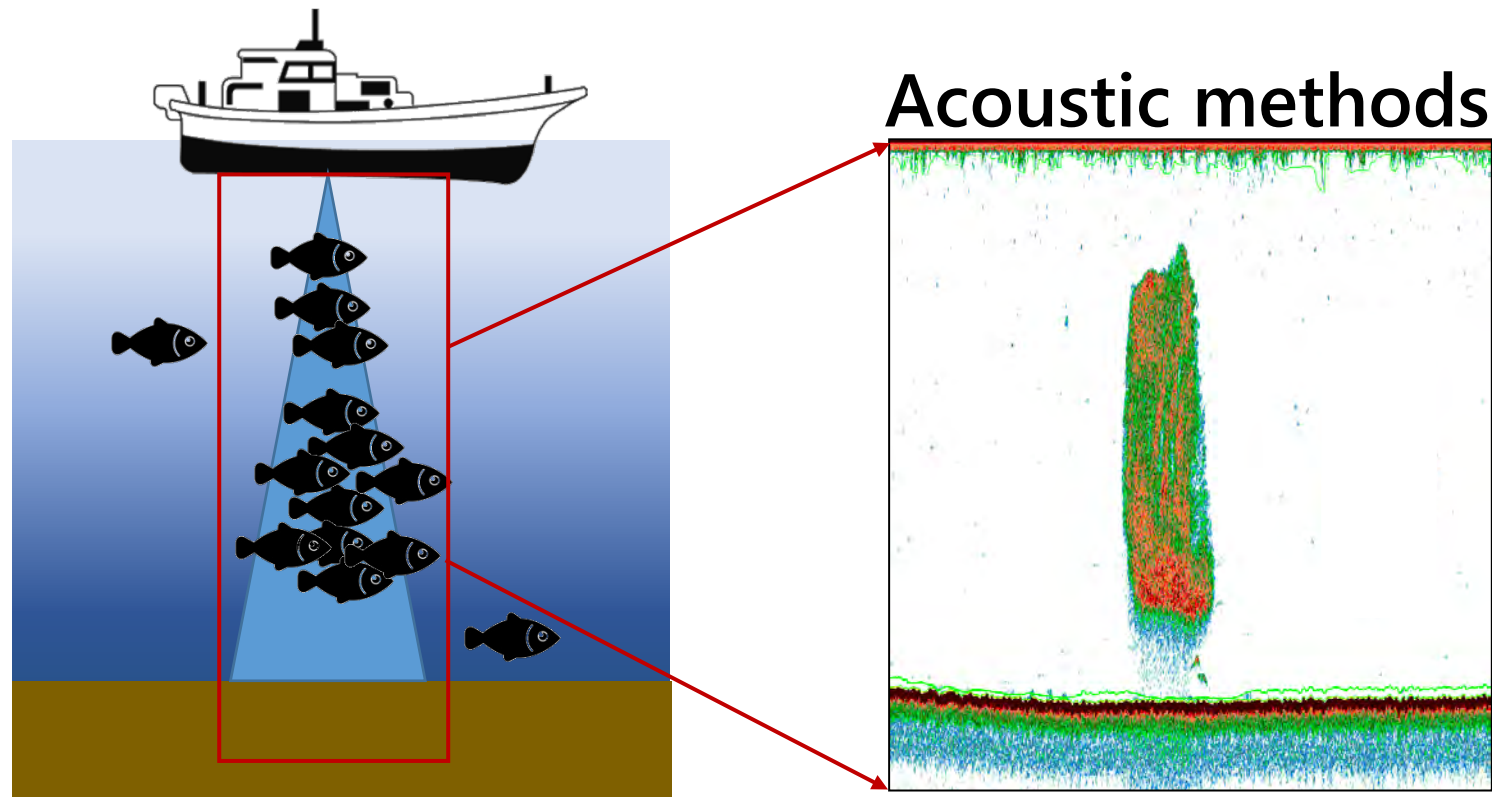


Seasonal dynamics in pelagic fish abundance around Set-net in Kochi prefecture



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Kentaro Oda³, Koichi Hidaka³, Osamu Hoson³, Kouji Morishita³, Sentaro
Tsuru³, Masahito Hirota³, Hokuto Shirakawa⁴, Kazushi Miyashita⁴

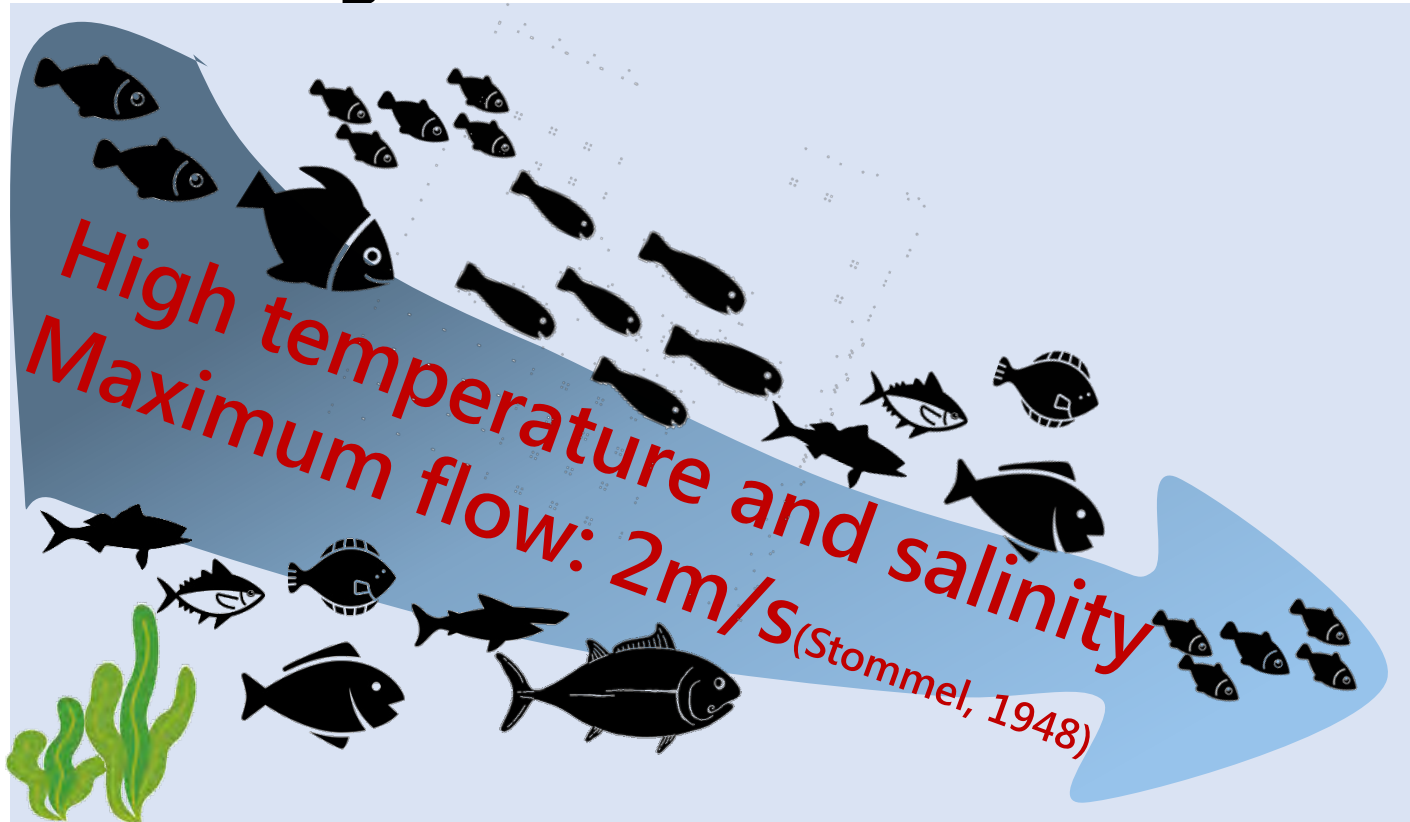
Introduction: Fishery resources in Japan



Wide variety of fish exist around Japan

Introduction: Characteristic of Kuroshio current

One of the largest world's scale ocean currents

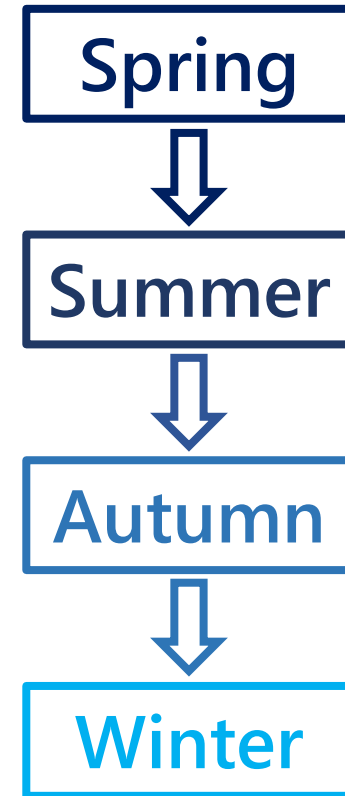
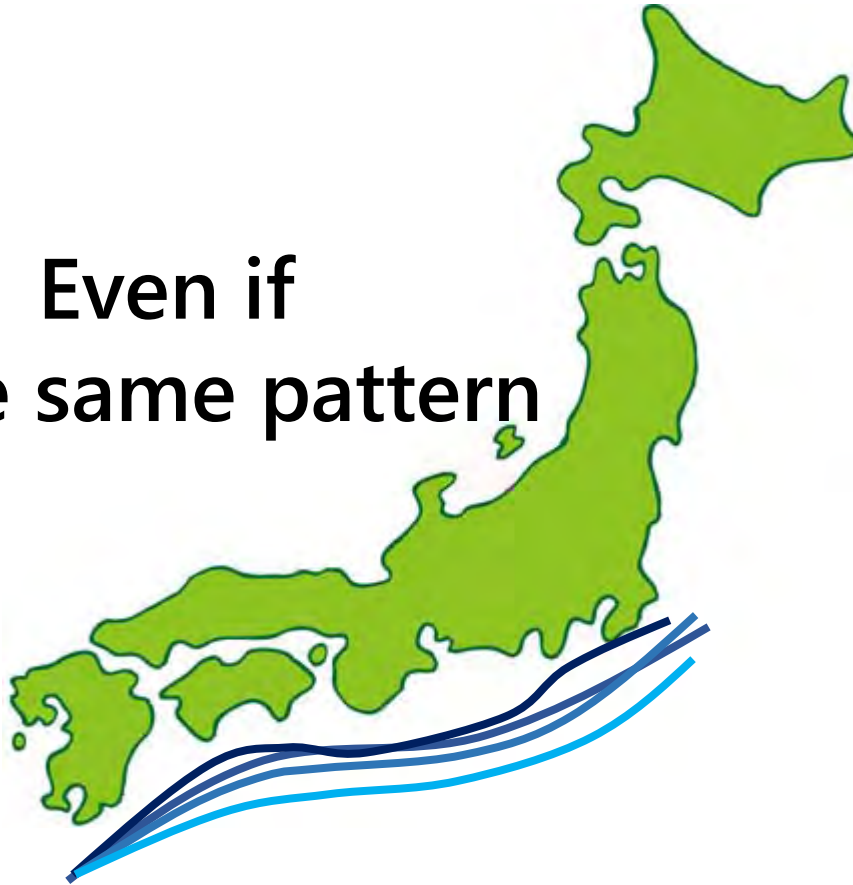


Features of the Kuroshio current flow?

Biological influence on fish population
are quite strong

Introduction: Characteristic of Kuroshio current

Even if
in the same pattern



Change of Kuroshio has an important effect on fish ecology

**Kuroshio current exhibits distinct
seasonal fluctuations** (Narukiyo, 2007)

Introduction: Previous research about Kuroshio

Many researches focus on single species and one season

Scombrops boops catch is controlled by change of Kuroshio in summer season

Japanese common squid are migratory riding the Kuroshio (kawabata, 2006)

Common Mackerel catch was influenced by Kuroshio flow path (Takeuchi, 2018)

↓ BUT

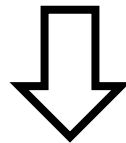
- Kuroshio large meander
- Seasonal dynamics

Scarce

Change of Kuroshio current

- Two patterns(Regular course & Large meander)
 - Seasonal dynamics

To clarify the variation in **fish composition abundance and distribution** bases on the change of Kuroshio current



Requirement for efficient fishery

A case study in the south of Japan(Kochi prefecture)



Kuroshio Current curves from 2017/8 for the first time in 12 years

Survey period

- Kuroshio regular course

 - Autumn (2016/11)

 - Winter (2017/2)

 - Spring (2017/5)

- Kuroshio large meander

 - Autumn (2017/11)

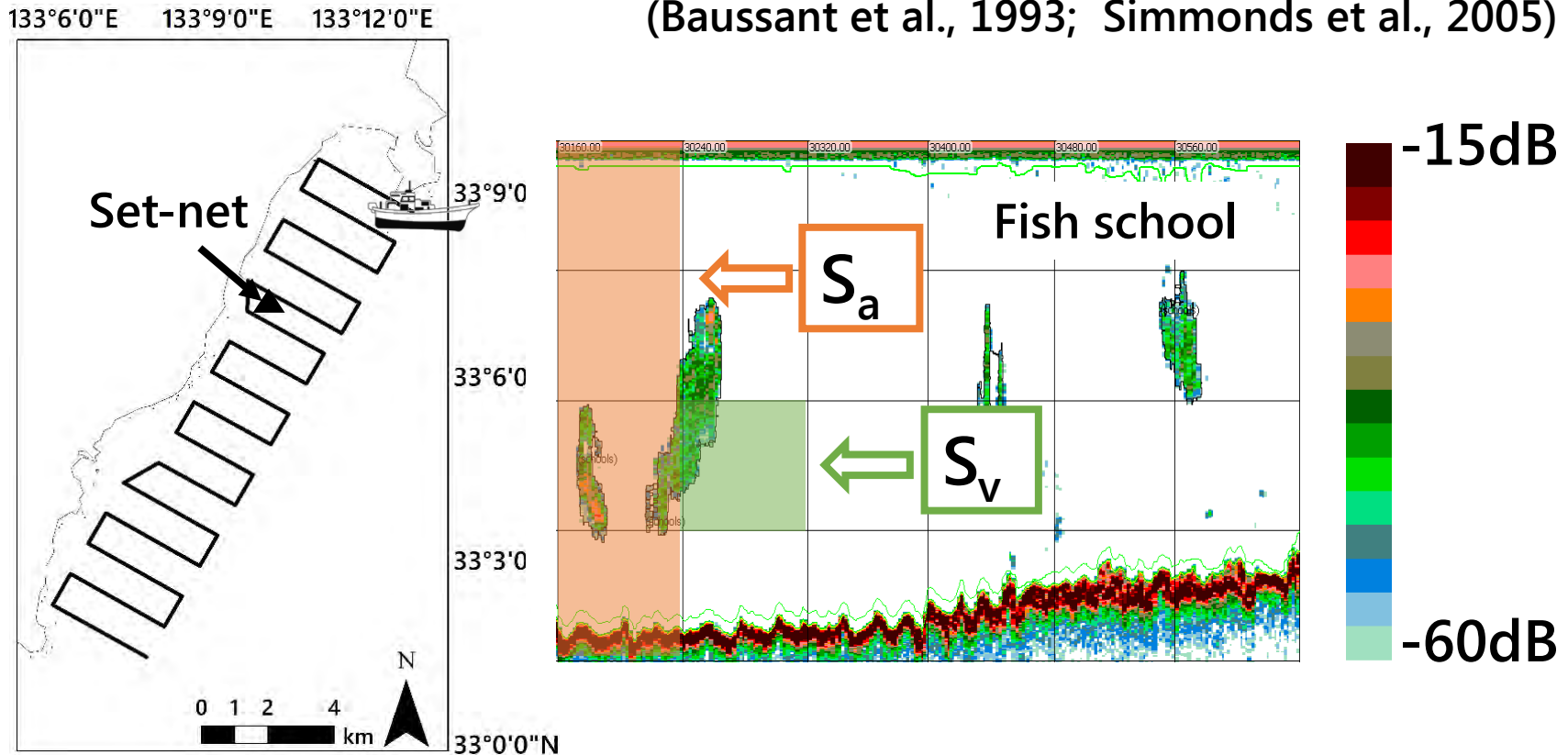
 - Winter (2018/2)

 - Spring (2018/5)

Materials and methods: Survey of fish distribution

Acoustic surveys are commonly used to estimate indices of fish distribution worldwide

(Baussant et al., 1993; Simmonds et al., 2005)



Indicator of fish density

S_a (dB): Area backscattering strength

S_v (dB): Volume backscattering strength

Fish distribution

- Extract fish school data (Echoview 7.1)
Sa; Sv
- Calculate fish position (ArcGIS 10.2.1)
Distance from shore
Depth

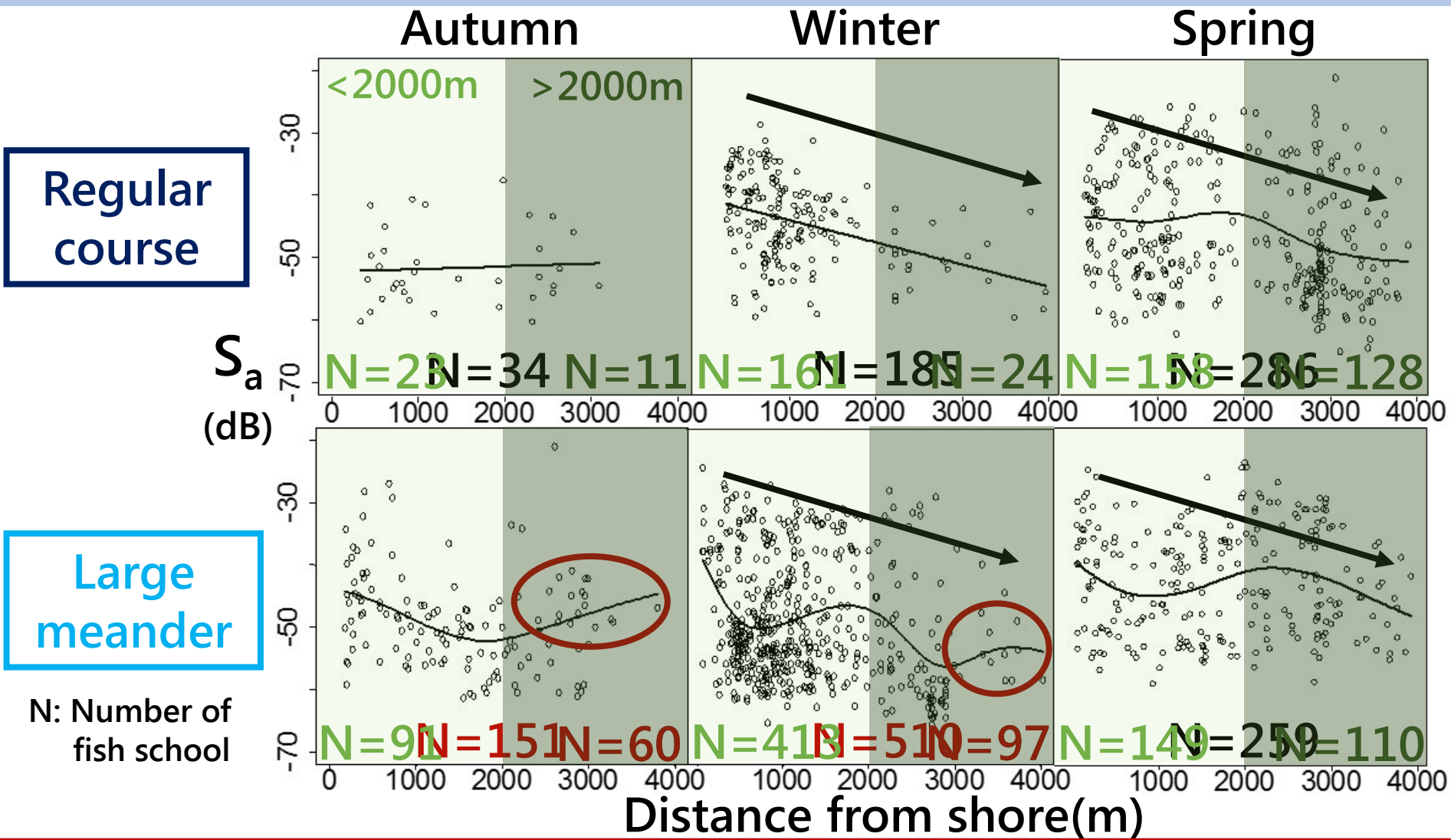
Generalized Additive Model

	Response variable	Explanatory variable
Horizontal structure	Sa	Distance from shore
Vertical structure	Sv	Depth

Fish composition: Catch data of Set-net

(every month: 2016/11~2018/5)

Results: Horizontal structure(S_a & Distance from shore)



Increase of density on offshore side with Kuroshio large meander in Autumn and Winter

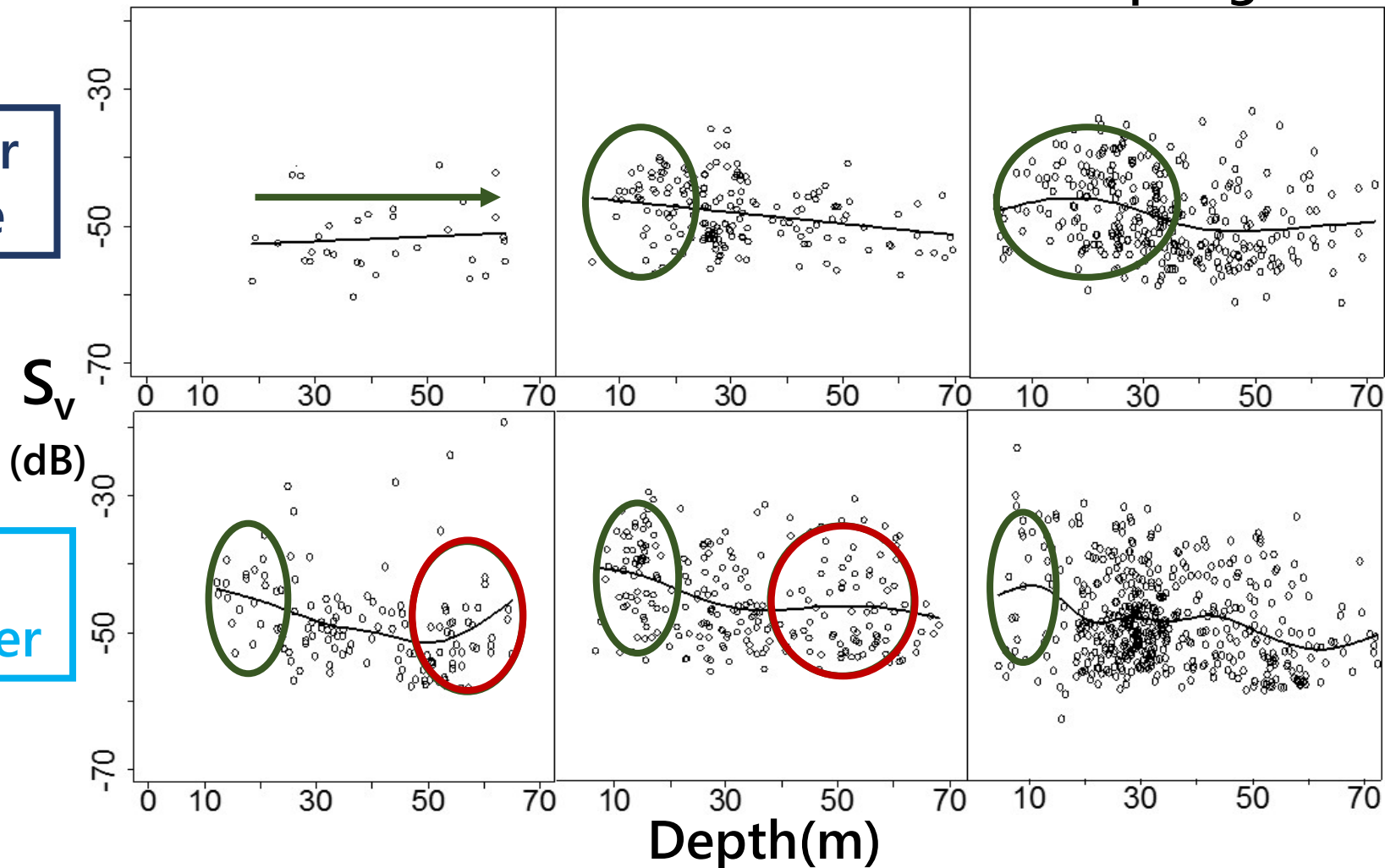
Results: Vertical structure(S_v & Depth)

Autumn

Winter

Spring

Regular
course



Increase of density in under layer with Kuroshio
large meander in Autumn and Winter

Results: Fish catch and composition (totality)

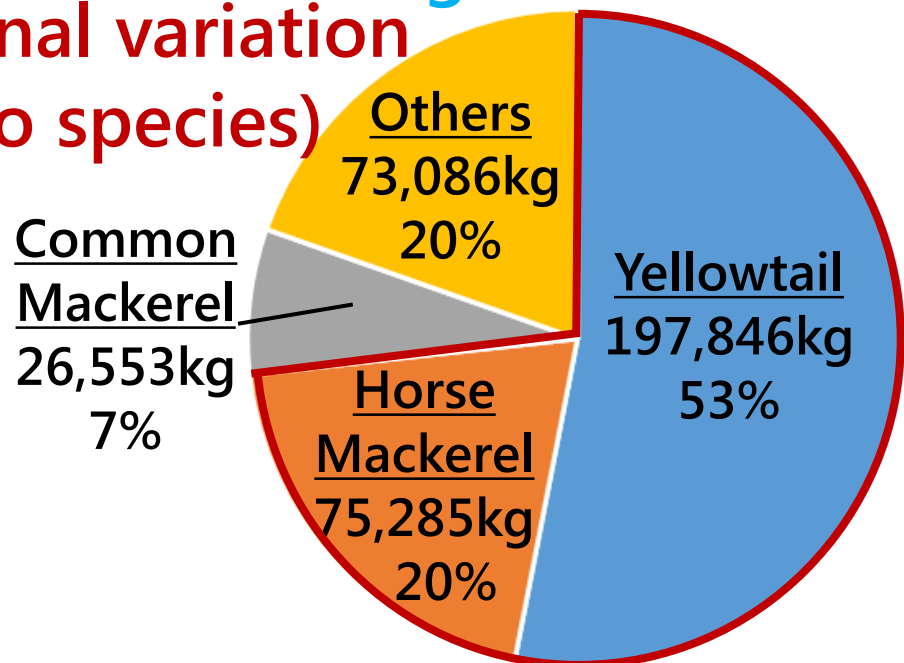
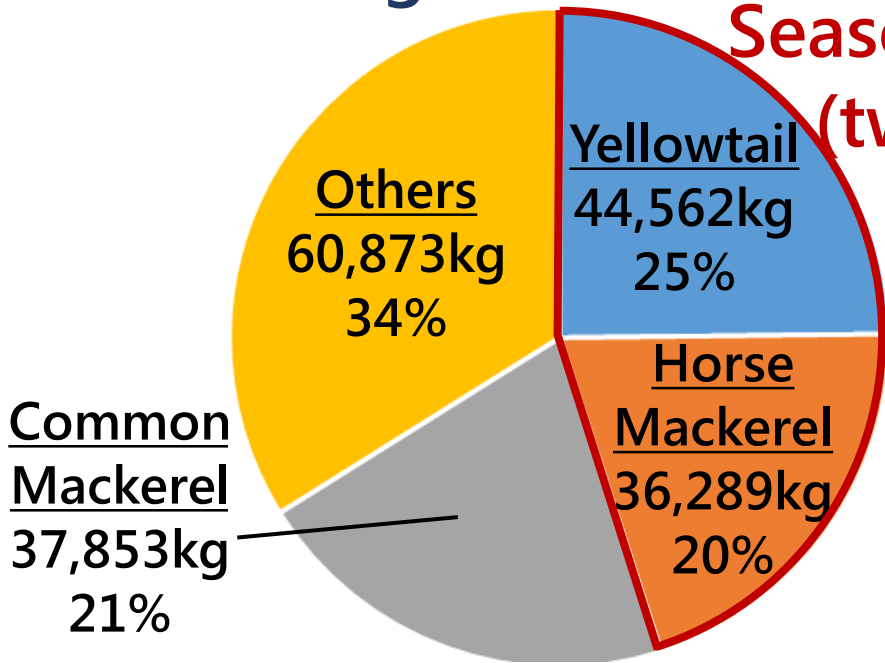
Annual	Regular course	Large meander
Total Catch(kg)	179,578	372,769

Twofold Increase!

Regular course

Large meander

Seasonal variation (two species)

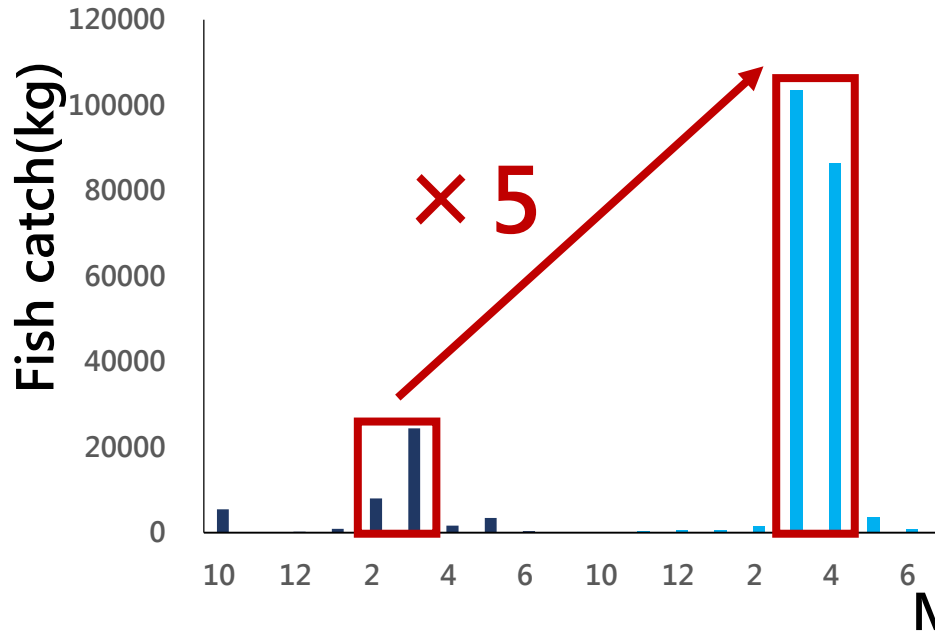


Significantly change of Yellowtail and Japanese Horse Mackerel with Kuroshio large meander

Results: Seasonal variation of fish catch(two species)

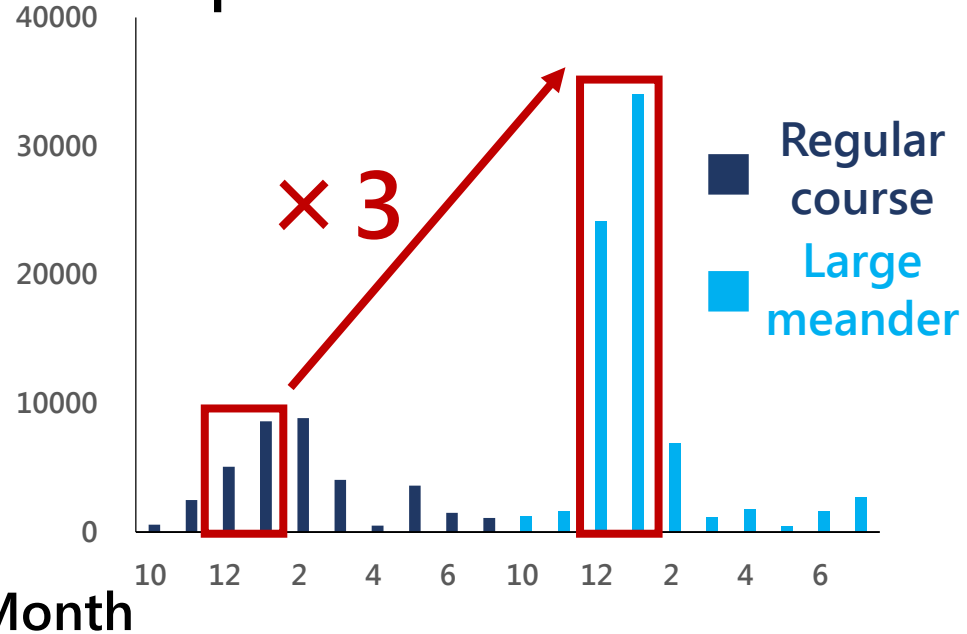


Yellowtail



WEB fish zukan. <http://zukan.com>

Japanese Horse Mackerel



Total length(average)

Yellowtail : Winter(100-120cm)

Japanese Horse Mackerel: Spring(10 cm)

Autumn & Winter(34 cm)

With the Kuroshio large meander

① Fish abundance increased greatly

↓ Mainly two species



Yellowtail



Japanese Horse Mackerel

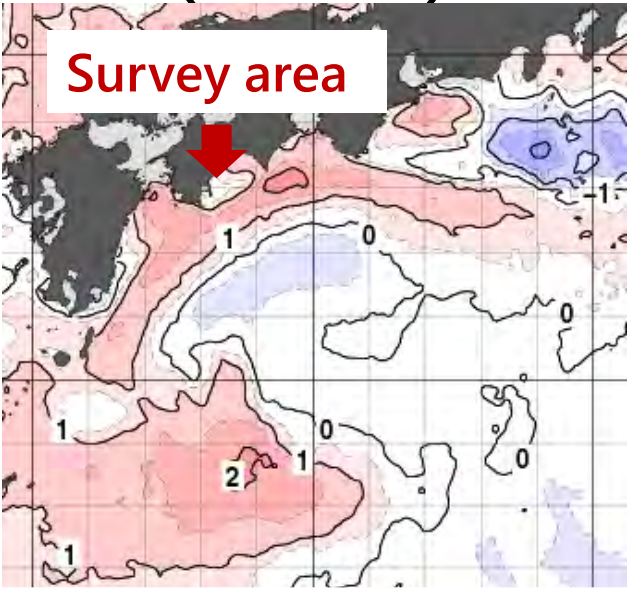
② Fish distribution changed significantly
(Autumn & Winter)

- Increase of density on offshore side
- Increase of density in under layer

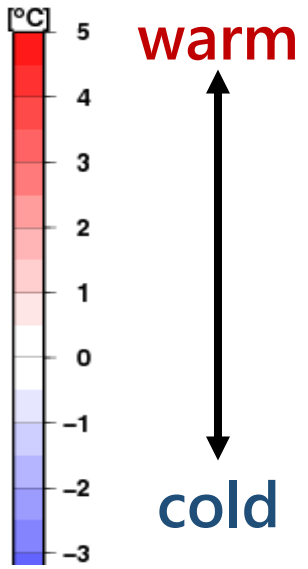
Why did that turn out like this?

Discussion: Fish abundance and Temperature

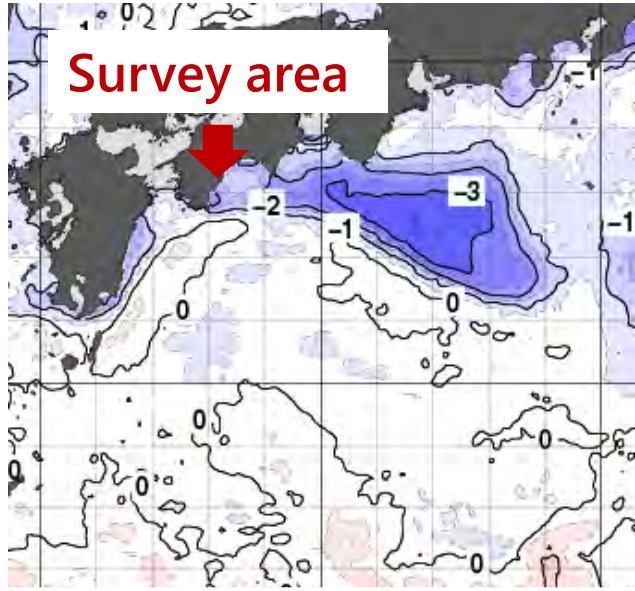
Regular course
(Winter)



$\Delta -3^{\circ}\text{C}$

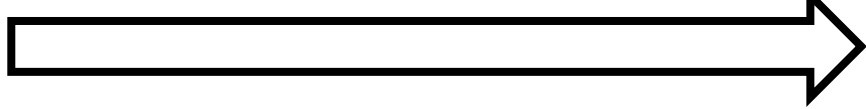


Large meander
(Winter)



Fish abundance

What kind of effect???



Fish distribution

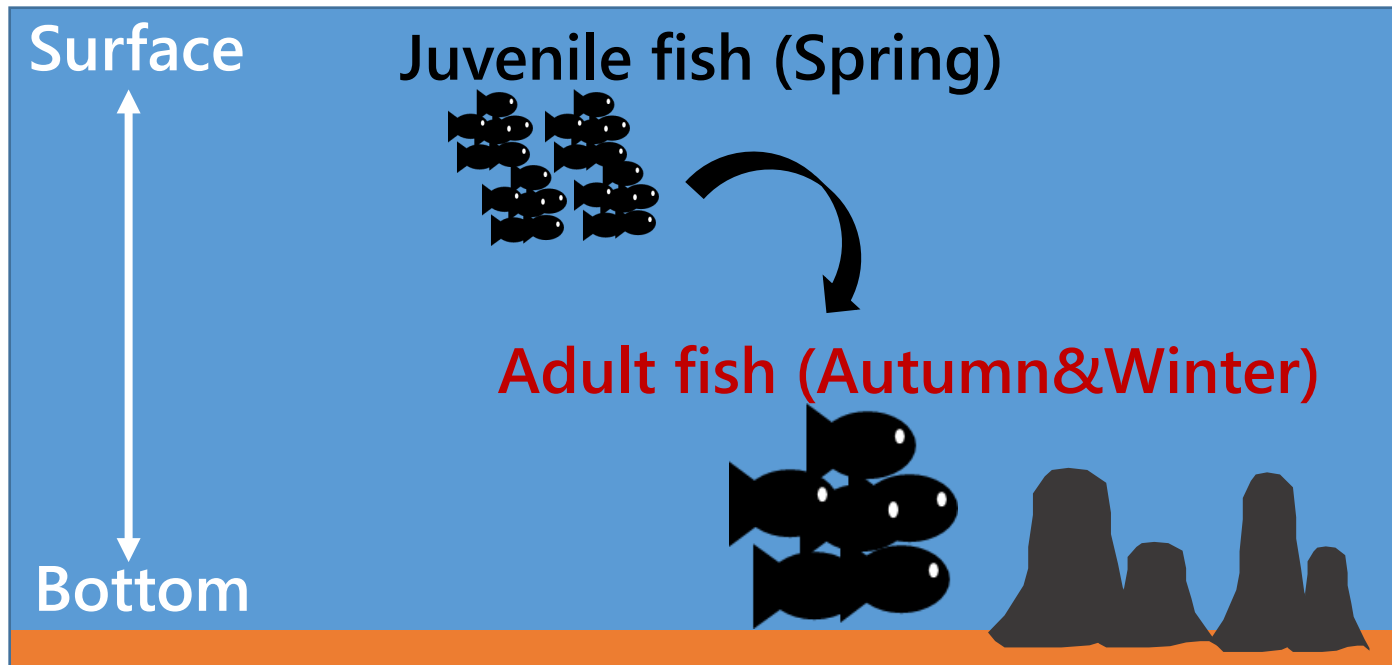
Changes in water temperature due to Kuroshio meander effect fish abundance

Discussion: Ecology of two species



Japanese Horse Mackerel

Change of distribution depth
based on fish length



Juvenile fish (spring): Inhabit the surface layer
Adult (autumn&winter): Move to the under
layer

Discussion: Fish ecology and distribution

Fish ecology

Yellowtail

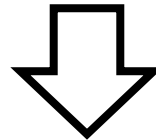
To southward From **offshore** in **early winter**

Japanese Horse Mackerel

Move to the **under layer** in **Autumn & Winter**

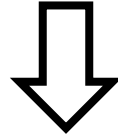
Fish distribution

Increase of density on **offshore side and under layer**
in Autumn & Winter



Changes of fish distribution with Kuroshio
large meander **due to ecology** of Yellowtail
and Japanese Horse Mackerel

For sustainable and efficient fishery in Suzu



Appropriate fishery form that matches fish distribution is important



To Grasp the change of fish distribution due to the change of Kuroshio over the years



THANK YOU
for your
ATTENTION!