# Study on Tritium Transfer in Marine Animals

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## Abstract

The operation of a spent nuclear fuel reprocessing plant is accompanied by the discharge of small amounts of various radionuclides into the natural environment. In the marine environment, tritium ($^{3}H$) is the most important among the radionuclides from the viewpoint of radiation dose assessment, because $^{3}H$ will be released in the form of water directly to the open sea. Tritium will deliver radiation dose to the neighboring population of the plant through ingestion of marine foods. Then, the transfer and/or accumulation factor of $^{3}H$ is one of the key parameters for the radiation dose assessment around the reprocessing plant.

The accumulation of tritium ($^{3}H$) in marine animals was examined by the culture experiment using deuterium (D) as a tracer. The exchange velocity constant of heavy water (HDO) between seawater and marine animals was estimated to be very large, being from 0.06 to 0.29 per hour in 6 kinds of fish, and from 0.87 to 9.22 per hour in non-fish animals, such as scallop, sea cucumber and others. The exchange velocity constant showed high dependence on temperature but only low dependence on salinity of sea water

Table 1 Exchange velocity constant of HDO in marine animals (15°C).

| Species (body weight) | | Inflow velocity constant $k$ ($h^{-1}$) | Outflow velocity constant $k$ ($h^{-1}$) |
|---|---|---|---|
| *Hexagrammos otaki* | ( 180–580 g ) | 0.18 – 0.26 | — |
| *Seriola quinqueradiata* | ( 110–700 g ) | 0.25 – 0.27 | — |
| *Kasreius bicoloratu* | ( 60–1330 g ) | 0.10 – 0.16 | — |
| *Sebastes schlegeli* | ( 60–100 g ) | 0.22 – 0.25 | 0.22 – 0.24 |
| *Paralichthys olivaceus* | ( 10–1580 g ) | 0.06 – 0.20 | 0.04 – 0.19 |
| *Sebastes thompsoni* | ( 4–24 g ) | 0.18 – 0.29 | — |
| *Strongylocentrotus nudus* | ( 40–80 g ) | 2.06 | 1.48 |
| *Strongylocentrotus intermedius* | ( 40–150 g ) | 1.00 | 1.66 |
| *Todarodes pacificus* | ( 410–470 g ) | 0.85 | — |
| *Patinopecten yessoensis* | ( 190–210 g ) | 6.13 | — |
| *Stichopus japonica* | ( 50–80 g ) | 2.03 | 2.31 |
| *Oratosquilla oratoria* | ( 38–84 g ) | 9.22 | 8.25 |

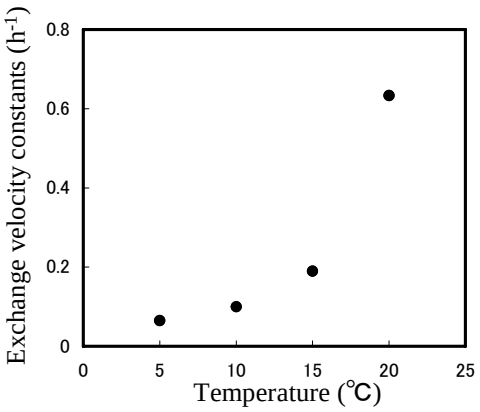


Fig. 1 Exchange velocity constants at various temperatures.

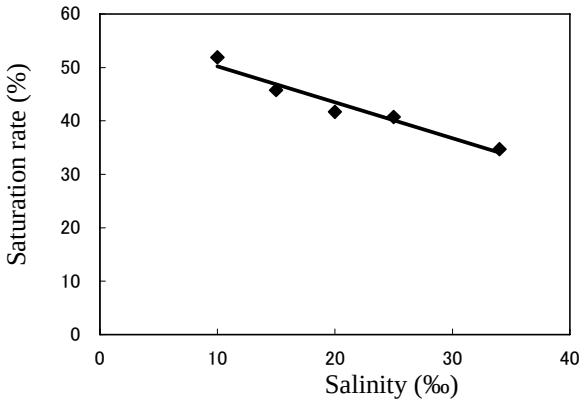


Fig. 2 Saturation rate of HDO concentration per 6 hours in *P. olivaceus* at various salinities.

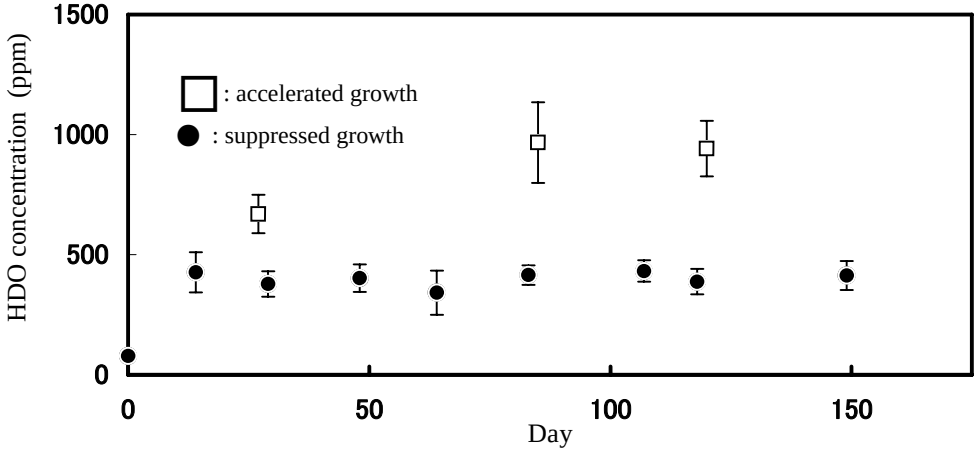


Fig. 3 HDO concentration in *P. olivaceus* in growth control experiments.