No More Fish For You!

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Given that the disaster at Fukushima nuclear reactors has introduced the radiation equivalent of 14,000 Hiroshima atomic bombs, what has this done to our health?

There are two ways to approach this question: one concerns external sources of radiation and the other internal. External sources means our exposure to radioactivity in our external environment -- that is, the radiation that bombards us from the world around us. Internal sources means our exposure to radioactive elements lodged inside our body.

Given the distance of Fukushima from North America, the slow rate of the radiation leakage, and the mixing of radioactive elements in the ocean and the atmosphere, the health dangers to us from external sources are relatively low. The main health risk concerns the introduction of internal sources of radiation through eating contaminated foods.

Radioactive elements blown into the air or evaporated from seawater are carried over North America by air currents and deposited on land by rain. Crops are harvested, processed into food for animals and people, and the radioactive elements collect in tissues where they can remain to emit constant, low radioactivity for decades.

I'm considering a move to British Columbia. I'm concerned about the long-term effects of Fukushima on the West Coast environment and food chain. I judge one of the greatest risks is that of ocean-borne contaminants and the ingestion of tainted fish.

I will be visiting the area shortly, and I wondered if I might learn something useful by renting a sensitive Geiger counter and making some measurements. But before I did that I wanted to know if there was any likelihood that such an instrument could yield useful information. To answer that question, I first needed to know what I'm looking for; so here is a short primer on radiation.

Radiation

Radiation can come from various sources. Most of what we're looking for in this case are photons, which means X-rays and gamma rays. These high-energy light particles are energetic enough to disrupt the structure and function of DNA and fundamental cellular processes.

The other form of radiation that is a health concern is due to heavy particles like neutrons. This form is extremely dangerous due to the amount of energy and large size of these particles, but these are not the major contaminants released into the environment by the Fukushima reactors. The two major isotopes released by Fukushima are Iodine 131 and Cesium 137 which emit gamma radiation.

Iodine 131 is airborne and, like other forms of iodine, is absorbed in your body and accumulates in your thyroid. If you "preload" your system with safe iodine, then toxic iodine won't be absorbed by the thyroid. But iodine 131 has an 8-day half-life so issues pertaining to iodine poisoning are only relevant within a week of a nuclear incident and mostly relate to the breathing of iodine as an airborne contaminant, since other means of ingestion are sufficiently slow to allow the radioactivity to decay.

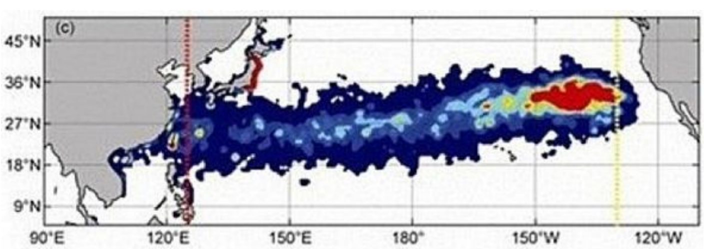
There was talk in the press of iodine poisoning raising the rate of infant deaths just after the disaster at Fukushima, but looking at the actual data I judge that the differences in the weekly rates of infant mortality were insignificant and that there was no discernible effect on infant mortality due to radioactive iodine.

Cesium 137 is a different story. Preventive iodine loading does not allay the risks of cesium poisoning. Cs-137 is primarily water-born or ingested through foodstuffs.

Wikipedia says: "Cesium 137 has a half-life of about 30.17 years, and decays by beta emission to a metastable nuclear isomer of barium-137: barium-137m (137mBa, Ba-137m). (About 95 percent of the nuclear decay leads to this isomer. The other 5.0 percent directly populates the ground state, which is stable.) Ba-137m has a half-life of about 153 seconds, and it is responsible for all of the emissions of gamma rays. One gram of caesium-137 has an activity of 3.215 terabecquerel (TBq)."

Radioactivity is measured in becquerels (Bq), which is "emissions per second". Each "click" of the Geiger counter would mark the reception of an emitted particle.

The photon energy of Ba-137m is 662 keV, so that's the decay product one looks for as the signature for Cs-137. This is a radioactive decay that is not found in nature. However, Geiger counters won't distinguish that particular frequency since they are only counting only high-energy events. The best one would do using a Geiger counter is to compare the gamma ray rate to the baseline. You would need a different instrument if you wanted to know for certain whether your sample was tainted with Cs-137.



One would not expect to find higher-than-expected background rates in the air or water at this point. Even in 2014, when the major portion of contaminated water and detritus is expected to arrive on the West Coast the increase in the baseline rate will not be measurable using a hand-held unit. Instead one would test specific substances. This is where one expects the isotopes will accumulate. However, from my reading these would also not register unusual rates when tested using a hand-held unit unless they were unusually "hot".

Safe Levels

The government sets "safe" rates for the radioactivity of food stuffs, and the Canadian government has set the action level for Cs 137 at 300 bequerels per kilogram in milk, 100 Bq/L in water, and 1,000 Bq/kg in food. Japan has set a level of 100 Bq/kg for fish.

That means that if one measures the gamma radiation being emitted in all directions from 1 Kg of this material, it should register as the source of fewer than the indicated number of particles per second in order to qualify as "safe." Of course, "safe" just means that few enough people die so that it is not disruptive to society. It does not mean that no one is hurt, just that the number killed or injured is judged to be inconsequential. There is no safe level of radiation, since even a single gamma can be toxic and can trigger cellular irregularities that lead to increasing damage and ill health over time.

Regarding the radiation levels that one expects, I read that one Halibut measured at 18 Bq/kg (i.e. 18 disintegration events/kg-sec) and one Sea Bass sample had 1,000 Bq/kg. But the question is: how might I measure this using a hand-held unit? To answer that, consider the following situation:

Consider 1,000 photons emitted from a 1 kg sample/sec exiting at random angles through a sphere of 6" radius. This sphere has a surface area of 4/3*Pi*R^3 =~ 900 sq.in. This implies that one would expect 1.1 events to be recorded per second by a perfect counter with 1 square inch of surface area. This is about the surface area of a hand-held radiation meter that one could hold 6 inches away from a sample.

If the 1 kg sample radiated at a lower rate of 10 Bq per second, then a hand-held counter would register .0011 Bq/sec. In this case, recording 10 events would require measuring the sample for 10,000 seconds, or 170 minutes. Since the hand-held counter is probably 50% efficient, a recording time of 300 minutes, or 5 hours, would be required to catch a significant number of events. The same measurement of background levels would need to be subtracted from this measurement in order to apprise its significance.

My conclusion is that if I take a Geiger counter with me when I visit Vancouver, and I purchase a kilogram of deep sea halibut or migratory salmon, then I would have to set this sample next to my Geiger counter for 5 hours just to get a single reading. I would need to get a few readings, and I'd need to interpret the results.

An October 2013 article titled "*Fukushima fish still contaminated from nuclear accident*" says:

Caesium does not normally stay in the tissues of saltwater fish for very long; a few percent per day on average should flow back into the ocean water. So, the fact that these animals continue to display elevated contamination strongly suggests the pollution source has not yet been completely shut off.

As you can see, measurements of this kind really require lab equipment and a shielded test bench. I would not be able to generate any useful readings with a hand-held Geiger counter, consequently I won't waste my time trying. Geiger counters are designed to measure hot spots, not faint sources or changes in background levels.

It does seem that eating fish will likely be the largest health hazard from the disaster for people living on the Pacific Coast and that the contamination will not resolve for decades. It may actually grow over the coming years as contamination continues to pour into the ocean. I have seen estimates that cleaning up Fukashima could take 40 years.

George Washington provides many useful sources of further information at: *What Is The ACTUAL Risk for Pacific Coast Residents from Fukushima Radiation?*

and "*The REAL Fukushima Danger*"

The basic debate between government regulators and independent agents as of October 2013 is presented here: *Fish data belie Japan's claims on Fukushima*

More detailed information found in: *Point/ Counterpoint – Replies and Rebuttals between Georgia Straight author Alex Roslin, and B.C. provincial health authorities Dr. Perry Kendall and Dr. Eric Young*.

The Sorry Conclusion is...

Don't eat any more deep sea or migratory Pacific Ocean fish. From now on just keep them as pets, or use them for pedicures.