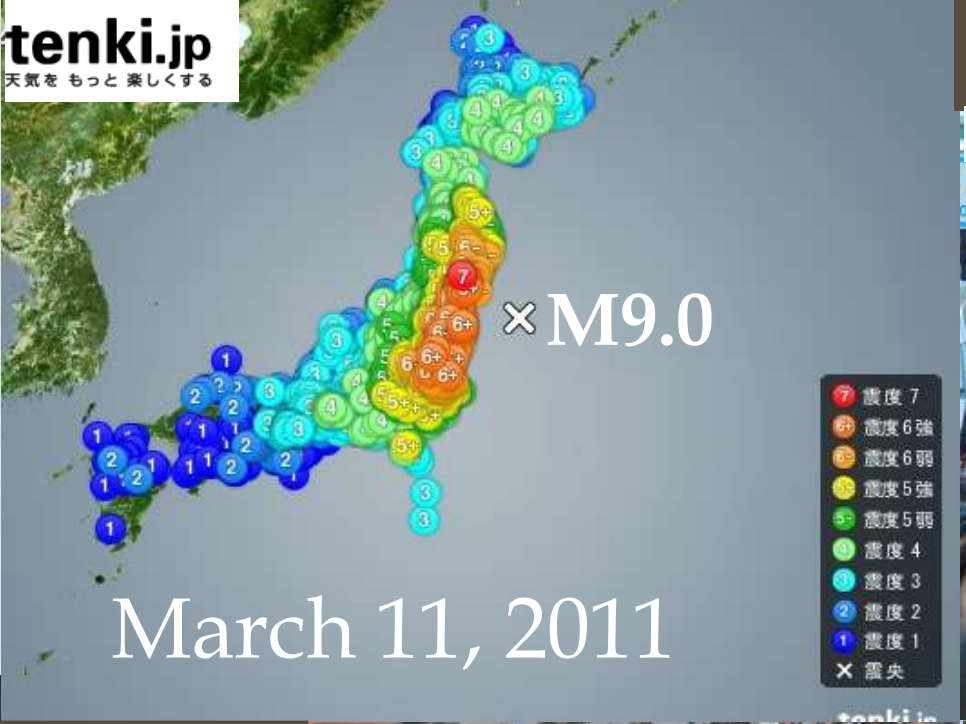
RADIOACTIVE CONTAMINATION OF NEST MATERIAL DUE TO THE FUKUSHIMA NUCLEAR ACCIDENT IN PASSERINE BIRDS

Matsui S[1], Kasahara S[1], Morimoto G[1], Mikami OK[2], Watanabe M[3], Ueda K[1]

1 Rikkyo Uni, 2 Iwate- Medical Uni , 3 Tsukuba Uni

OUTLINE

- Fukushima Nuclear Accident
- Contamination of nest material in the Tree Sparrows in 2011 & 2012
- Comparison of contamination of nest material between Tree Sparrows and Great Tits in 2012

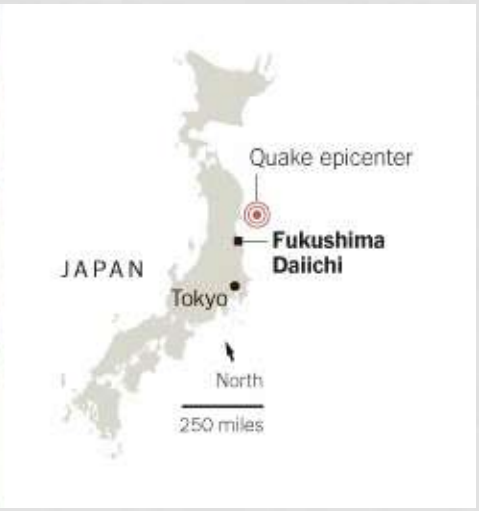

tenki.jp
天気を もっと 楽しくする
×M9.0
震度 7
震度 6強
震度 6弱
震度 5強
震度 5弱
震度 4
震度 3
震度 2
震度 1
震央
March 11, 2011


Tokyo
日本経済新聞


Chiba
日本経済新聞


Tohoku
日本経済新聞

Fukushima Daiichi Nuclear Accident

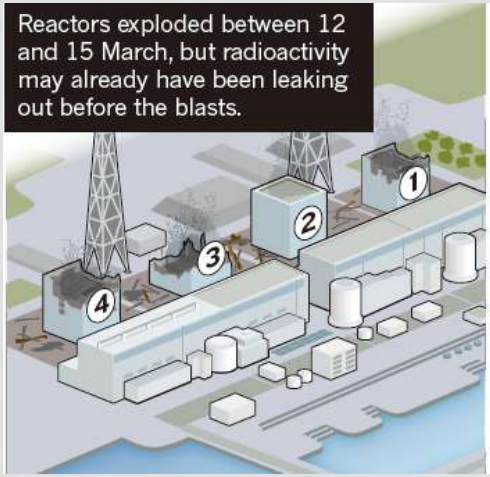


Explosion of Reactor #3 on 14 March

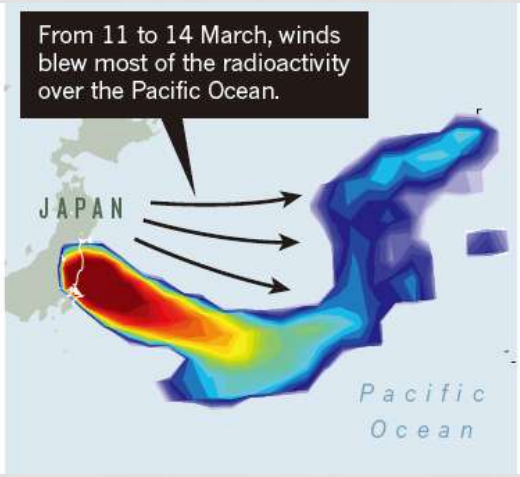
Reactors on 15 March

FUKUSHIMA NUCLEAR ACCIDENT IN MARCH 2011

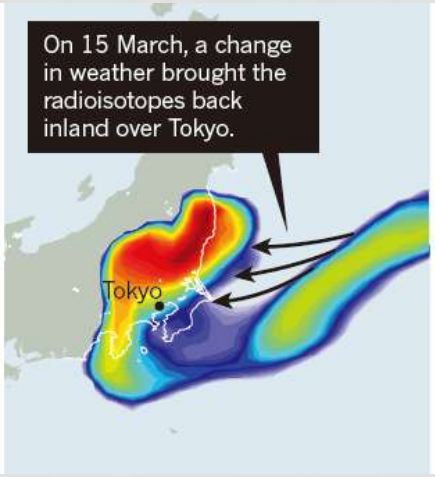
Tohoku Region Pacific Coast Earthquake & a substantial tsunami on 11 Mar 2011.



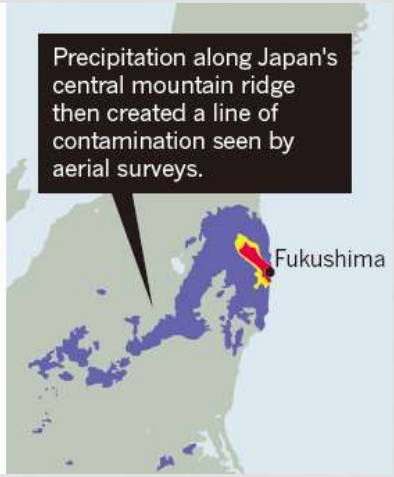
Mar 12 - 15



Mar 11 - 14



Mar 15



After Mar 15

Brumfiel (2011) Nature 478: 435-436.

26 Aug, 2011

Amount of isotopes releasing into the atmosphere

Accident	Hiroshima bomb	Fukushima
Type of isotopes	16	31

University of South Carolina

UNIVERSITÉ PARIS SUD
Comprendre le monde, construire l'avenir®

IRSN
INSTITUT DE RADIOPROTECTION ET DE SÛRETÉ NUCLÉAIRE

Tree Sparrows

Great Tits

RIKKYO UNIVERSITY 立教大学

筑波大学 University of Tsukuba

from 2011- 2012

OUTLINE

- Fukushima Nuclear Accident
- Contamination of nest material in the Tree Sparrows in 2011 & 2012
- Comparison of contamination of nest material between Tree Sparrows and Great Tits in 2012

EXPOSURE TO RADIATION IN NEST

Tree Sparrows

External dose of

eggs & nestlings in

contaminated nests.

PURPOSE

Comparison of radiation

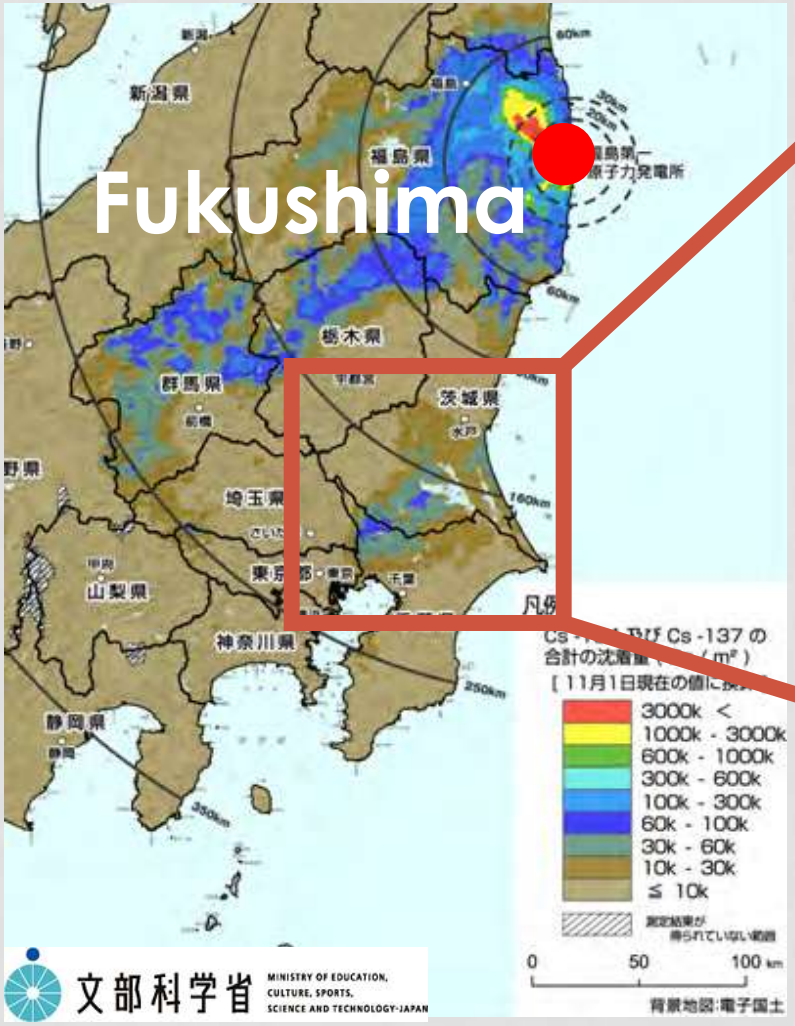
levels in nest-boxes in

Tree Sparrows between 2011 & 2012.

HYPOTHESIS

Radioactive particles released from the Fukushima nuclear accident fell on grasslands, in which Tree Sparrows collected their nesting materials.

STUDY SITES



Ibaraki (175 km SW)
Tokyo (222 km SW)

PREDICTIONS

(1) Level of contamination in nest-boxes would be greater in Ibaraki compared with Tokyo.

(2) Level of contamination in nest-boxes would be greater in 2011 compared with 2012.

(3) Level of contamination in nest-boxes would be positively related to nest weight.

METHODS

- **Total 44 nest-boxes at Ibaraki & Tokyo in 2011 & 2012**
- **Measurement of dose rate (μGy/h, Geiger Counter)**

  19 times at 10 sec intervals over a 3 min period

  at 1cm above inner surface of nest cup.
- **Collect & weigh the nest materials (g)**

Checking precision

Measurement of Cs concentration (Bq/kg, Ge detector)

"μGy/h" & "Bq" in nest (Spearman $r = 0.73$, $P < 0.001$, n=19)

STATISTICS

Initial model

Dose rate inside nest-boxes (µGy/h) ~ Nest Weight(N)+Site(S)
+Year(Y)+N:S+N:Y+S:Y

Site(Ibaraki, Tokyo)

Year(2011, 2012)

Contamination Levels in Nest-boxes

Best model

Dose rate inside nest-boxes (µGy/h) ~ Site(S)*+ Year(Y) + S:Y*

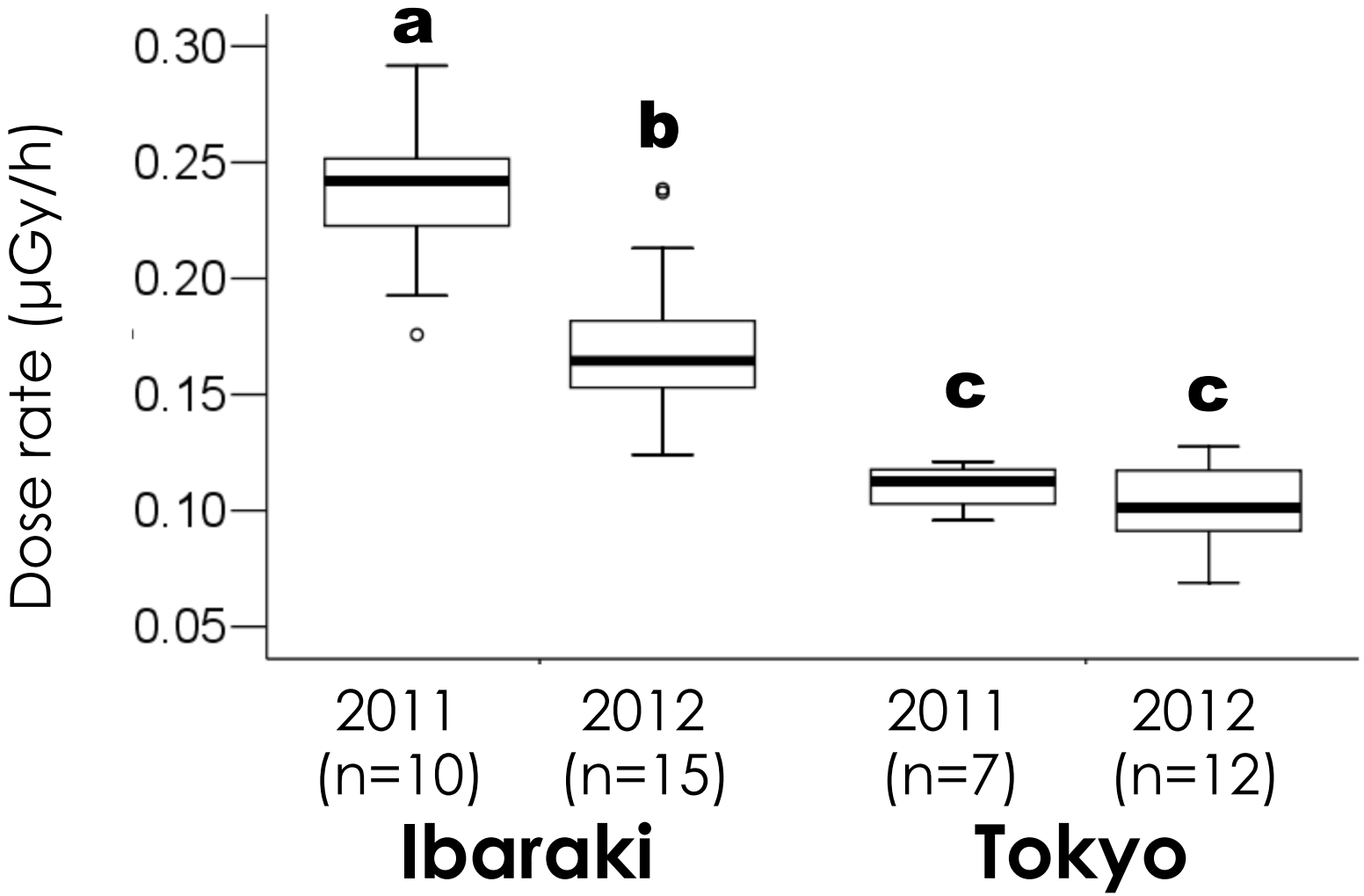
	Estimate
Site	0.07 *
Year	0.008
S:Y	0.06 *

GLM, family = Gaussian

Deviance = -0.118, P < 0.001

** coefficient is significant*

Contamination Levels in Nest-boxes

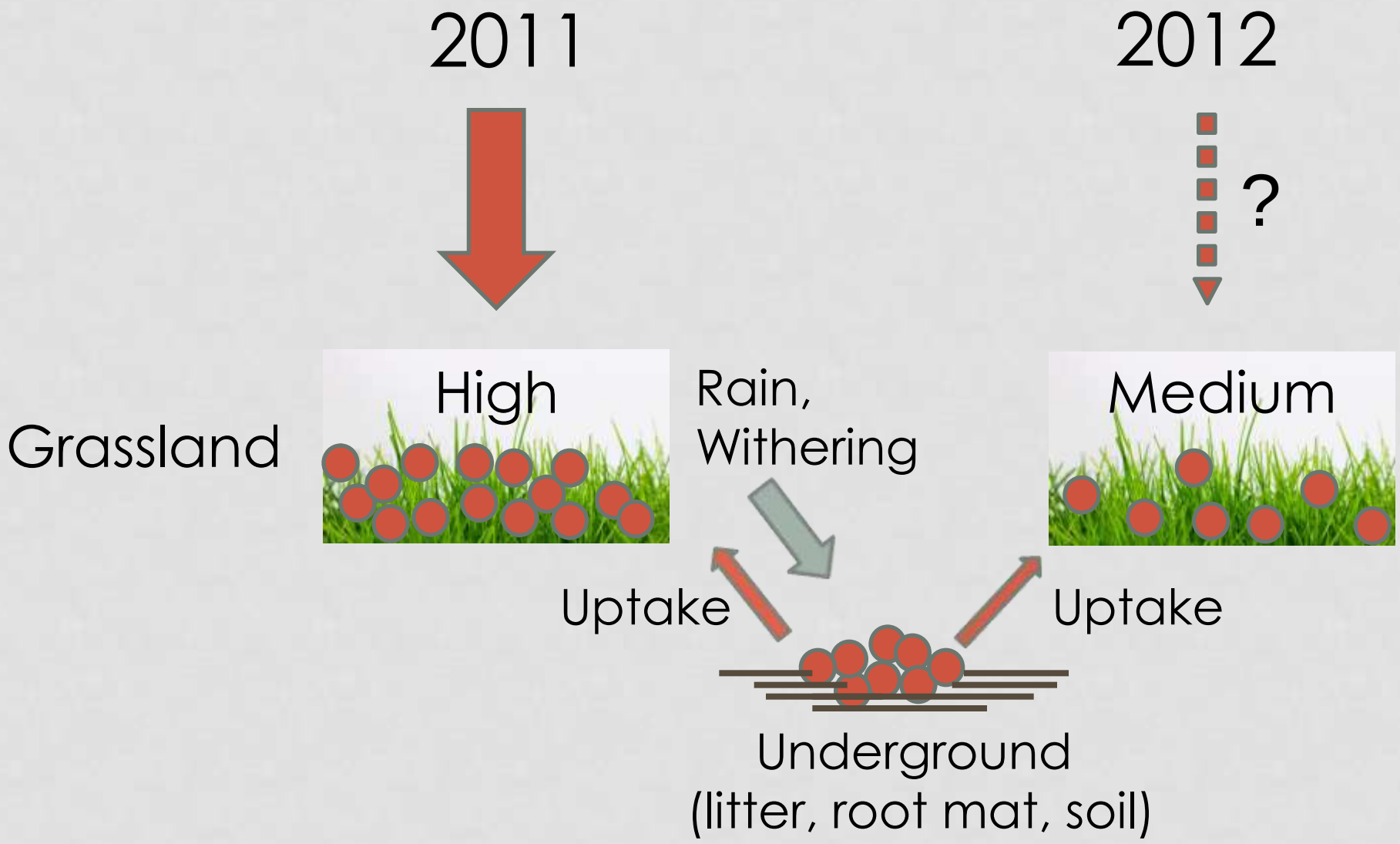


PREDICTIONS

- (1) Level of contamination in nest-boxes would be greater in Ibaraki compared with Tokyo.
- (2) Level of contamination in nest-boxes would be greater in 2011 compared with 2012.
- (3) Level of contamination in nest-boxes would be positively related to nest weight.

Ibaraki

● Radioactive fallout



Contamination Levels in Nest-boxes

- Cs concentration (Bq/kg) by Ge detector

  Ibaraki (n = 10) & Tokyo (n = 9) in 2012.

- The amount of Cs in nest-boxes (Bq)

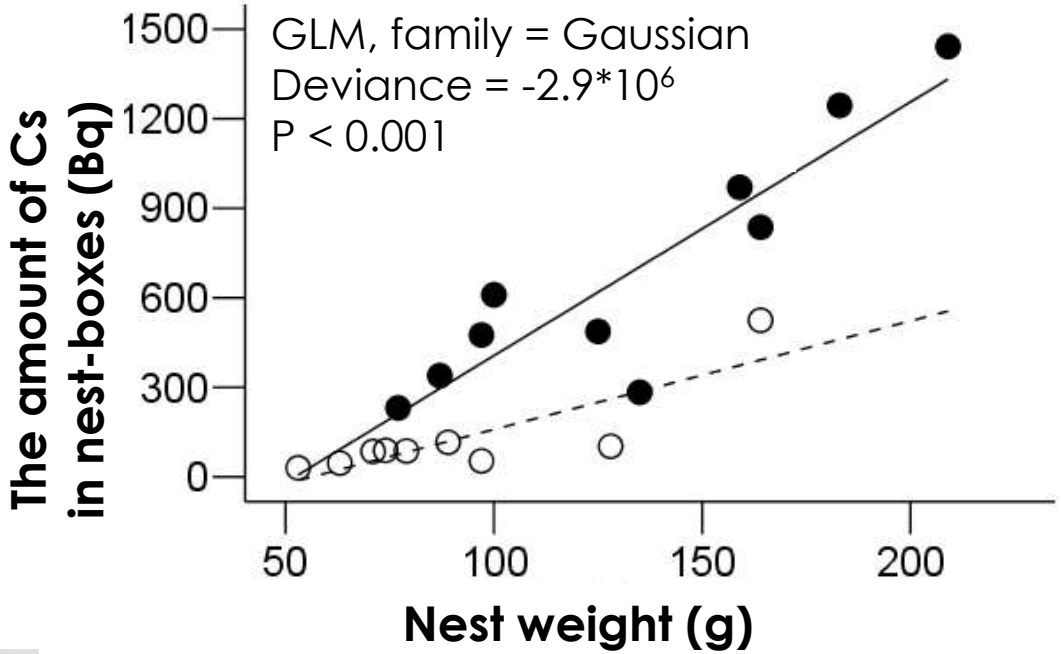
  = Cs concentration (Bq/kg) * Nest weight (g)/1000

- Model selection

  The amount of Cs in nest-boxes (Bq)

  ~ Nest weight (N) + Site (S) + N:S

Contamination Levels in Nest-boxes



- **Ibaraki**
- **Tokyo**

	Estimate
Nest weight	8.50 *
Site	239.0
N:S	-4.86 *

** coefficient is significant*

Nest contamination was positively related to nest weight.

PREDICTIONS

- (1) Level of contamination in nest-boxes would be greater in Ibaraki compared with Tokyo.
- (2) Level of contamination in nest-boxes would be greater in 2011 compared with 2012.
- (3) Level of contamination in nest-boxes would be positively related to nest weight.

✗ ***by Geiger Counter*** ○ ***by Germanium Detector***

SUMMARY 1

- Bird species could be more highly exposed to radiation in the breeding season directly after the nuclear accident than in the later seasons.
- The amount of radioactive contamination would be positively related to nest weight.

OUTLINE

- Fukushima Nuclear Accident
- Contamination of nest material in the Tree Sparrows in 2011 & 2012
- Comparison of contamination of nest material between Tree Sparrows and Great Tits in 2012

Great Tits

Open-cup shape
82 g (dry weight)

Tree Sparrows

Dome shape
113 g (dry weight)

STUDY SITES

Ibaraki (175 km SW)

Tree Sparrow (n =10)

Great Tit (n = 3)

Tokyo (222 km SW)

Tree Sparrow (n = 9)

Great Tit (n = 3)

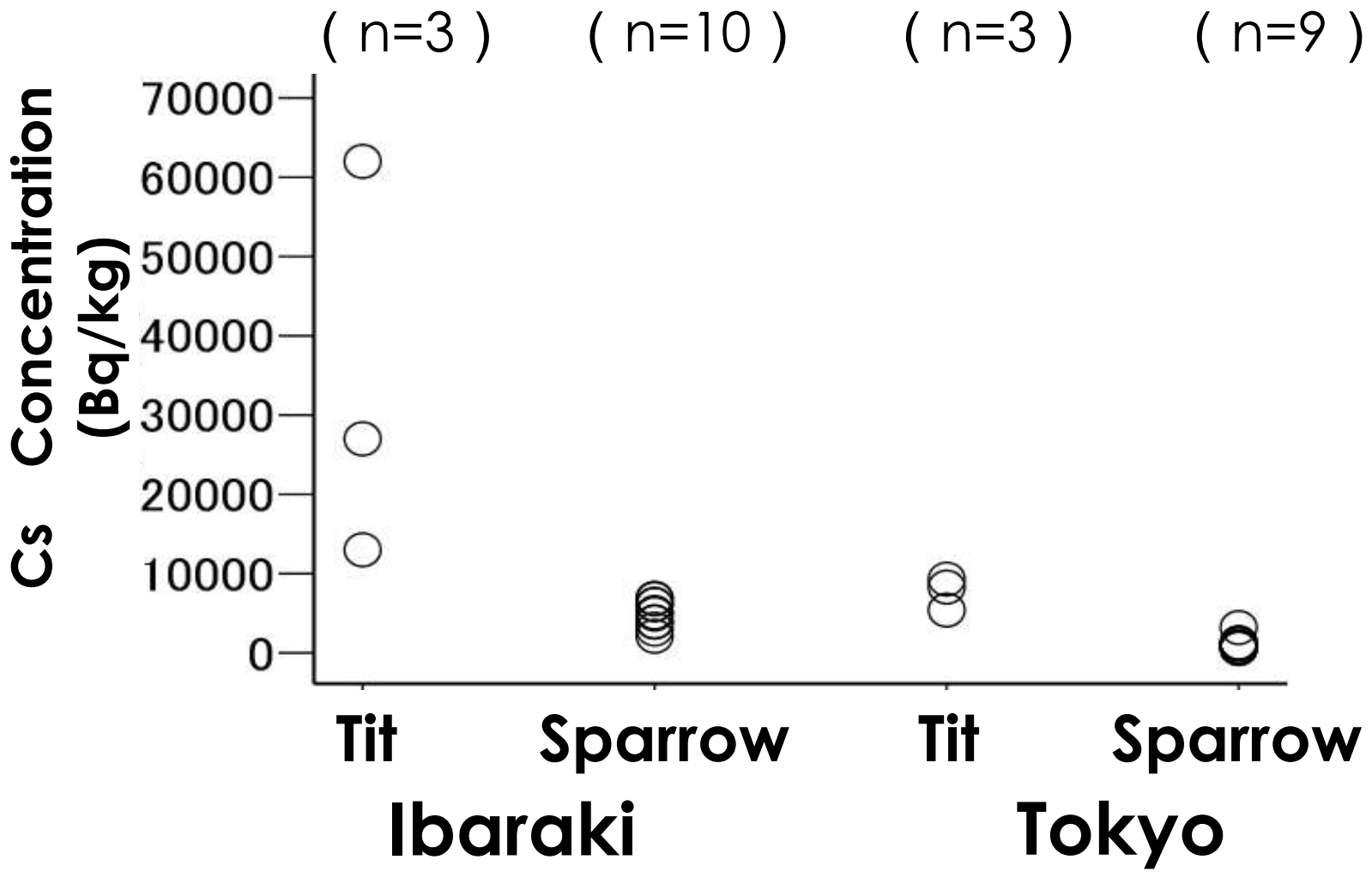
METHODS

- Measured the weight of nests (g・ dry)

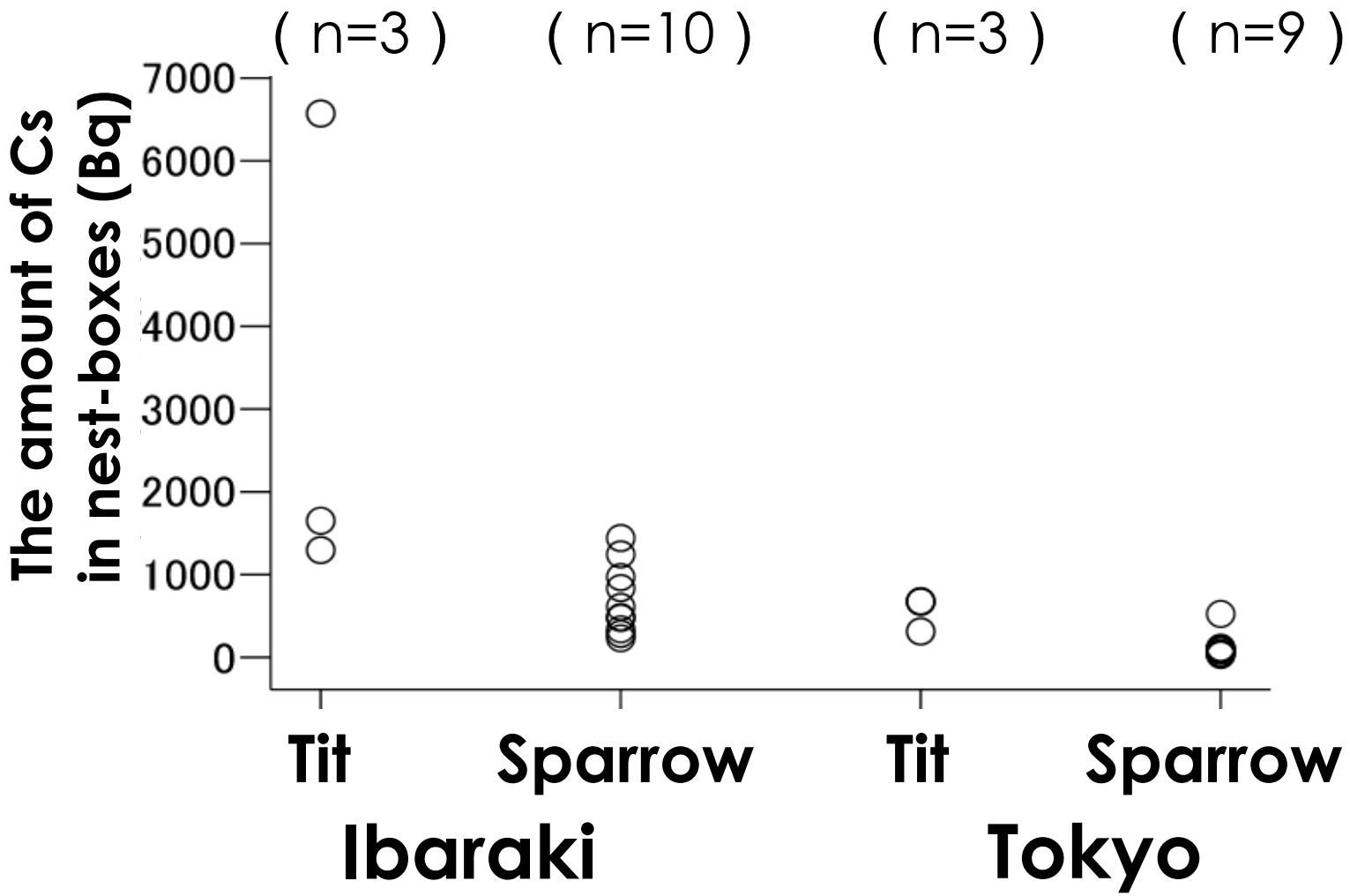
  after the breeding season of 2012.
- Cs concentration (Bq/kg) by Ge detector
- The amount of Cs in nest-boxes (Bq)

  = Cs concentration (Bq/kg) * Nest weight (g)/1000

CESIUM CONCENTRATION OF NEST MATERIALS



The AMOUNT OF CESIUM IN NEST-BOXES



SUMMARY 2

Moss tend to trap Cesium than dead grasses.

→ External doses to eggs and nestlings may be higher in nests consisted of moss than other type of materials.

Nestlings of Great Tit

FUTURE ISSUES

Estimate external dose of eggs and nestlings in high contaminated nests

Monitor physiological factors

FUTURE ISSUES

Movement of radionuclides through bioaccumulation

(e.g., Cs-134 and Cs-137)

ACKNOWLEDGEMENTS

This research is supported by

the J-RAPID Program of Japan Science and Technology Agency (JST).