Radiocesium contamination histories of Japanese flounder *Paralichthys olivaceus* after the 2011 Fukushima Nuclear Power Plant accident

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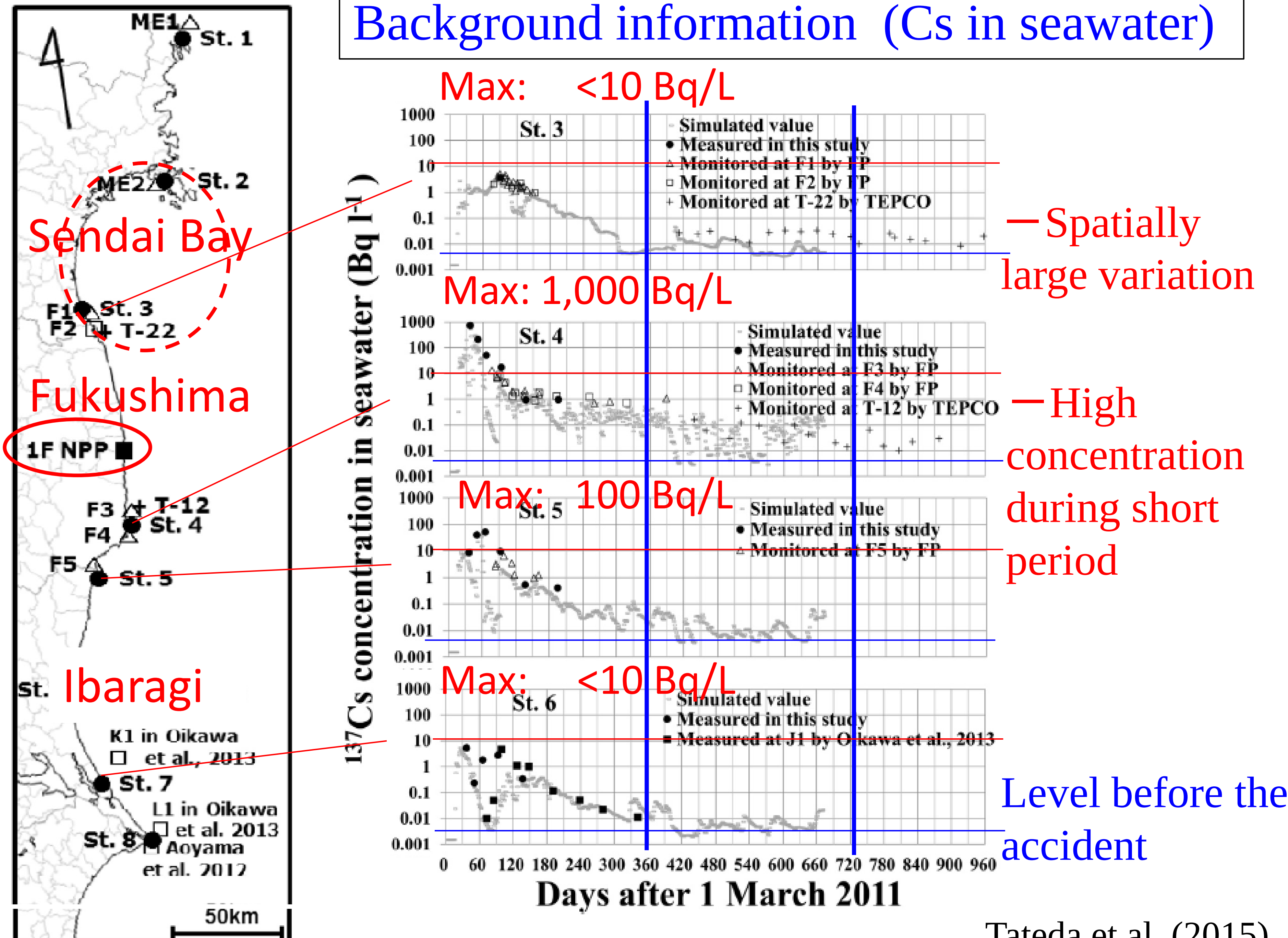
Objective

Information

- Directly released water with extremely high radiocesium (Cs) concentration contaminated animals from the end of March to the end of April 2011.
- Contamination process will be different from that before the accident (equilibrium process).

To understand the radiocesium (Cs) contamination histories of Japanese flounder to facilitate prediction of the dynamics of Cs concentration.

Background information (Cs in seawater)



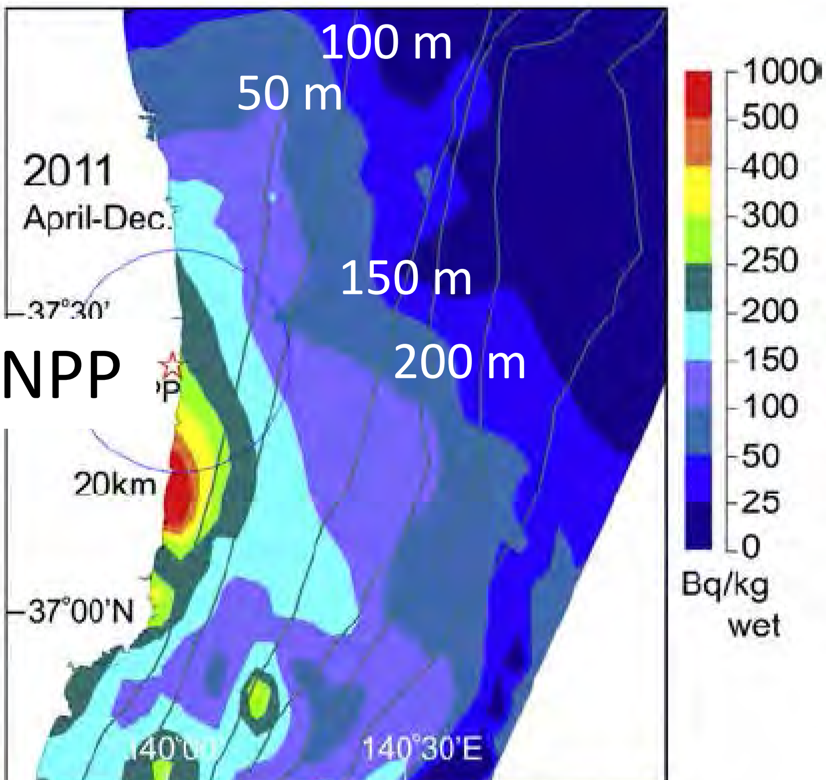
Tateda et al. (2015)

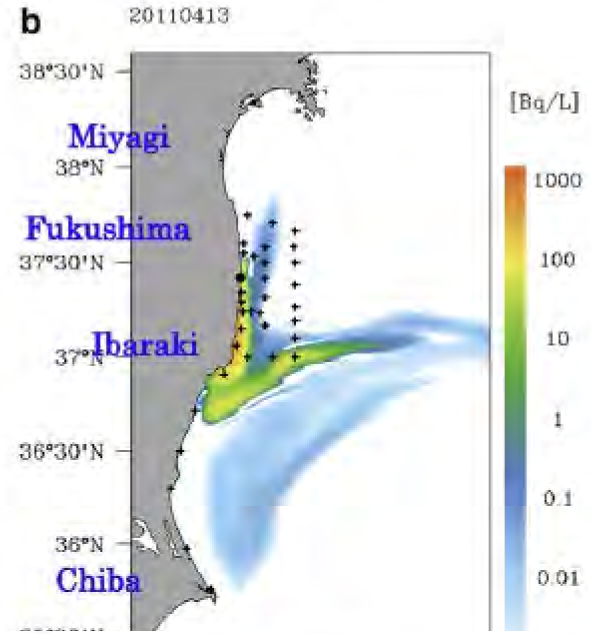
Background information (Spatial distribution of contamination)

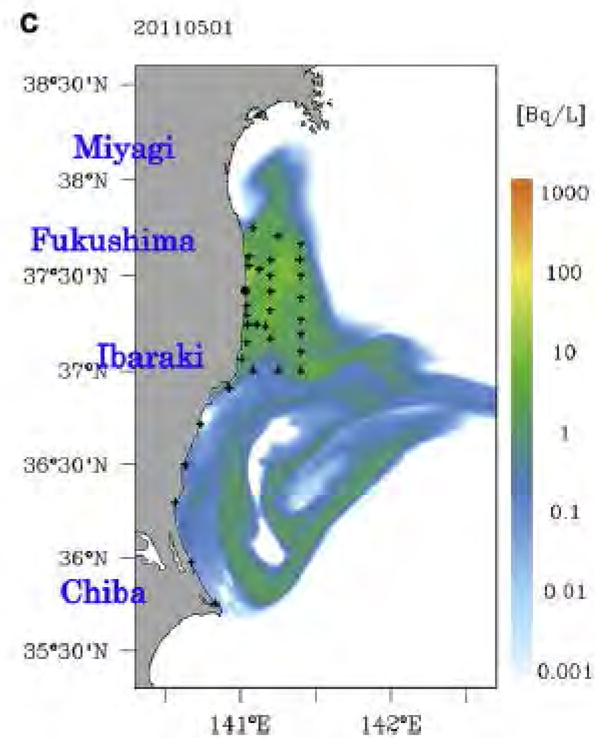
Tsumune et al. 2012

Contamination map of bottom fishes (Apr – Dec 2011)

Wada et al. 2013



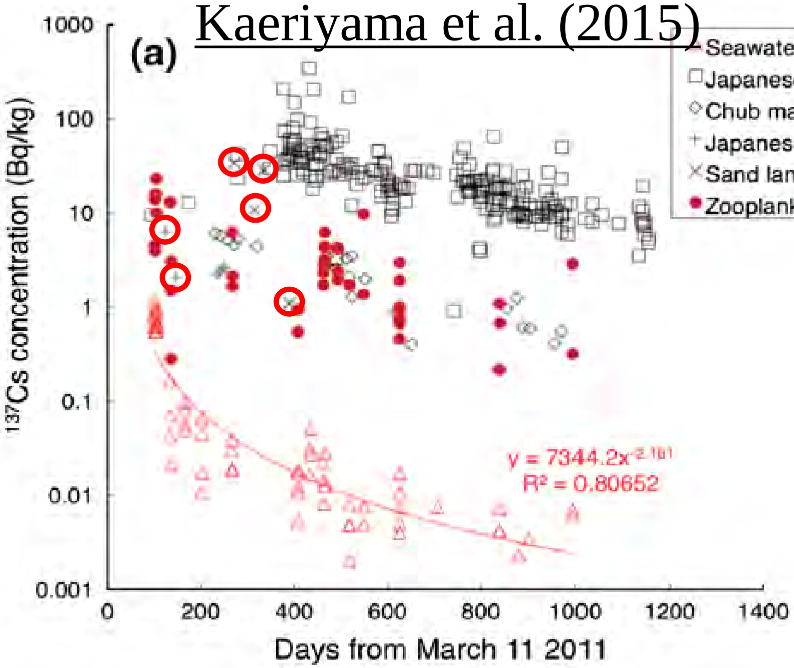




Background information (Cs in foods)

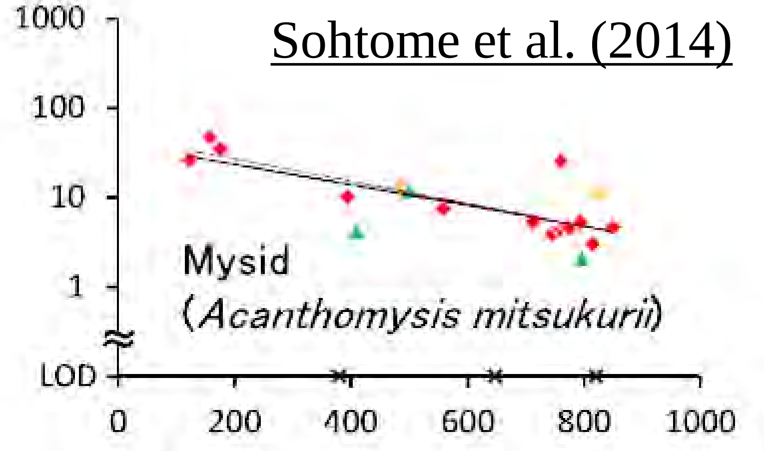
Baitfish (Sendai Bay)

Kaeriyama et al. (2015)



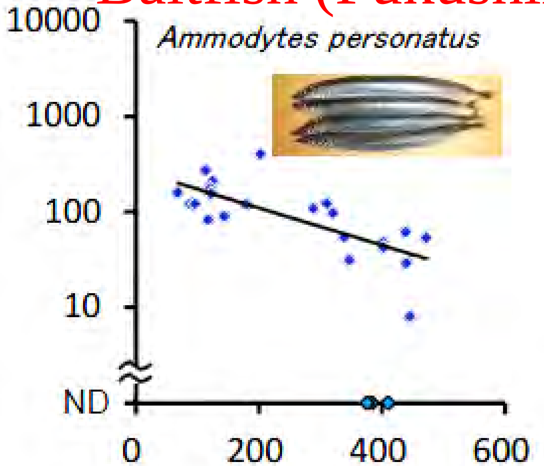
Mysids (Fukushima)

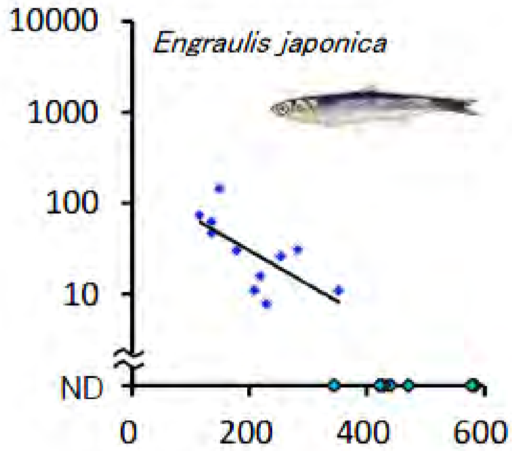
Sohtome et al. (2014)



Baitfish (Fukushima)

Wada et al. (2013)





Mostly < 100 Bq/kg-wet

Background information (contributions of seawater and foods to Cs in the flounder)

Seawater: ×23～35

Baitfish: ×1.2～1.6

Observed (maximum)

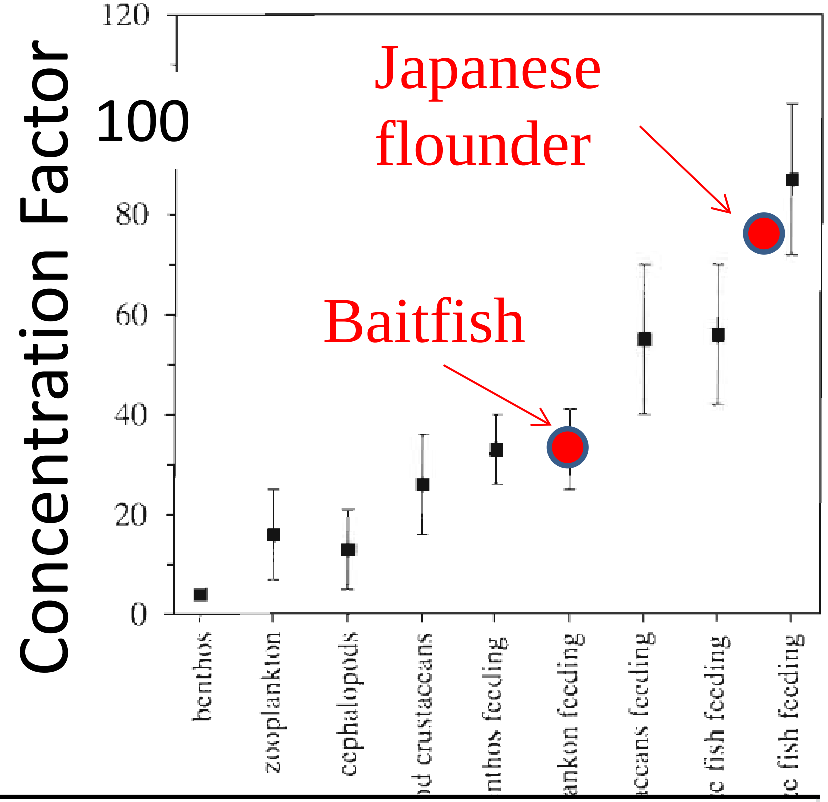
Seawater: 10 ～ 1,000 Bq/L

→ 230 – 35,000 Bq/kg-wet

Baitfish: < 100 Bq/kg-wet

→ 120 – 160 Bq/kg-wet

Kasamatsu & Ishikawa (1997)



Sources	CF	Ratio of contribution（W : F)			
		1:1		1:2	
			Accumuration		Accumuration
Seawater (W)	1	35	×35	23	×23
Food (F)	30	35	× 1.2	47	× 1.6
Flounder	70	70		70	

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Baitfish: ×1.2～1.6

Expectations

Large variation among individuals

Quick increase followed by quick decrease of Cs

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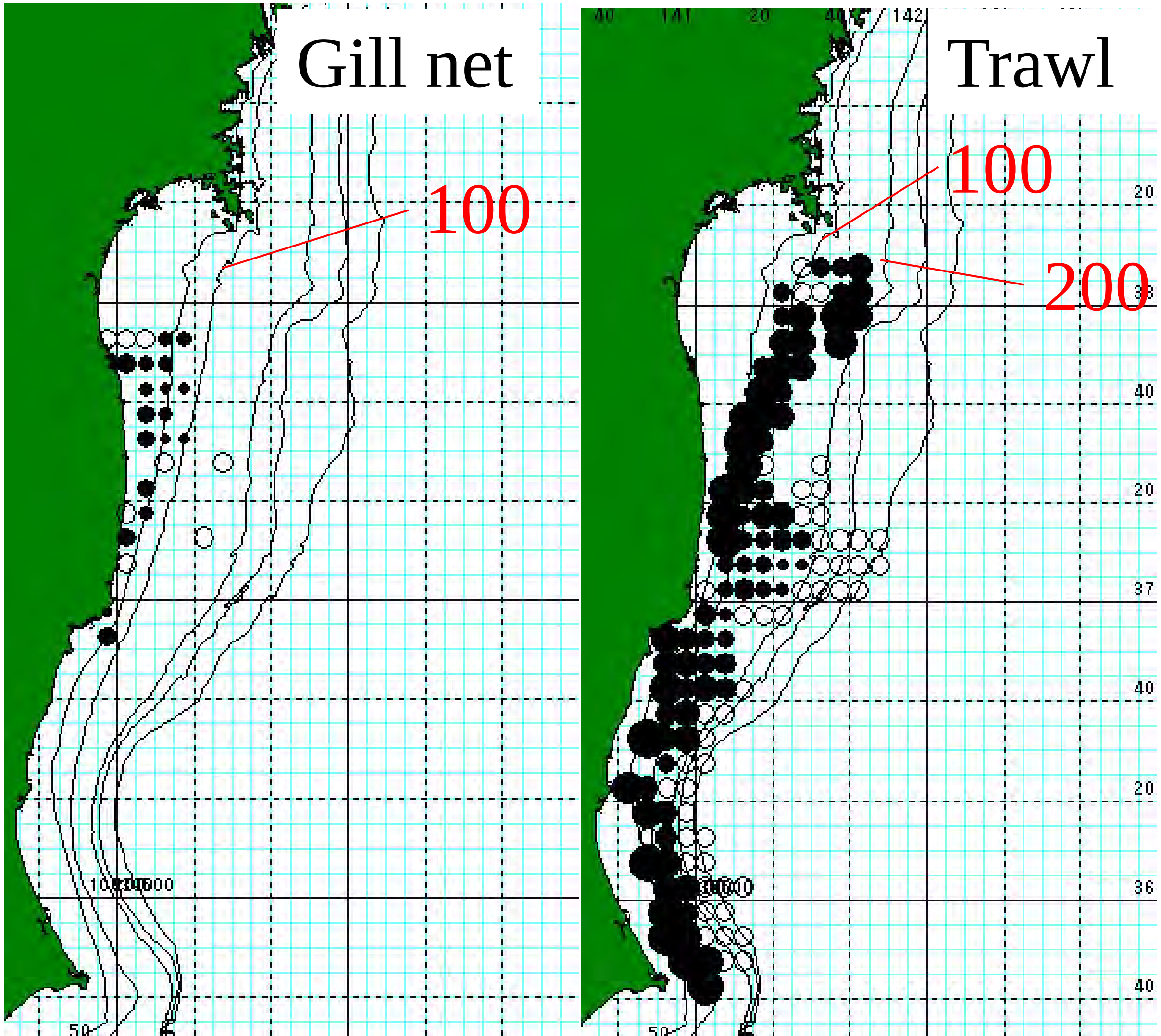
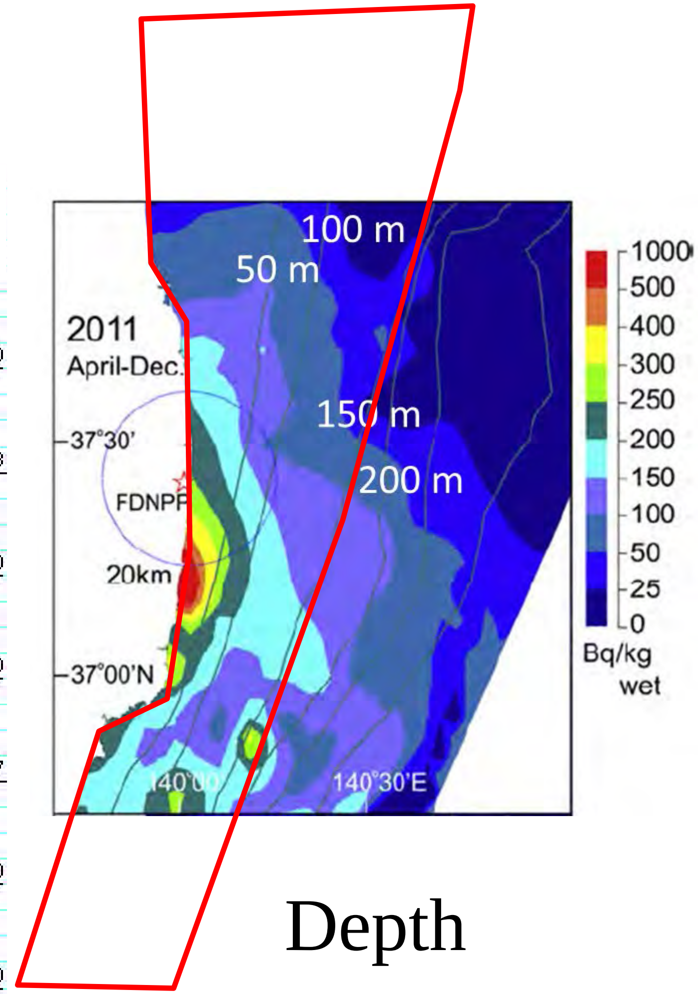
Distribution of Japanese flounder

2008 March

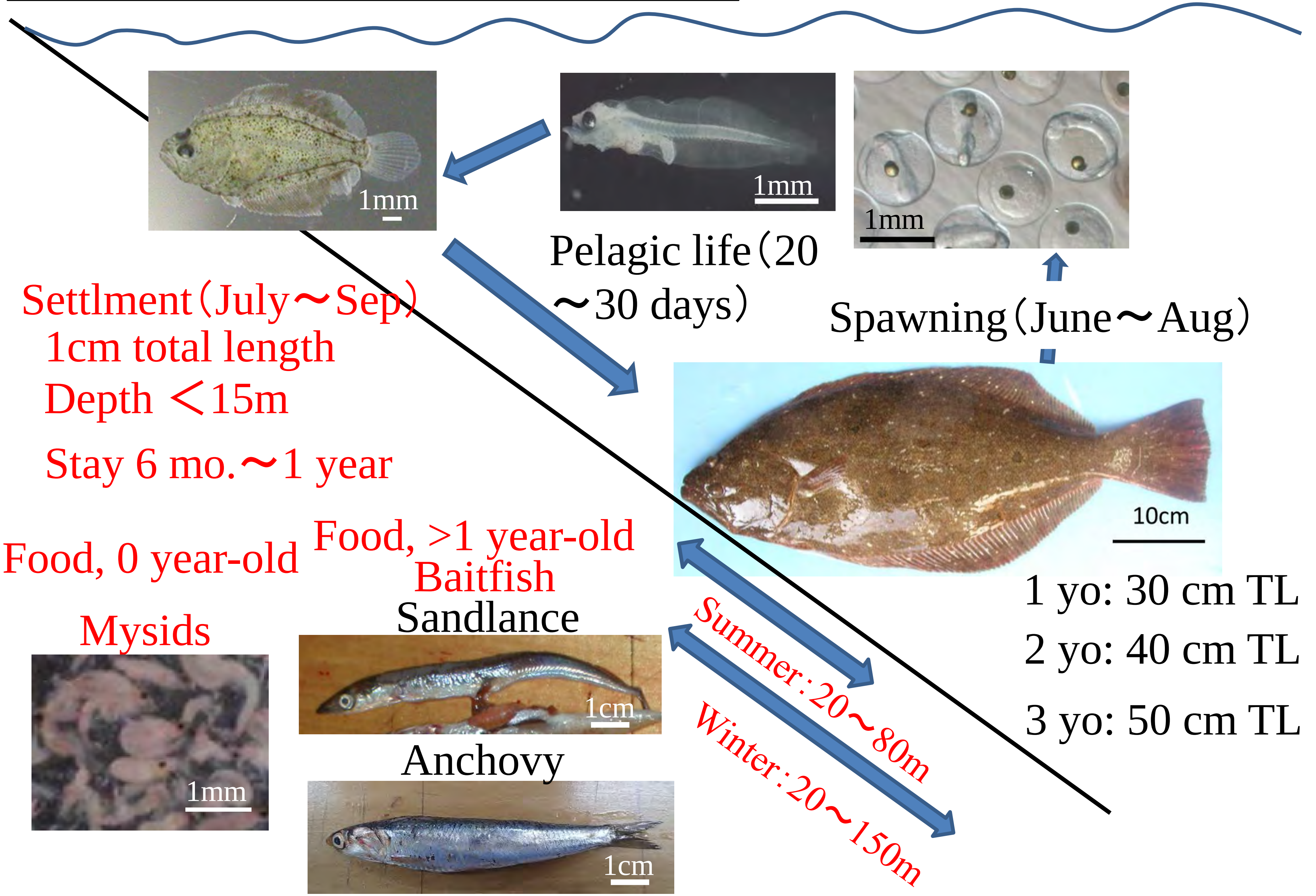




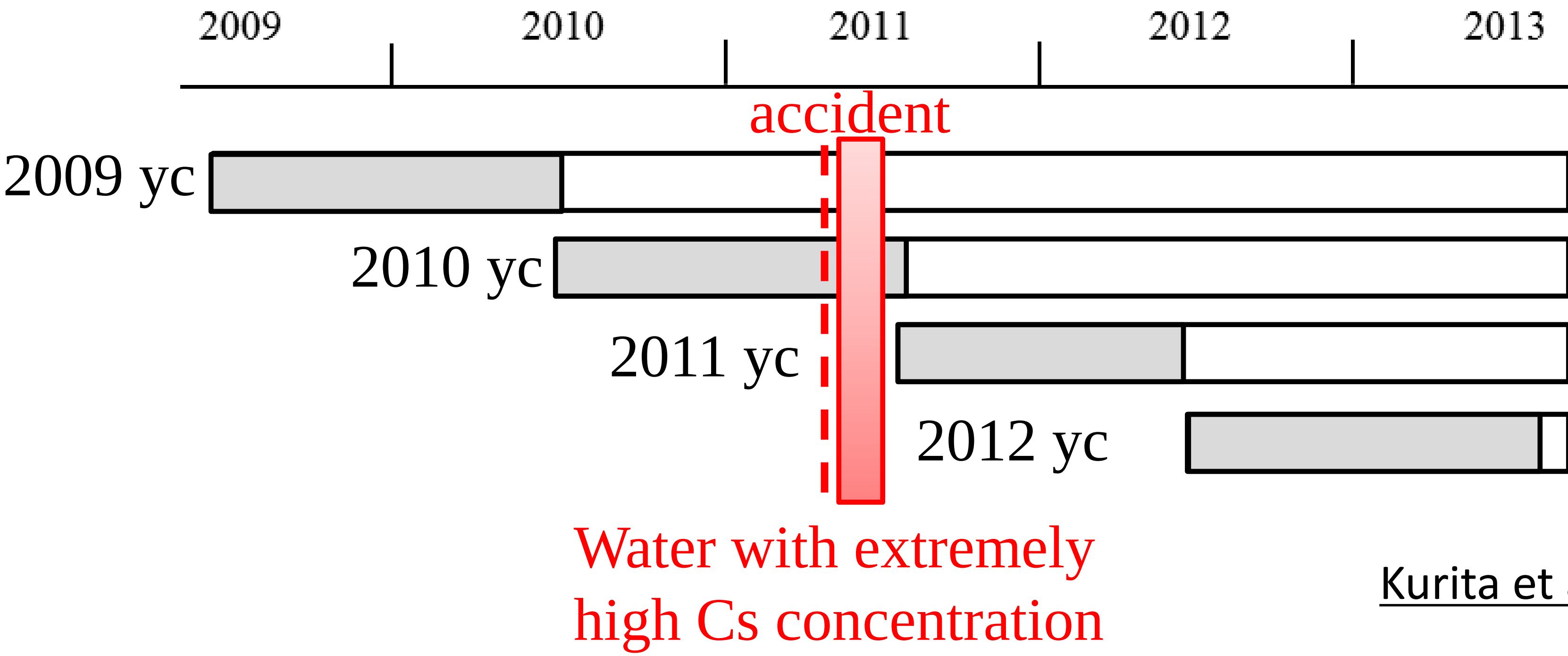
Depth

0 ― 150 m

Life history of Japanese flounder



Timing of the accident and life history of the flounder by year class



Kurita et al. (2015)

	Age	Distribution	Food
(grey bar)	0 year-old	0 ～ 30 m	Mysids
(white bar)	1 year-old and older	0 ～ 150 m	Baitfish

Expectations

Different sources will induce different occurrence of Cs concentrations

Two sources

1. Water with extremely high Cs between Mar and Apr 2011

    Earlier peak and large variation in Cs concentration among individuals

    Different concentration in fish body among year-classes

2. Food

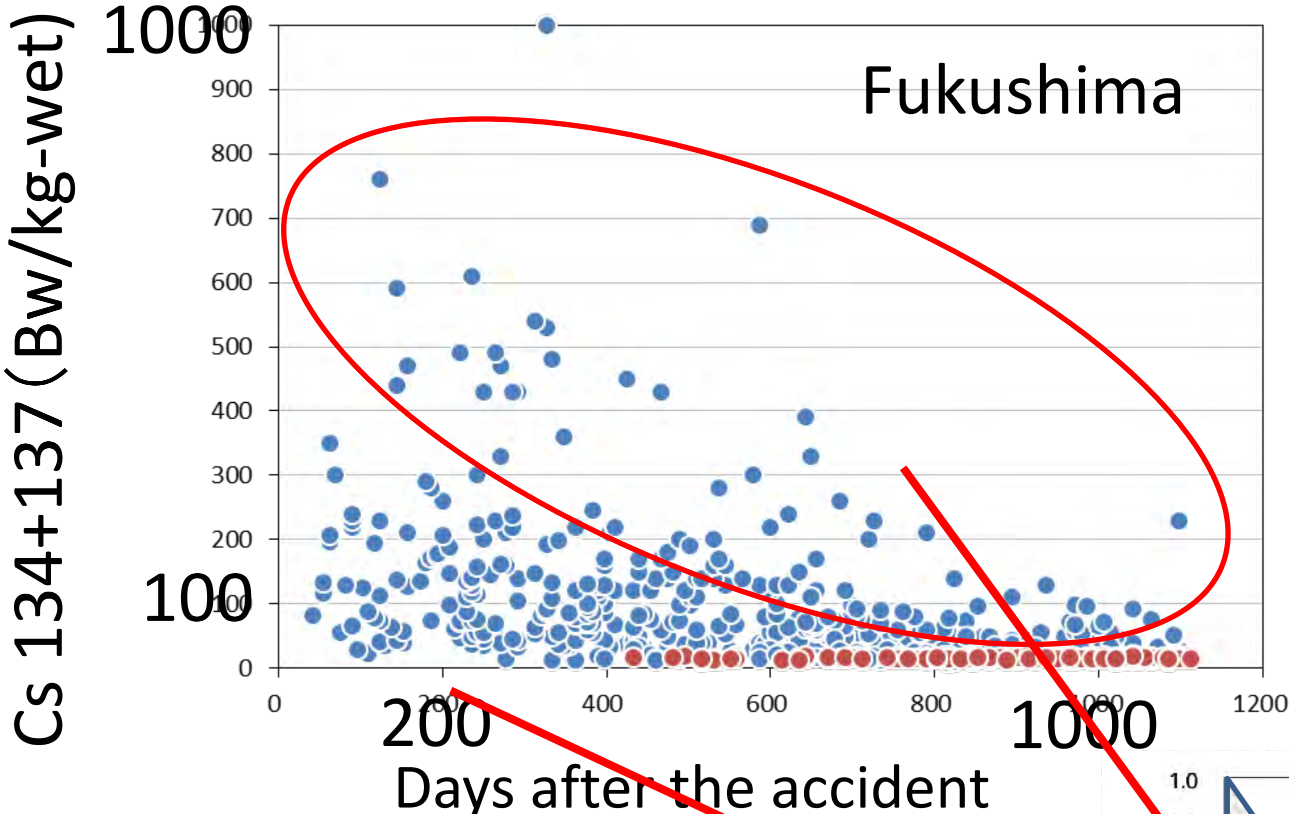
    Later peak (around 6 months after the accident, cf. Japanese see bass after the Chernobyl accident)

We examined the expectations with the following data to test the concept of two main contamination histories.

Data sources

1. Monitored data by local governments
2. Analysis of Cs concentration by year class
3. Simulation

Monitored Cs data off Fukushima



Kurita et al. (2015)

Large variation among individuals

Quick increase followed by quick decrease of Cs

Later peak (around 6 months after the accident)

This accident

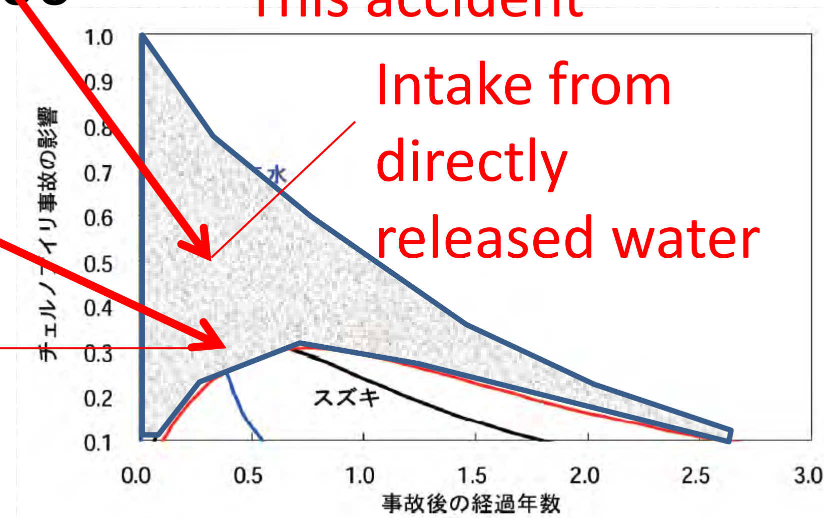
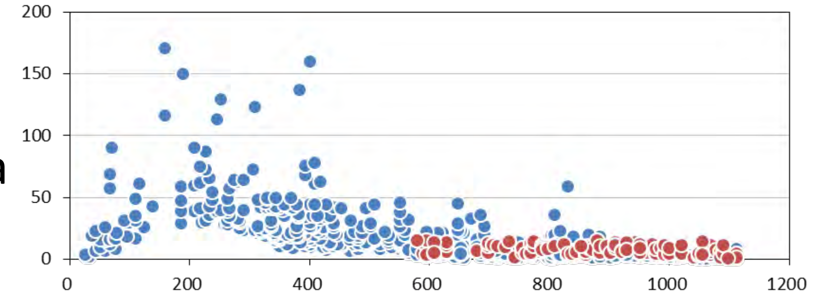


図3　チェルノブイリ事故の影響の比較：平常値を差し引いた値の推移

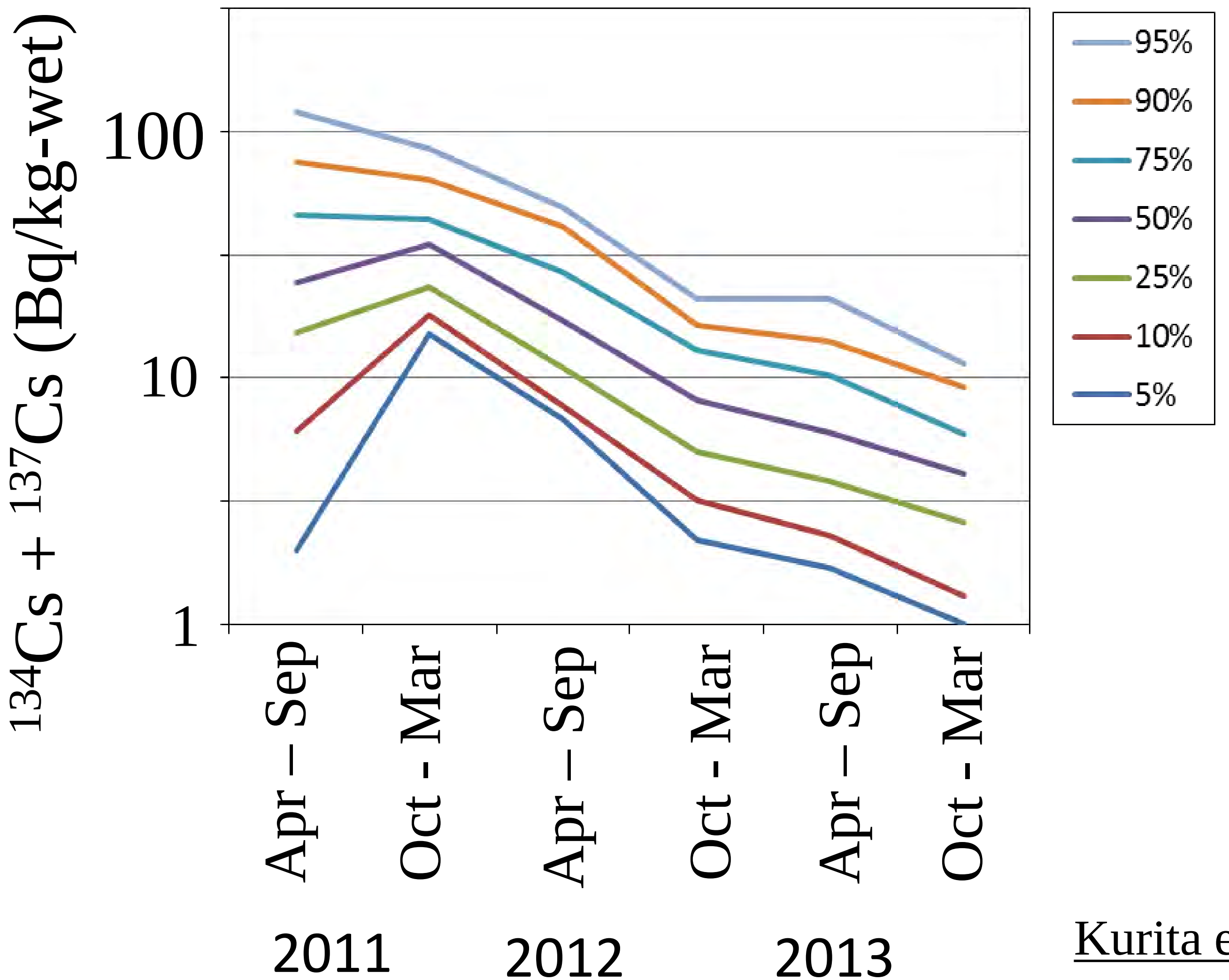
Accumulation through food web

Monitored Cs data off Ibaragi*

* Neighbor prefecture in the south of Fukushima



Percentiles of Cs concentrations



Kurita et al.(2015)

Monitored Cs data off Ibaragi

Percentiles of Cs concentrations

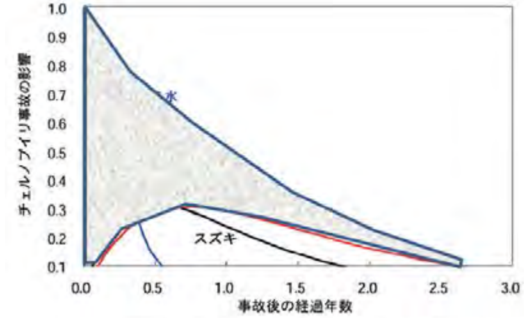
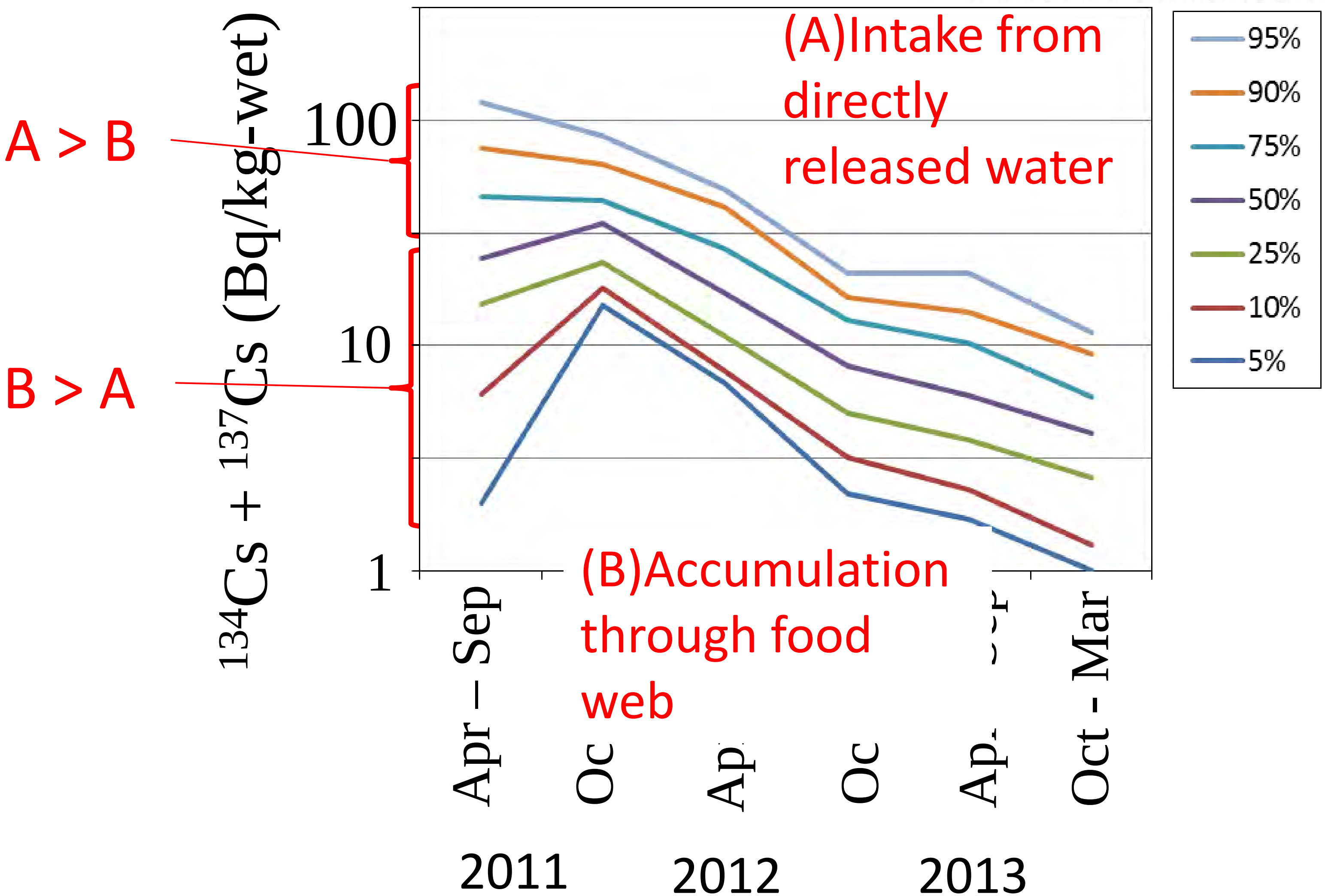
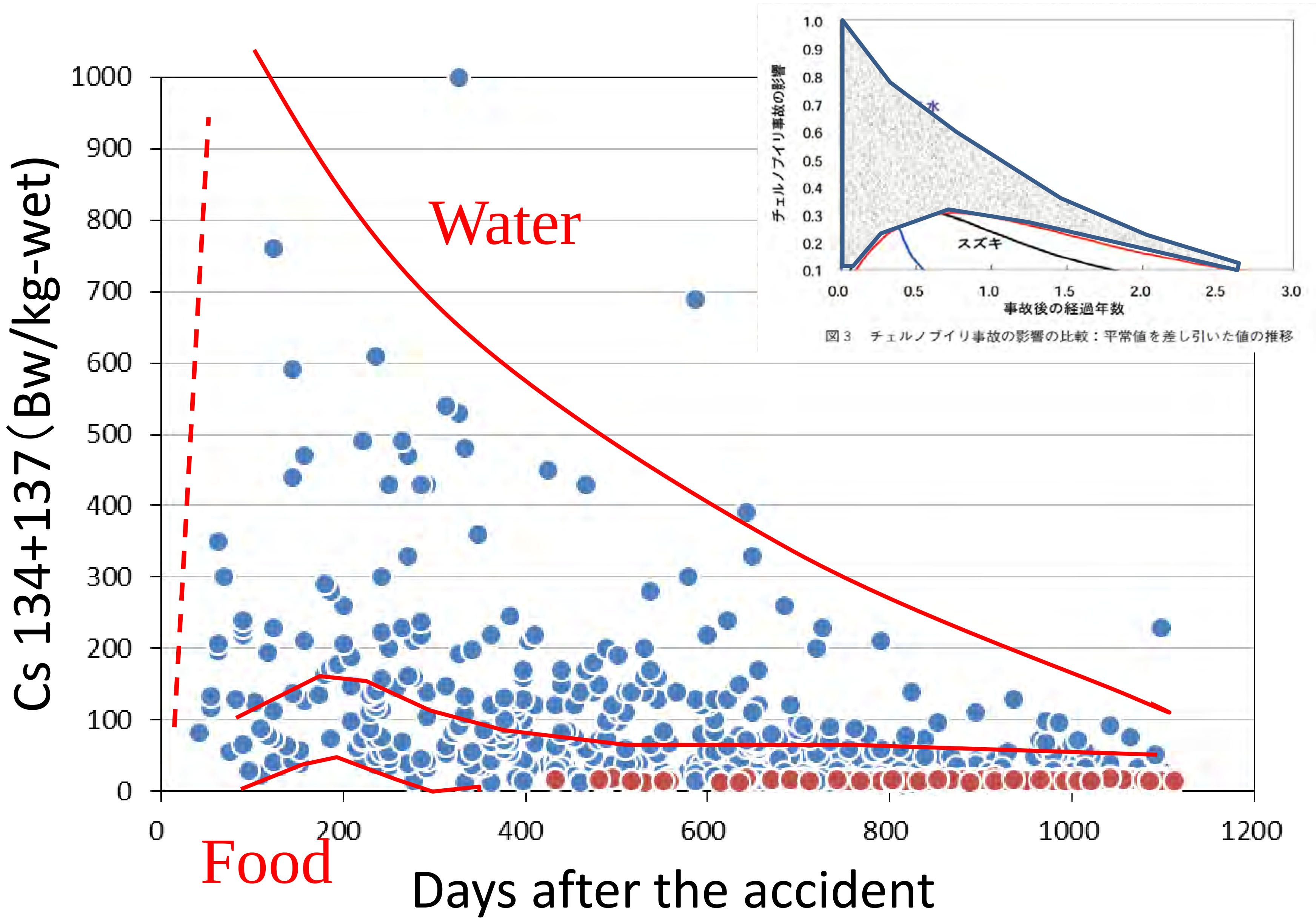


図3　チェルノブイリ事故の影響の比較：平常値を差し引いた値の推移

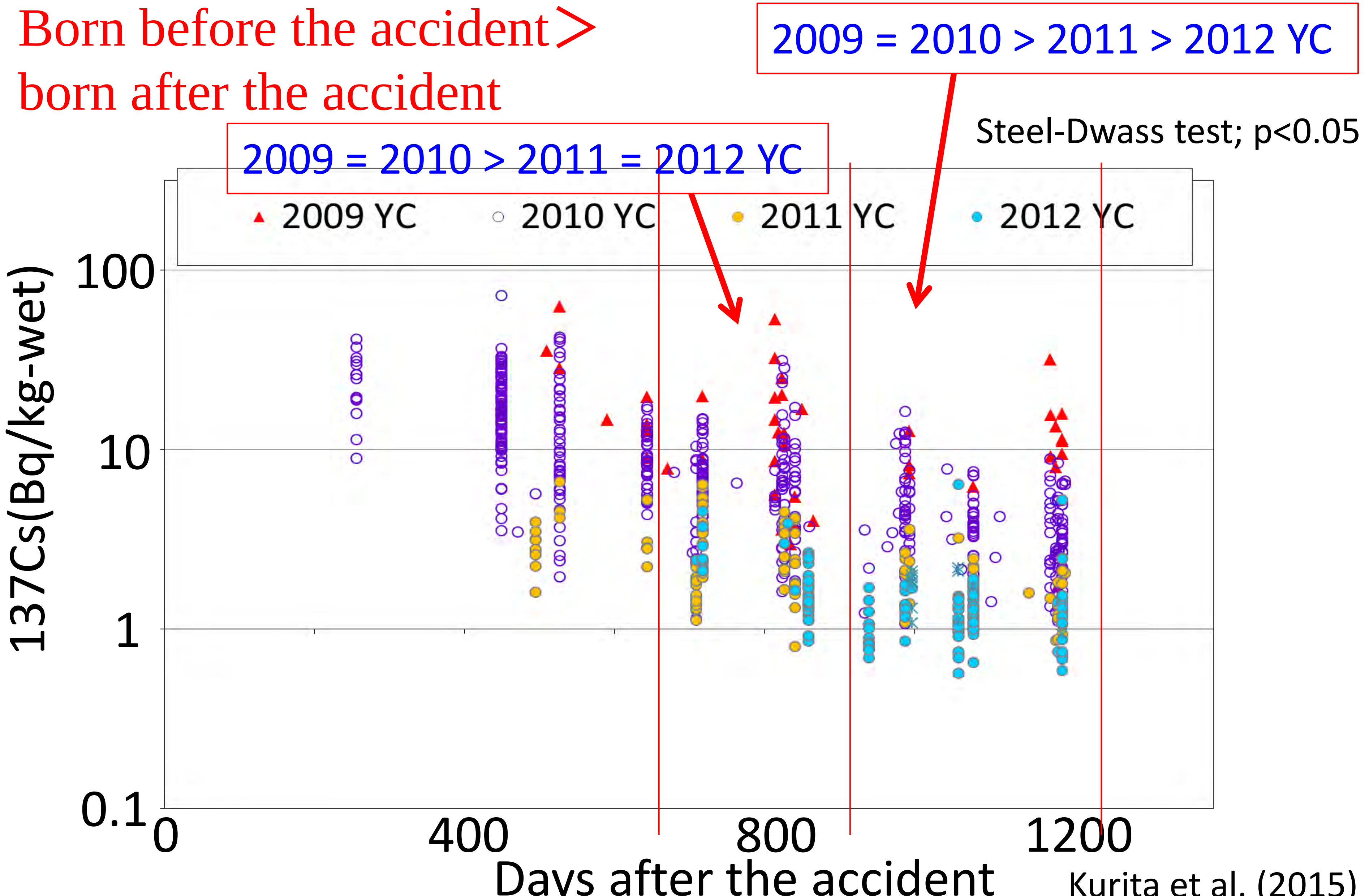


Monitored Cs data off Fukushima



Different Cs concentrations by year class in Sendai Bay

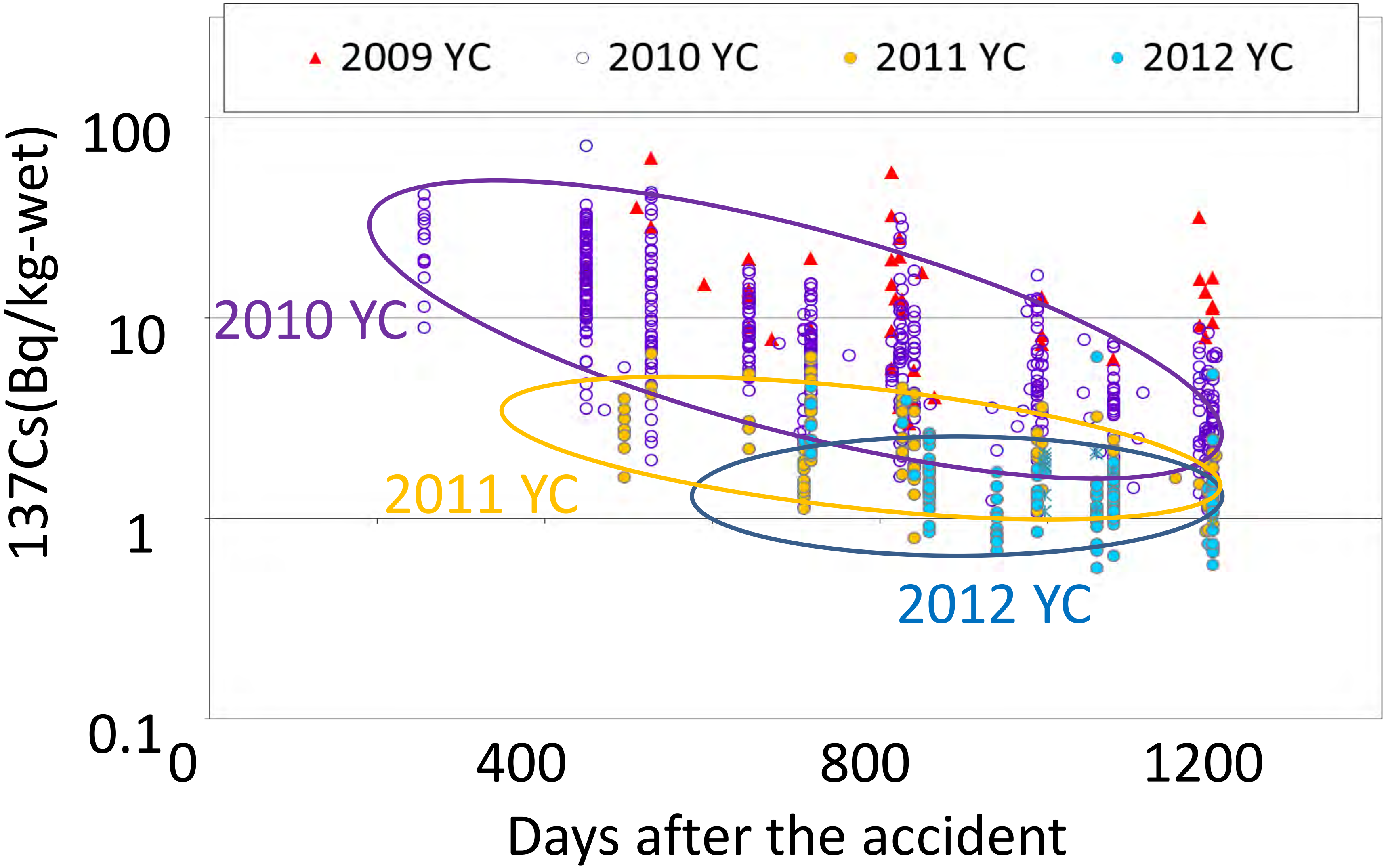
Born before the accident > born after the accident



Kurita et al. (2015)

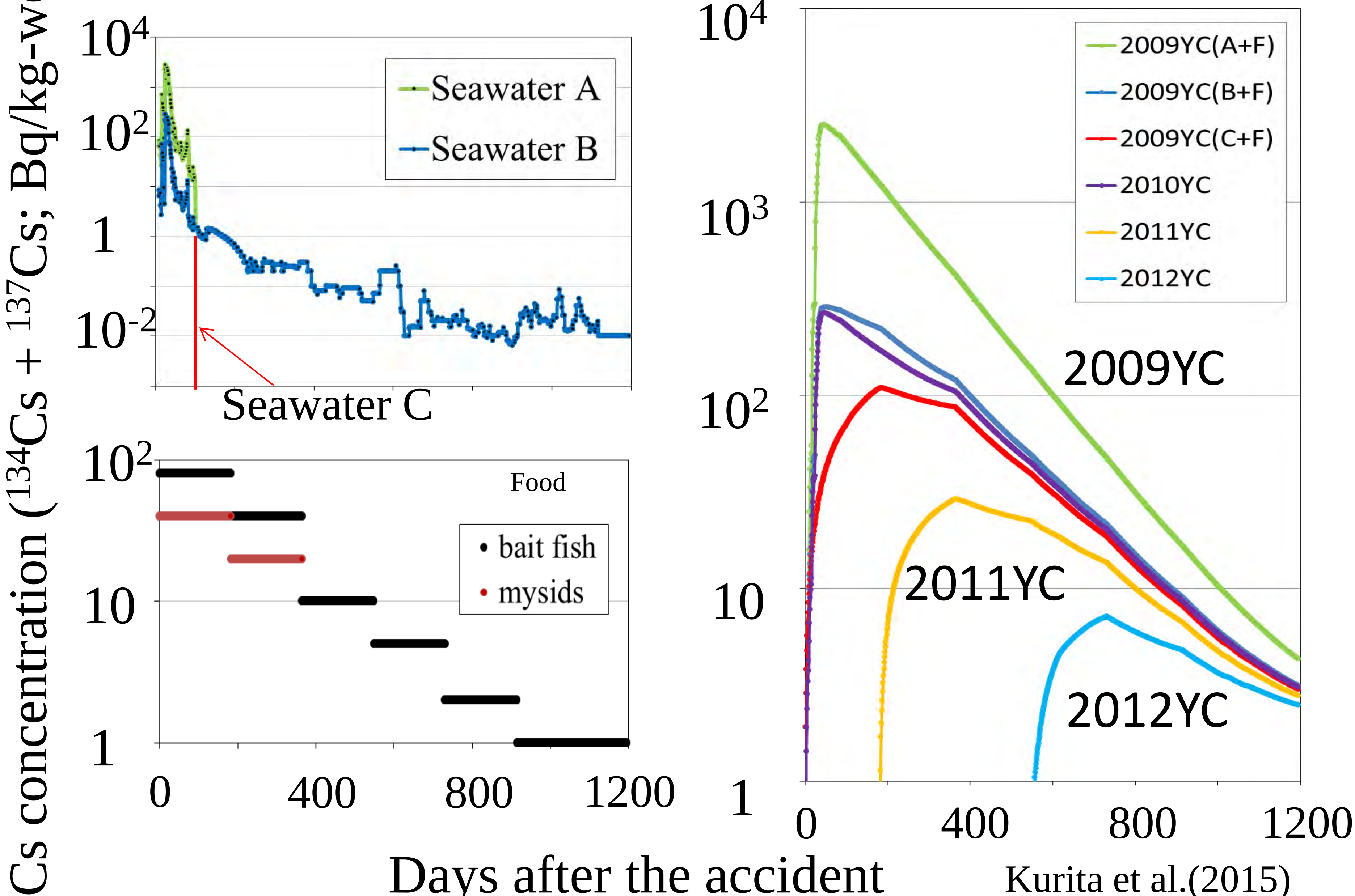
Different Cs concentrations by year class

Different concentration in fish body among year-classes



Simulation

Simulation: $\Delta Cb/\Delta t = aCw + bCf - cCb$



Kurita et al.(2015)

Simulation

Quick increase followed by quick decrease of Cs

simulated

184th day
109 Bq

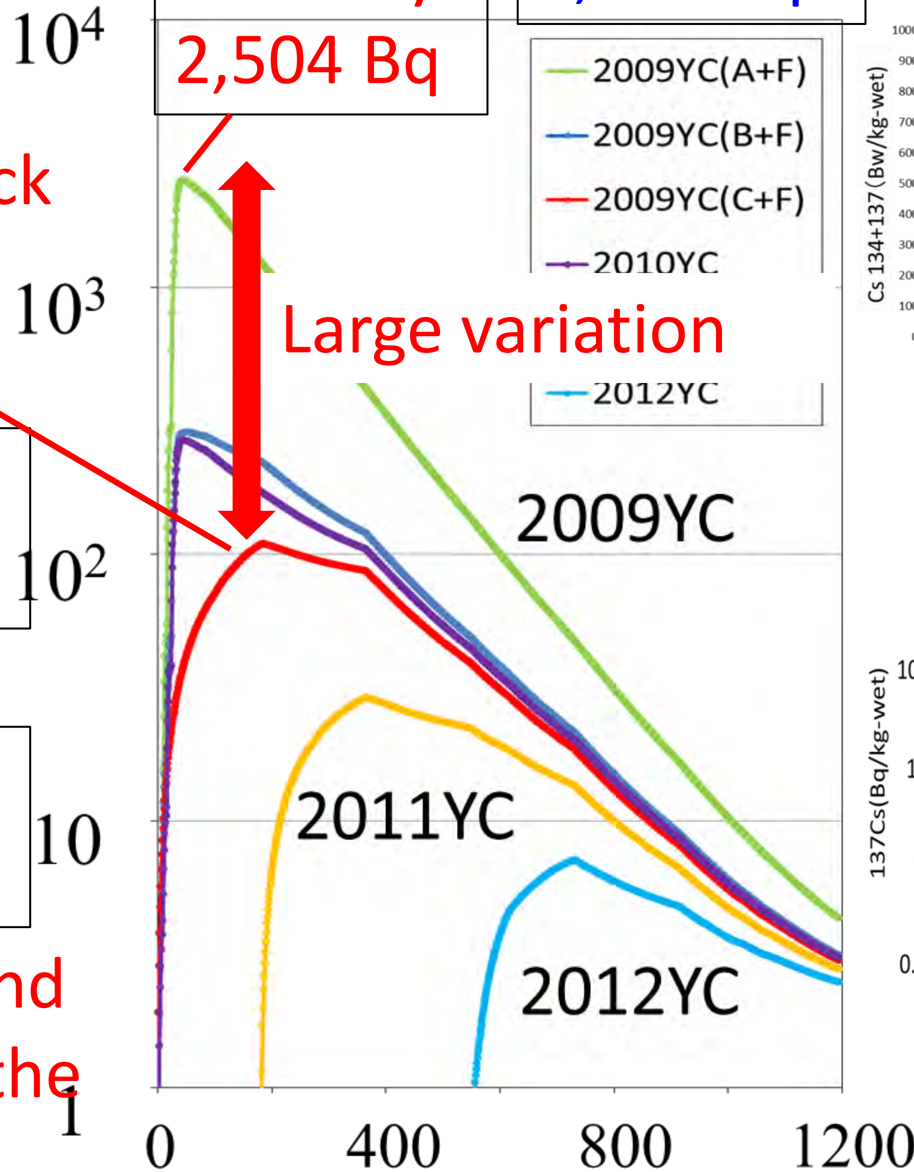
observed

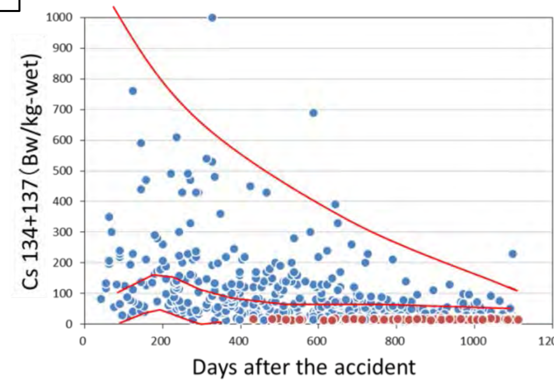
200th day
80 Bq

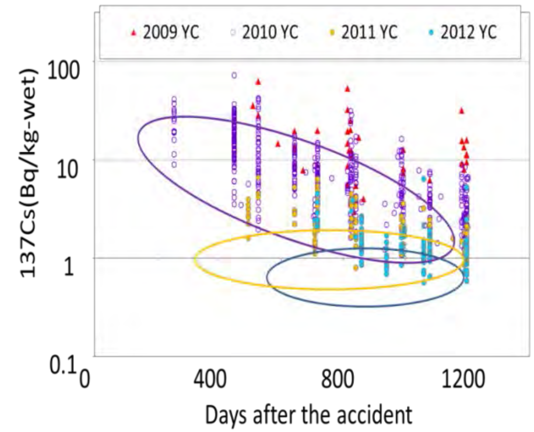
Later peak around 6 months after the accident

43rd day
2,504 Bq

4,500 Bq







Different among year classes

Kurita et al.(2015)

Summary

Two contamination histories were revealed.

1) Directly released water with extremely high contamination for a few months after the accident

2) Foods with relatively low concentration for a long time

Observed data and simulation studies supported the concept.

1. Water with extremely high Cs between Mar and Apr 2011

   Earlier peak (sim.) and large variation (obs. & sim.)in Cs concentration among individuals

   Different concentration in fish body among year-classes (obs. & sim.)

2. Food

   Later peak (around 6 months after the accident (obs. & sim.))