Dose rates to marine organisms and seafood consumers from the Fukushima accident

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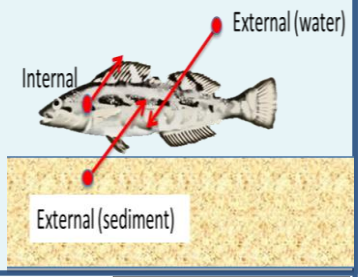
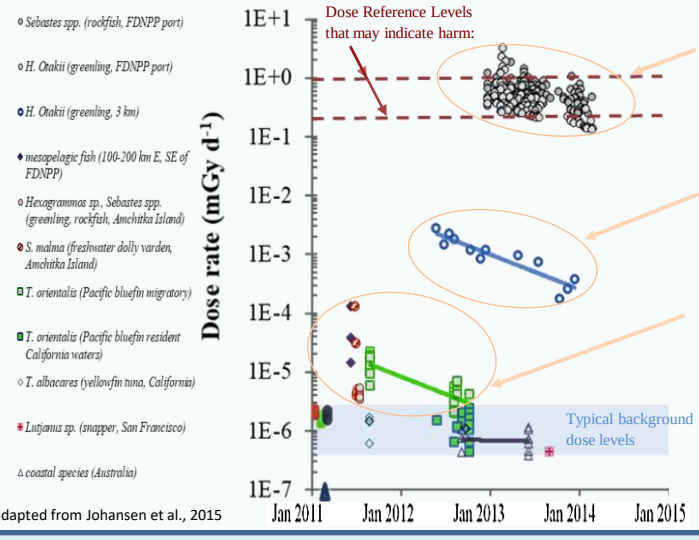
1. Introduction

- 'Radiological Dose Rates' help us better understand nuclear events. They reflect the amount of exposure to ionising energy from radionuclides in the environment.
- Here we report estimated dose rates for marine fish and also for seafood consumers following the accident.
- The dose calculations are made possible by the many measurements gathered by Japan government agencies as well as Japan/international institutions and researchers.

A marine fish may receive ionising energy from radionuclides in the surrounding water, sediments or from the food it eats.



2. Dose Rates to fish



adapted from Johansen et al., 2015

At the FDNPP Port:
- Some dose rates were higher than reference levels of concern.
- Most of the fish dose was from ^{134,137}Cs and ^{90}Sr.

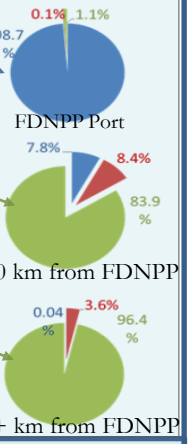
At 0.1-10 km from FDNPP:
- Dose rates were below reference levels.
- Most dose was from natural radionuclides (not from the accident).

At 100+km and across the Pacific:
- In some fish, a very low dose was from the accident (<1%) for ~ 2 yrs, after which it became difficult to distinguish accident dose from background levels.

Since about 2015, the dose rates to fish have returned to background levels in most Pacific areas, except near the FDNPP where slight increases persist.

Which radionuclides caused dose?

^{134,137}Cs, ^{90}Sr, ^{3}H, ^{99}Tc, ^{110m}Ag, ^{235}U, ^{239}Pu, ^{240}Pu, ^{241}Am, ^{210}Po , other natural radionuclides



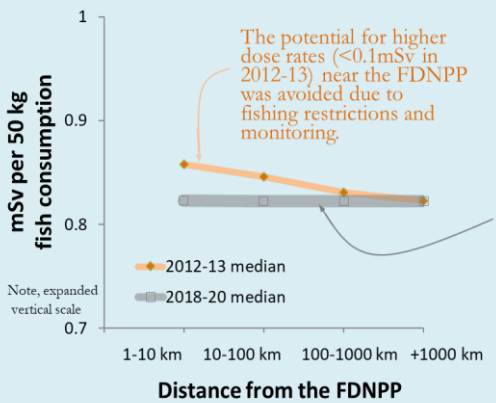
3. Dose Rates to Seafood Consumers

While eating seafood, consumers also ingest small amounts of radionuclides that come from artificial and natural sources.

The normal background dose of about 0.82 mSv (after consuming 50 kg fish) comes mostly from the natural radionuclide ^{210}Po, with small amounts from ^{3}H, ^{40}K, ^{90}Sr, ^{137}Cs, ^{226}Ra, ^{228}Ra, ^{228}Th, ^{238}U, ^{239,240}Pu and ^{241}Am.

Here we have assumed that a hypothetical consumer eats fish from various distances from the FDNPP. In 2012-13, near the FDNPP, there is a slight hypothetical increase of < 0.10 mSv in the median dose (per 50 kg of fish consumed). This increase is very low and is hypothetical as fishing was restricted in that area. The slight hypothetical increase can be viewed as the amount of dose avoided due to the restrictions.

1 mSv is a standard dose limit



By 2018-20, the potential dose is very similar to background levels typical of consuming 50 kg marine fish from any ocean (~0.82 mSv).

Almost all of this background dose is from the natural radionuclide Po-210.

The dose estimates are provisional, based on available data. Data sources include: Fisheries Agency (MAFF), Fisheries Research Agency, Ministry of Environment, Nuclear Regulation Authority (NRA), Marine Ecology Research Institute, Fukushima Prefecture and other prefectures as well as a range of institute and researchers. Data are accessed via NRA, JAEA, Japan Chemical Analysis Center and the IAEA MARiS database.

For details see: **Johansen M.P., Ruedig E., Tagami K., Uchida S., Higley K., Beresford N.A. Radiological dose rates to marine fish from the Fukushima Daiichi accident: the first three years across the North Pacific. (2015). Environmental Science & Technology 49(3): 1277-1285.** https://doi.org/10.1021/es505064d