The determining factors of radio-cesium levels in fish off Fukushima derived from dynamic biological transfer model simulation

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1. Introduction

Why radiocesium levels in fish were different those collected from the same coastal water?

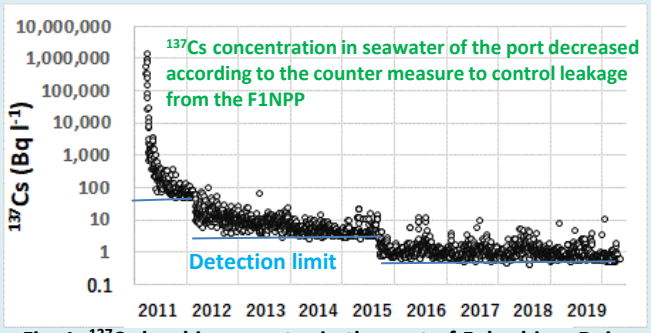


Fig. 1. ^{137}Cs level in seawater in the port of Fukushima Dai-ichi nuclear power plant F1NPP (TEPCO, 2020).

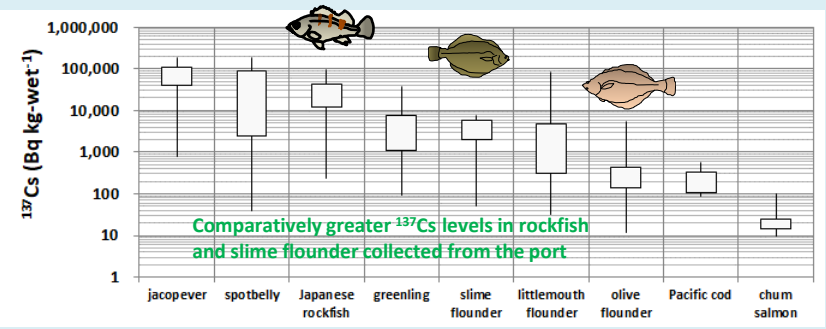


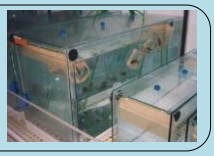
Fig. 2. Reported ^{137}Cs level in fish collected from the port of F1NPP ~Dec. 2016 (TEPCO, 2020).

2. Data / Primary Information

Clarification of radiocesium kinetics by biological model analyses

Radio-tracer laboratory experiment

Metabolic parameters

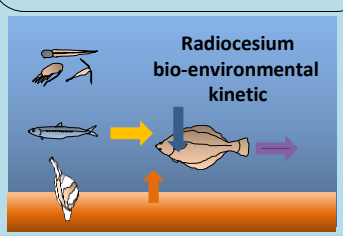


Bio-environmental kinetic model

Transfer from seawater food sediment

$$\frac{dB_2(t)}{dt} = k_{02}S(t) + d_{12}B_1(t) - k_{20}B_2(t) + d_{sed}Sed_{labile}(t)$$

Excretion from fish



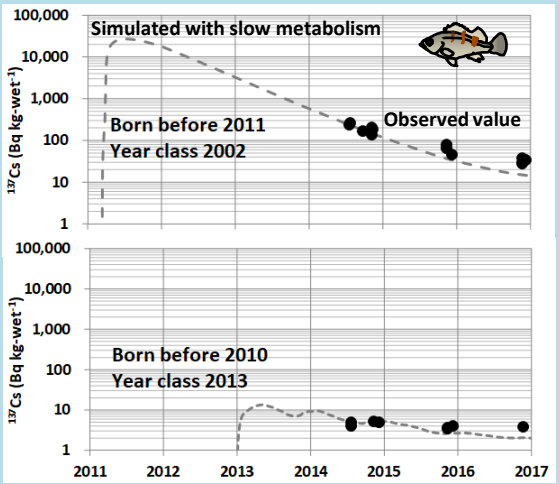


Fig. 3. ^{137}Cs levels in rockfish born at 2002 and 2013 at the south of the 1FNPP (Ishimaru et al., 2019).

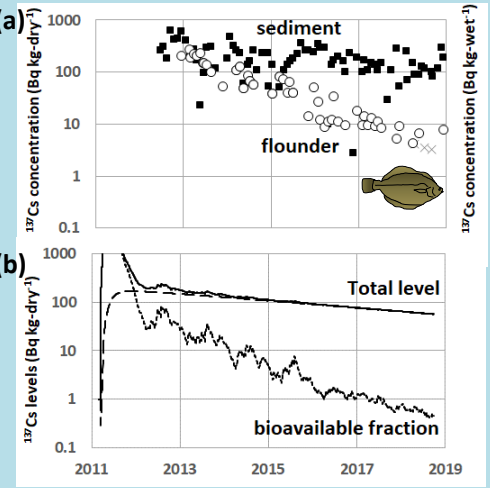


Fig. 4. Observed ^{137}Cs levels in a) sediment and slime flounder, and b) simulated levels in total and labile fraction in sediment (Tateda et al., 2020).

3. Takeaway Message

- The radiocesium concentrations of rockfish and some flounder were higher in coastal fishes off Fukushima during 2011-2014.
- The reasons of comparatively higher radiocesium level of the rockfish were understood to be caused by sedentary to bottom reef near the F1NPP, slow metabolism, and long life span (>20 y).
- Observed greater levels in some flounder species were considered to be caused by contribution of labile radiocesium transfer from bottom sediment.
- Although the depuration were slow, the radiocesium concentrations in these fishes of 20 km radius area decreased below the Japanese regulatory level (100 Bq kg ww^{-1}) after 2015.
- After 10 years from the accident, radiocesium levels in coastal fish off Fukushima were below 10 Bq kg ww^{-1}, having nearly negligible radiological significance for seafood safety.

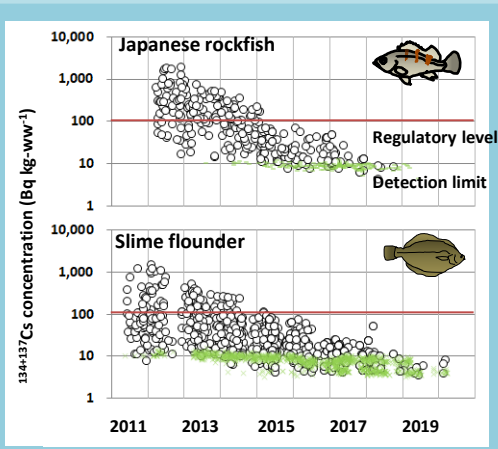


Fig. 5. Observed ^{137}Cs levels in rockfish and slime flounder in 20 km radius area from F1NPP (Japan Fishery Agency, 2020; TEPCO, 2020).