachina*, *santona*, parsley, *shinobu fuyuna*, *kosaitai*, cauliflower, *chijirena*, *aburana*, and others. Fukushima prefecture was also barred from distributing the same greens and turnips. Ibaragi prefecture was stopped from shipping spinach, *kakina*, or parsley. Tochigi and Gunma prefectures were disallowed from shipping spinach or *kakina*. These trashed shipments will affect consumers and producers. Gunma, Fukushima, Ibaragi and Tochigi prefectures together supplied sixty percent of the greens to Tokyo in 2010. It turns out that greens are more susceptible to radiation absorption than other fruits and vegetables and have been found to exceed normal radiation limits since the leaks at the six-reactor Fukushima Daiichi nuclear power plant, though data varies according to source.

At the same time, Chief Cabinet Secretary Edano attempted to reassure the public in a press conference by stating that there is no immediate harm from temporary consumption of green leafies, even while he stated that the long-term effects of consumption of these vegetables are not clear. Consumers were simply asked to limit consumption of these greens and farmers were blocked from selling their vegetables. One farmer who had just seeded a new crop a week prior to the reactor accidents stood to lose 2,000,000 yen on his crops. A farmer of *kakina*, who had just missed harvesting by a mere day or two, lost

an entire crop. At distribution centers, boxes of greens from Fukushima and Ibaragi were marked with black felt pens "return produce." Shop owners in Tokyo complained that consumers even chose not to buy vegetables from prefectures lying outside the no-distribution zones. Family chain restaurants stopped including parsley with their meals. Regardless of whether Fukushima is declared uninhabitable, even minimal radioactivity in the soil could plague farmers for years to come, threatening family livelihoods and the health of the town.

Milk and Mothers

Fukushima and Ibaragi prefectures were also asked to halt milk shipments because of fear of contamination. One farmer pumping milk from his cow directly into the drain, as one of his cows seemed to peer over his shoulder, lamented that he must "throw away milk like garbage."



Fukushima dairy farmer disposes of milk

Milk is highly vulnerable. Industrial toxins are stored in fatty tissue of bodies and the biomagnification of toxins up trophic tiers means that milk brings with it a greater accumulation of toxins in our bodies, just as fish did for human Minamata victims. Usually with the food chain, people visualize a generic man at the top of the link, but Sandra Steingraber illustrates that it is not "man," but a fetus that is the final resting place for Earth's toxins. The placenta magnifies levels of toxins admitted to the fetus. In the case of pesticides, "those with low molecular weights cross the placenta barrier without restriction."¹ Pesticides of heavier molecules can become even more toxic as they get metabolized by the placenta's enzymes.

On mercury (which destroys brain tissues) and the placenta, Steingraber writes, "Even if the mother's blood is contaminated with only trace amounts of methylmercury, the placenta will still actively pump it into the fetal capillaries as though it were a precious molecule of calcium or iodine. As the pregnancy continues, the mercury levels in umbilical cord blood will eventually surpass their levels in the mother's blood. In the case of methylmercury, the placenta functions more like a magnifying glass than a barrier."² Nearly as vulnerable as the fetus is the breastfeeding infant. About the breastfeeding infant and biomagnification, Steingraber writes, "After the tuna sandwiches and glasses of cow's milk are all consumed, there still remains one more chance for the contaminants they carry to magnify, and that takes place inside the breasts of nursing mothers" who add a

trophic tier to the human food chain.³ Toxins from veggies and milk are potentially harmful for mothers breastfeeding since they transfer toxins to infants through the milk that contains chemicals trapped inside milk fat globules, at least 60% of which are from long-lived fat-soluble contaminants from a lifetime burden of contaminants in the female body. These have even been transferred to her through the milk of her own mother. Mothers in the evacuation zone who may have experienced radiation and were in the process of breastfeeding during this tragic event could pass on toxins to her infant unless she chose to "pump and dump"—to dump her milk instead of feeding it to her child.

Other common food sources that raise concerns about toxins in the food supply are fish and seaweed, which can concentrate radioactive elements as they grow, leading to levels that are higher than in the surrounding water. Seaweed can concentrate iodine-131 10,000-fold over the surrounding water and toxic substances can concentrate in higher levels in water than on land because food chains tend to be longer there. This is why Minamata fishing communities suffered the effects of mercury poisoning so dramatically. It makes it doubly important to watch radiation levels in the ocean off the coast of the nuclear reactors in Fukushima. The degree to which fish concentrate cesium-137 varies. Noguchi Kunikazu has elaborated on the process of biomagnifications in the current situation. He writes, ". . . although half of the cesium ingested by fish is discharged as waste in about 50 days, the fact that the fish in the ocean are continuously exposed to radiation in seawater leaves open the possibility of further contamination of fish at high levels. . . . He added that a considerable amount of radioactive materials attach to seaweed after about a week to 10 days so seaweed in waters where radiation contamination has been confirmed should also be checked for contamination."⁴

While the trophic tier is an important part of understanding the eventual impact of radioactivity in ocean-going organisms on fish-eating humans, it is also true that particular fish anatomies more easily uptake toxins in the water despite their size. For example, in Minamata where fishermen used anchovies as a kind of currency, anchovies were more susceptible to the mercury than other small fish because they proved physiologically adept at absorbing mercury from the water. Particular anchovies ate zooplankton, which had absorbed mercury, by sifting them out of the water, but they also swam and forced water into their gills. This meant that anchovies absorbed methyl-mercury in two ways--through their food source and through water: "This made them extremely potent repositories of mercury and prime gateways for this non-metabolizing toxin to infiltrate the food web."⁵ In other words, particular fish may be more or less susceptible to radioactivity. A study of cesium-137 in the Baltic Sea after Chernobyl similarly showed discernable differences among fish species in terms of the amount of uptake of cesium-137. The cod in affected areas mirrored the amount of cesium-137 in the water while other sea-going fish carried lesser amounts of radioactivity. Similarly, it has been found that freshwater fish are more susceptible than saltwater fish in the Baltic sea, and have higher levels of cesium-137 than seawater fish.⁶ Just as some fish show more or less propensity toward the uptake of radioactivity, particular human bodies are more or less susceptible to toxins. The anchovy showed a particular readiness to upload mercury. The fetus and child have shown a particular susceptibility to toxins in the environment.

Common Industrial Pollutants and Clean-up

Perhaps the sadder truth that has emerged in my research of the role of cesium-137 in Chernobyl is the fact that daily industrial contaminants play a far greater role in the contamination of nonhuman and human bodies and environments. To return to the mother's body as an example, Steingraber demonstrates that organic pollutants from industrial life are plentiful in human breast milk. They make it the most contaminated of all human foods: "Breast milk, if regulated like infant formula, would commonly violate FDA action levels for poisonous or deleterious substances in food and could not be sold." On average, in industrialized countries, breastfed infants ingest each day fifty times more PCBs per pound of body weight than do their parents. We have DDT, PCBs, flame retardants, fungicides, wood preservatives, termite poisons, toilet deodorizers, cable-insulating materials, gasoline vapors, dry-cleaning fluids, chemical pollutants of garbage incinerations, and other contaminants in breast milk. This holds true for studies of the contamination in biota around Chernobyl. Studies of cesium-137 and radioactive fallout in the wake of Chernobyl more than a decade after the tragedy illustrate that common industrial pollutants are more predominant in biota than radioactivity. A recent study of the biota in the Baltic Sea shows the following four materials to have the highest contamination rates in descending order: PCBs (20%), lead (13%), mercury (13%), cesium-137 (12%).⁷ The high levels of PCBs, lead, and mercury do not have a connection to the Chernobyl fallout, only cesium-137. The others are related to daily toxins produced by modern living.

And any cleanup of radioactive particles stands to introduce more chemicals into the environment. If extensive contamination of the soil in Fukushima occurs, one likely cleanup method would be to use chemicals to keep the radioactivity from spreading. Dan Coyne, a vice president with CH2M-WG Idaho, which is cleaning up an Energy Department site in that state, said that given the uncertainty at Fukushima, one approach might be to spray a chemical on the soil that would prevent the cesium from migrating further. "Go and put a fixative on it, control the area, and save the remediation of that for a time when it fits your priorities."⁸ And workers could fall ill from the use of those kinds of clean-up chemicals. In the case of the BP spill in the Gulf of Mexico, workers have fallen ill not from exposure to the oil but to the chemicals used for cleanup. The perversity of our energy choices is heightened by the fact that an area may need to be revived through the use of chemicals that could turn out to be just as toxic as the radiation itself.

Data and Consumption

One frequent complaint among Japanese people following the Fukushima disaster was the lack of transparent data that would provide guidelines for consuming food safely. For example, when viewers were told by NHK that “the ejection of water into the sea is equal to the amount of fish and seaweed consumed daily (which they likely would in the affected areas) for a year which is equal to ¼ of the ‘natural radiation’ they get per year, which is 2.4 millisieverts,” they could likely only limp haltingly toward understanding. Some clarity emerged on 5 April 2011 when the government of Japan set level standards for iodine and cesium levels in seafood. It was determined that seafood may contain 2000 becquerels per kilogram of iodine-131 and 500 becquerels per kilogram of cesium-137. This was done after Japanese sand lance caught in Kita-Ibaraki were found to have levels of iodine at 4020 becquerels per kilogram and, as a consequence, the government asked Ibaraki Prefecture to stop shipments of sand lance under the Law on Special Measures Concerning Nuclear Emergency Preparedness.⁹

The risks involved in eating land- and sea-produced foods may be as yet hard to predict because there are so many environmental factors that will contribute to the movement of radioactive material and there is so little clarity about what has happened at the plant. But experience in the wake of Chernobyl provides a roadmap for food consumption: the testing and monitoring of vegetables, fruits, fish, animals, soils and liquids is essential. In the post-Chernobyl landscape, for example, Belarus created 370 local public centers for the monitoring of foodstuffs, including for cesium-137. Long lists of limits for cesium-137 intakes have been created for a whole host of foods.¹⁰ The official allowable amounts of cesium-137 for any number of foods like mushrooms, milk, caraway seeds, hazelnuts, apricots and figs are available. And hundreds of thousands of samples have been taken to measure current levels of cesium-137 in fungi, vegetables, fish and meat. We have already seen cows in Fukushima being removed from the food chain for having radioactivity just as lambs from Scotland and Wales were not brought to market, and moose and reindeer meat in Sweden was instead fed to mink on farms, but the Japanese government has not begun to make a dent in the necessary testing that must be done.



Cows in Fukushima

While Japan begins to set limits for iodine-131 and cesium-137 intake, some bodies may not have any resistance. As Steingraber writes, there is nothing to suggest that fetuses have any threshold to toxins *at all*.¹¹

Movable Nature and Biotic Relations

The fact that a debate has recently emerged over whether the dumping of toxic water by TEPCO into the Pacific is legal suggests the importance of reiterating how readily radioactivity moves and how connected bodies are to the environment. In evaluating Japan's responsibility to neighboring countries, Edano has made two related claims. One is that fish beyond one kilometer off the coast will be safe, and the second is that Japan is not in violation of any international laws designed to protect and preserve marine life. But there are no such boundaries in the physical world. Water off of Japan's northeast seaboard travels through strong ocean currents. Seaweed, plankton and zooplankton that travel within those currents are food for fish that travel, under their own power, chasing after food sources or as part of natural migrations.¹² Under these circumstances, it makes no sense to imagine that a food source like fish could be deemed safe

through reference to relative proximity from a spot on the shore (the Fukushima plant), given the ocean's fluidity. Relatedly, Japan's government insists that it is not in immediate violation of international law by discharging radioactive water into the sea either under the U.N. Convention on the Law of the Sea, designed to protect and preserve marine life, and the Convention of Early Notification of a Nuclear Accident.¹³

The capacity to make such bald claims must rest on the notion that we are national bodies before we are biotic bodies—that there are clear boundaries between this nation and the next, or between this body of water and the next.¹⁴ But we know this must be false. Nature moves. It moves around us and through us. The processes of biomagnification, anatomical particularities that lead to increased contamination of bodies, soil properties, currents in wind and water, the agency of fish, and the hubris of man who believed an engineered plant to be invulnerable to natural forces, all contribute to the growth of a complex web of contamination. There is no “Japan” here, but both a highly localized world of contamination that can be described as a mere “spot” (as in “hot spot”) and a highly dispersed one in air, sea and ocean currents that move unpredictably.

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Notes

¹ Sandra Steingraber, *Having Faith: An Ecologist's Journey to Motherhood* (Cambridge, MA: Perseus Publishing, 2001), 34.

² *Ibid.*

³ *Ibid.*

⁴ Noguchi also stated that contamination by strontium was of concern because it can take 18 years for half of it to be discharged as waste matter from humans and because it can be accumulated in the human body due to characteristics similar to calcium, *Asahi*, 7 April 2011.

⁵ Brett Walker, *Toxic Archipelago* (Seattle: University of Washington Press, 2010).

⁶ Alexey V. Yablokov, Vassily B. Nesterenko, Alexey V. Nesterenko, *Annals of the New York Academy of Sciences*, vol. 1181, 2009—a volume entitled “Chernobyl: Consequence of the Catastrophe for People and the Environment,” 291. If the cesium-137 is in the water column or plankton and zooplankton, then the fish cannot excrete it as it is taken up by the fish until the cesium lives out its half-life. Belton A. Burrows, Thomas C. Chalmers, and John A. Cardarelli, “Global Fallout Distribution in Fireplace Ashes,” Department of Medicine, and the Epidemiology and Biostatistics Section, School of Public Health, Boston University School of Medicine, Boston, Massachusetts and Nuclear Medicine Service, Boston V. A. Medical Center. See also HELCOM, 2010. Hazardous substances in the Baltic Sea – An integrated thematic assessment of hazardous substances in the Baltic Sea. *Balt. Sea Environ. Proc.* No. 120B.

⁷ HELCOM, 2010.

⁸ [Link](#).

⁹ [Link](#).

¹⁰ For detailed report of the levels of cesium-137 in affected areas, biota, and adult and children's bodies after Chernobyl see: Alexey V. Yablokov, Vassily B. Nesterenko, Alexey V. Nesterenko, *Annals of the New York Academy of Sciences*, vol. 1181, 2009—a volume entitled “Chernobyl: Consequence of the Catastrophe for People and the Environment.”

¹¹ Steingraber, 49. And children are more susceptible for their lower weights. From 1995 to 2007, up to 90% of the children from heavily contaminated territories of Belarus had levels of Cs-137 accumulation higher than 15–20 Bq/kg (see Yablokov, et al).

¹² As stated in a study of artificial radionuclides in seawater in the Baltic Sea over the years 1999-2006 by HELCOM, the fate of any pollutant introduced into the sea is determined by both its own chemical properties and hydrographical conditions of the sea itself. In the case of cesium-137 being introduced into the Baltic Sea, the greatest concentrations of it will be found where there is less current to move the water, where it can bind to sediment particles in brackish water.

¹³ [Link](#).

¹⁴ For example, following the analogy of Chernobyl, up until 1991 the United States imported food products with measurable amounts of Chernobyl radioactive contamination, mostly from Turkey, Italy, Austria, West Germany, Greece, Yugoslavia, Hungary, Sweden, and Denmark.