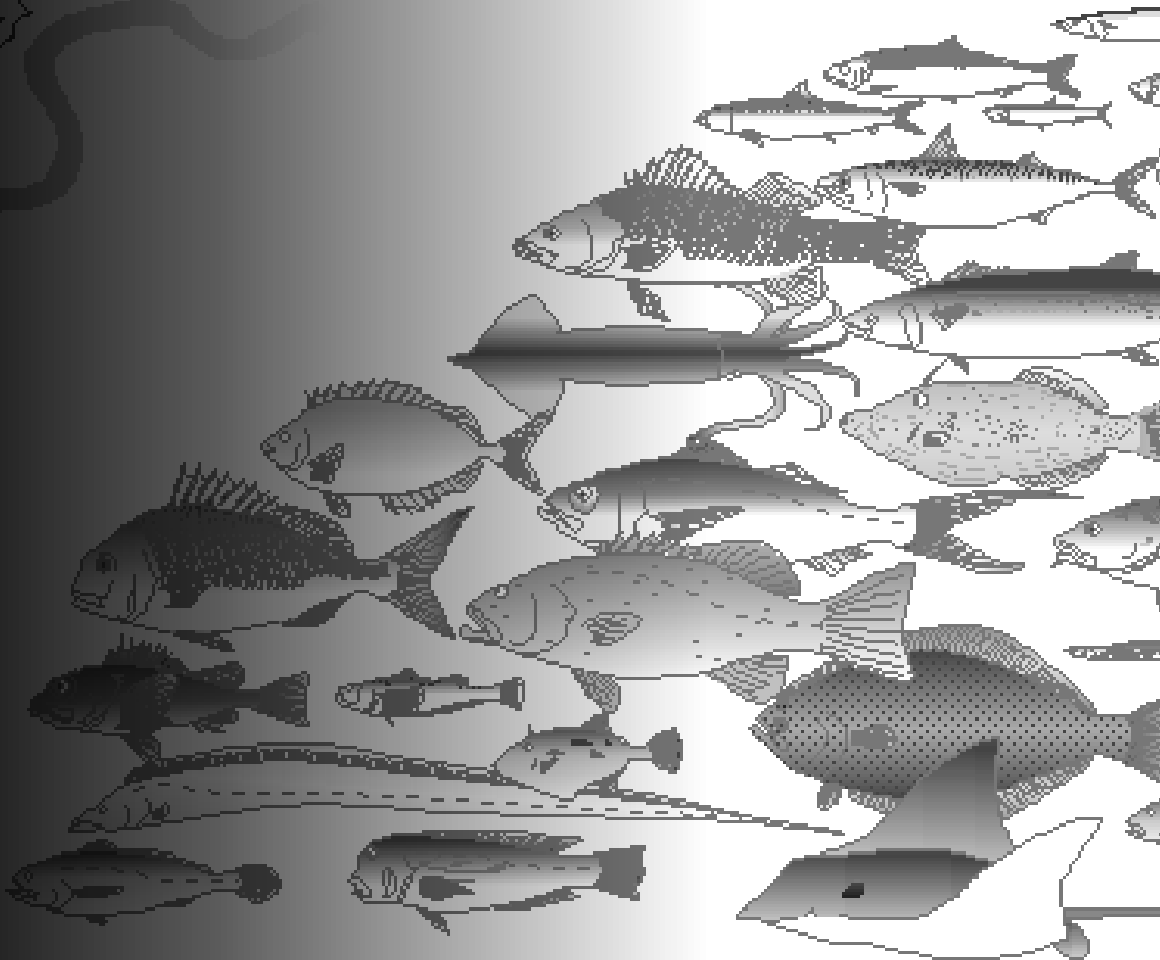




Urgent challenges
Japan faces in
understanding the
impact climate
change is having
on fisheries

Kaoru NAKATA

(Japan Fisheries Research and
Education Agency)

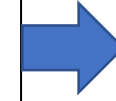


For the sustainable fisheries in Japan

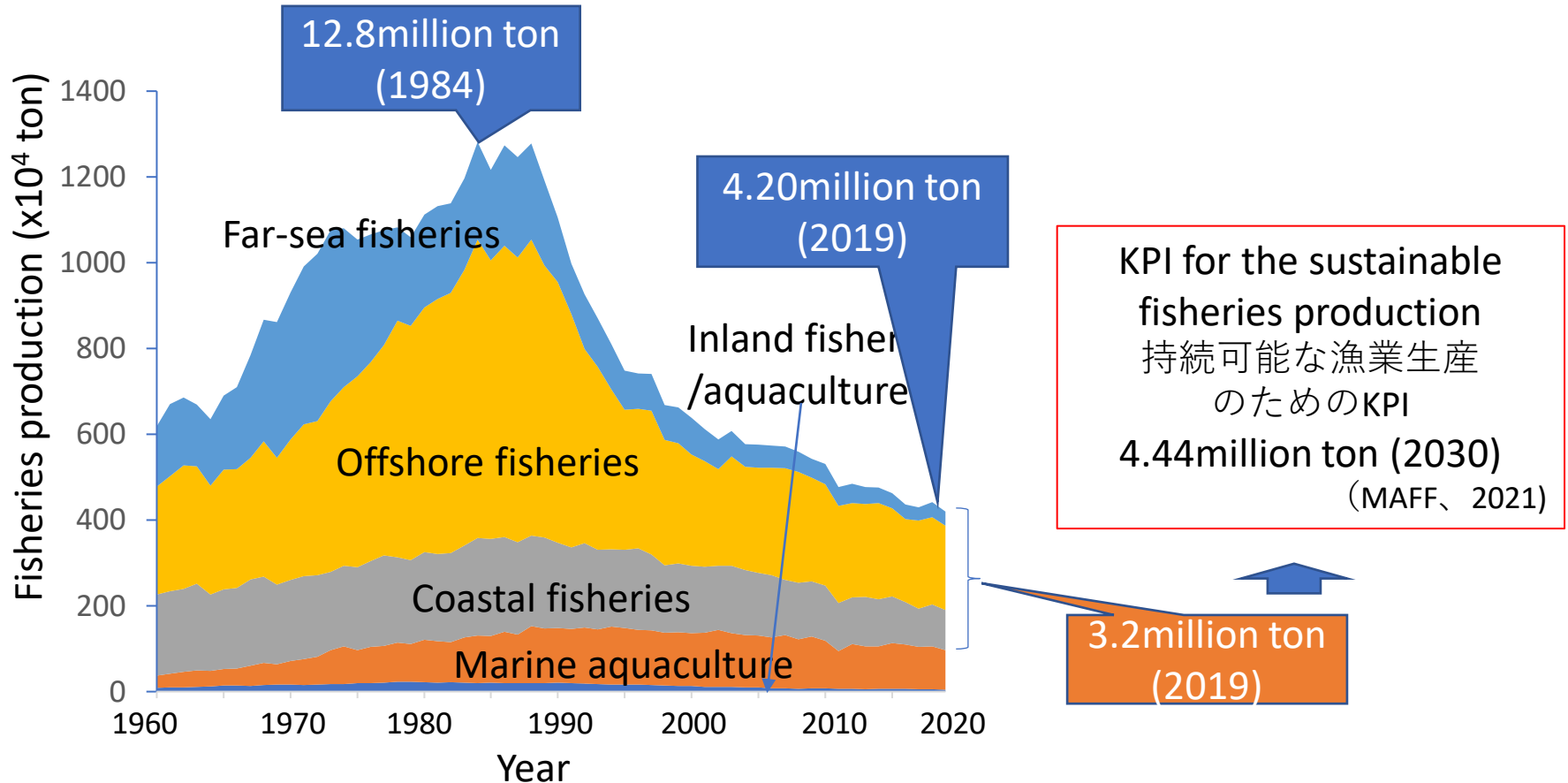
日本漁業の持続可能化のために

The new Fisheries Act Enforcement (2020)
Strategy for Sustainable Food Systems, MeaDRI* (2021)
新漁業法施行とみどりの食料システム戦略

The new fisheries management
新たな漁業管理

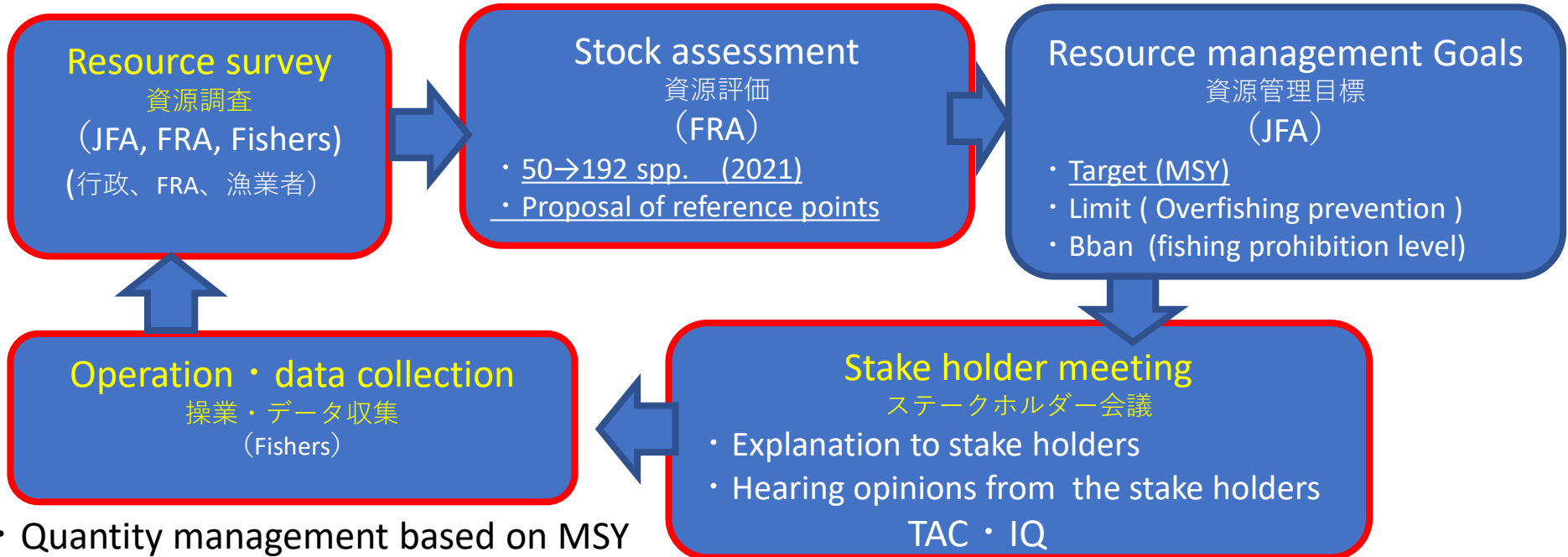


* Measures for achievement of Decarbonization and Resilience with Innovation

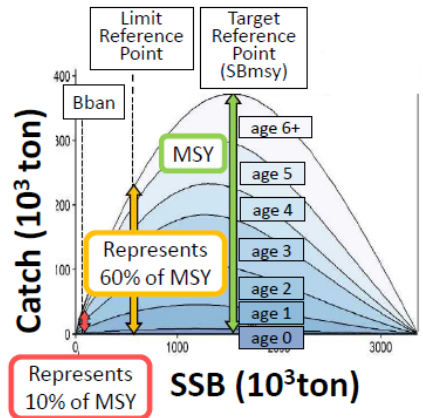


New fisheries management (2020-)

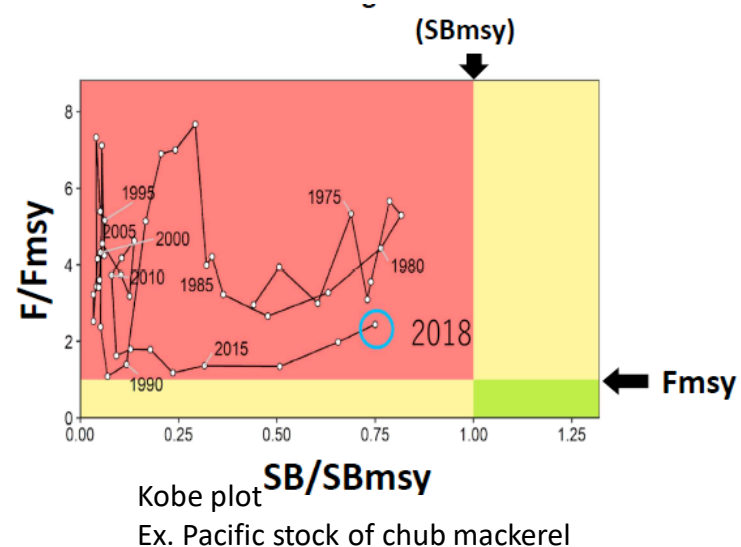
新たな漁業管理



- Quantity management based on MSY
MSYに基礎をおく数量管理
- Participation and cooperation of fishers are essential
漁業者の参加と協力が不可欠



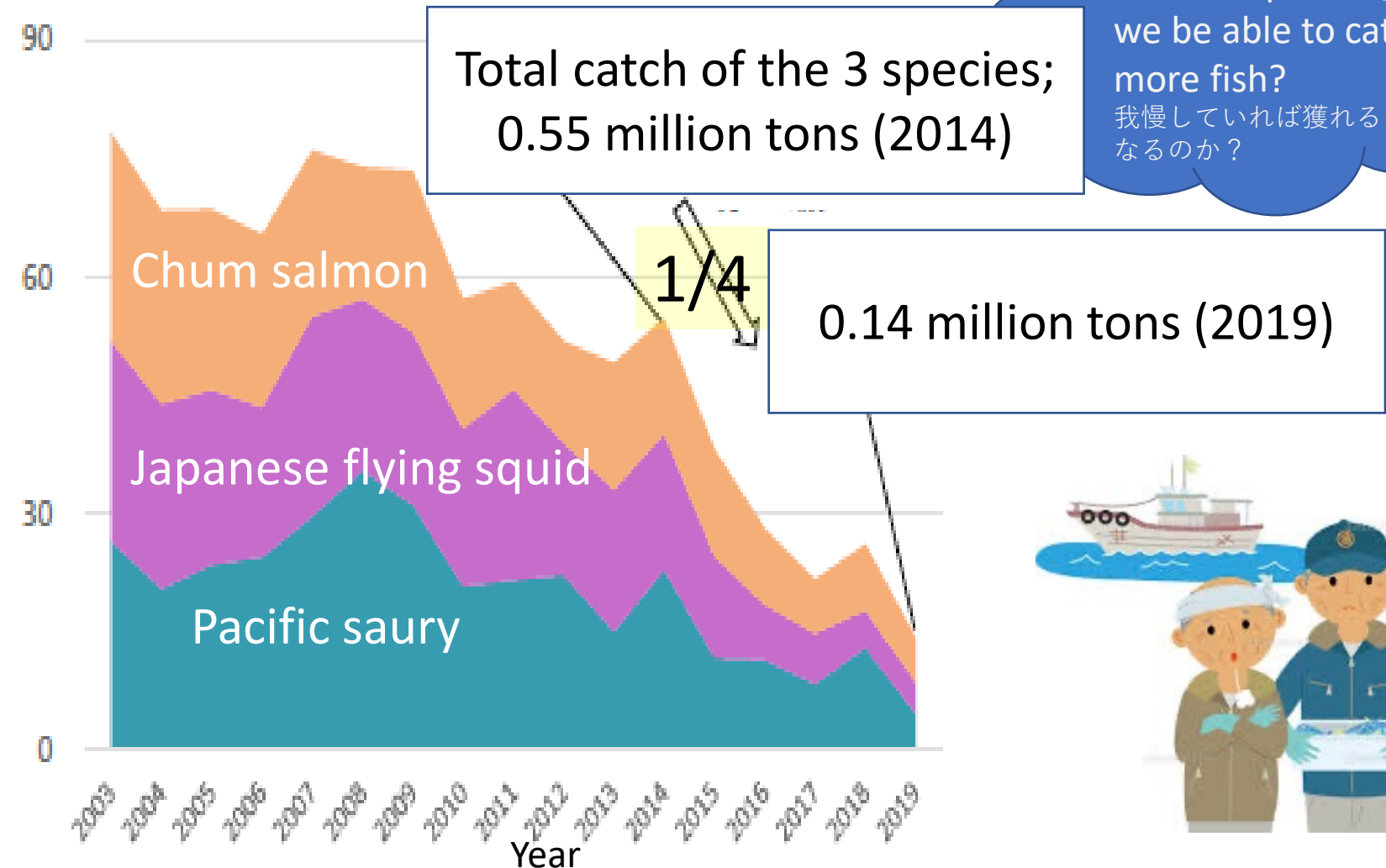
Reference Points	Catch (10 ⁴ ton)	SSB (10 ³ ton)
Target (SBmsy)	37	1545
Limit	22	562
Bban	4	67



Drastic drop in catch amount!

不漁問題の顕在化！

(x10⁴ ton)



If we are patient, will we be able to catch more fish?
我慢していれば獲れるようになるのか？



1 What do we most urgently need to know about how climate change is affecting fisheries ?

- Is the bad catch a matter of recruitment failure or changes in the distribution?
- When and where did it occur?
- What was the trigger?

これは加入の失敗の問題かそれとも分布の変化によるのか？
いつどこで起こり何がトリガーだったか？

2 What can today's science tell us?

Key words; Recruitment failure, Ecosystem

- FRA researchers in the fisheries resource field and the oceanography field collaborated to build hypotheses about the mechanism of the bad catches issue based on facts.
- We tried to identify necessary data to prove the hypotheses

FRAの資源研究者と海洋研究者が協力し、観測事実に基づき不漁問題のメカニズムについて仮説を構築。仮説を実証するのに必要なデータを整理した

Pacific saury (*Cololabis saira*)

Japanese flying squid (*Torarodes pacificus*)



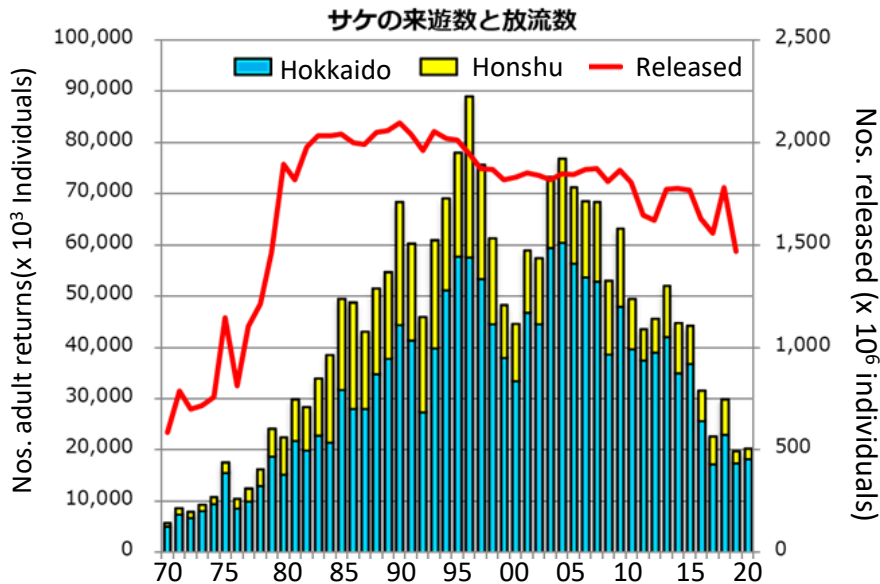
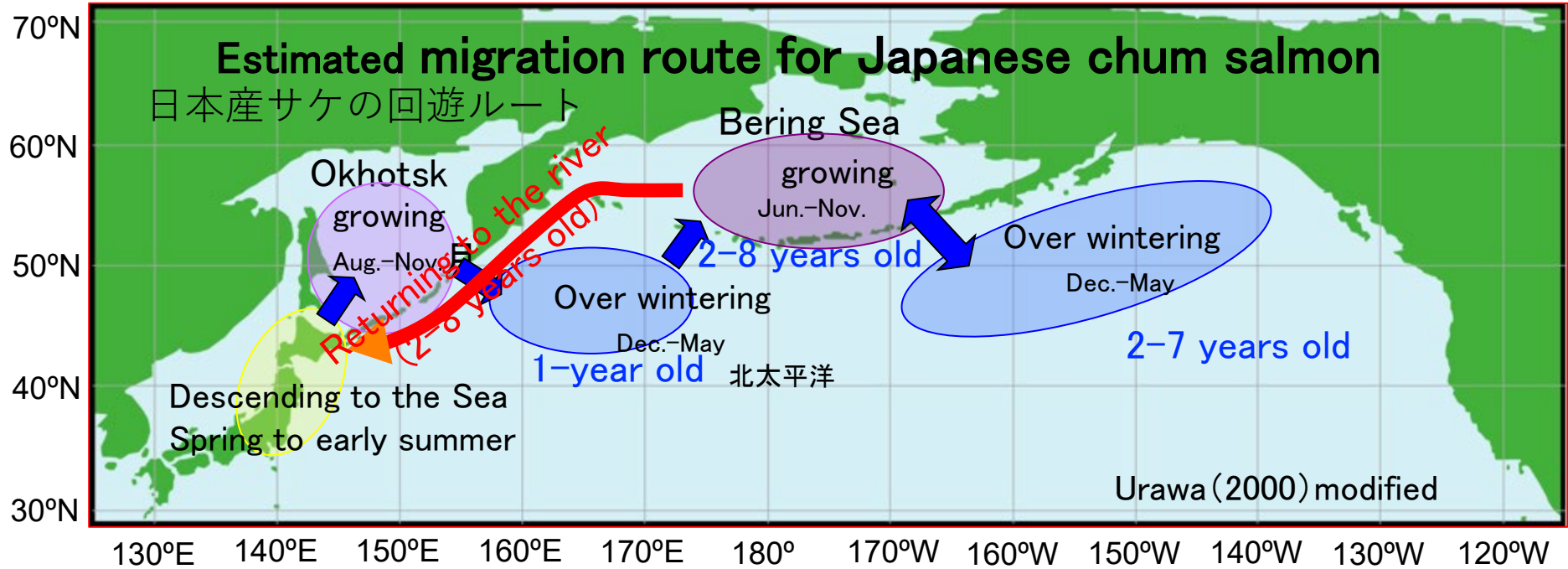
(The 2nd day, by Dr. Yonezaki)

Chum salmon (*Oncorhynchus keta*)



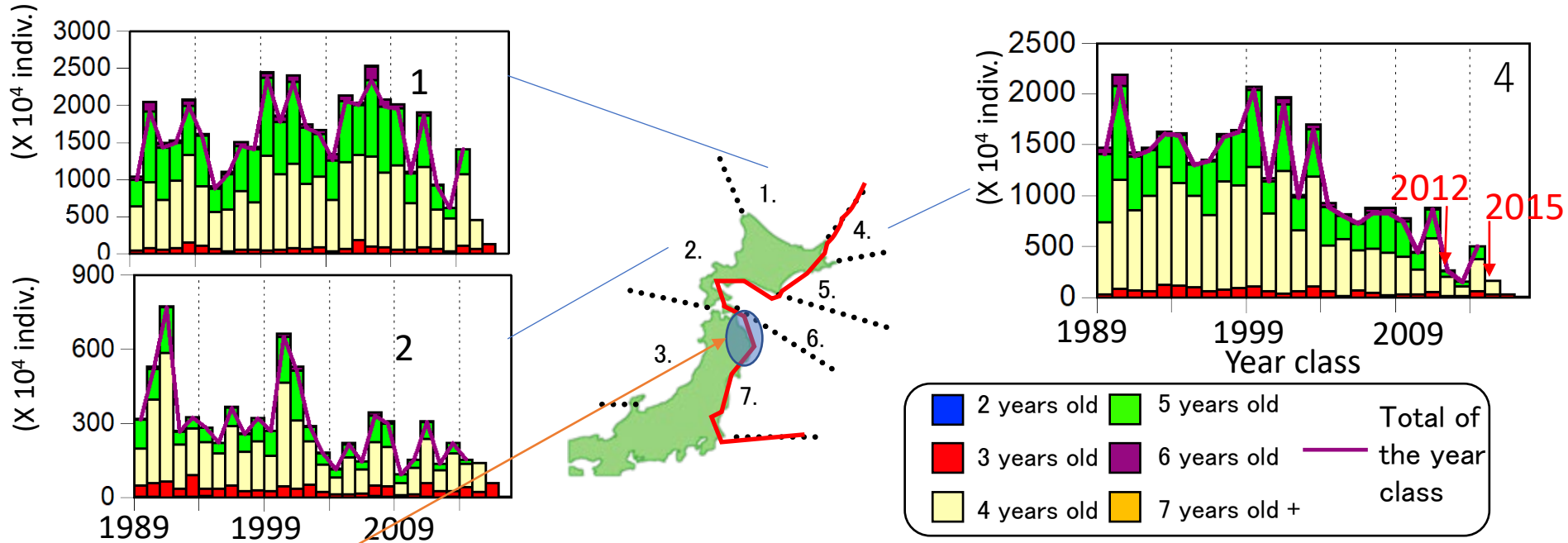
Estimated migration route for Japanese chum salmon

日本産サケの回遊ルート

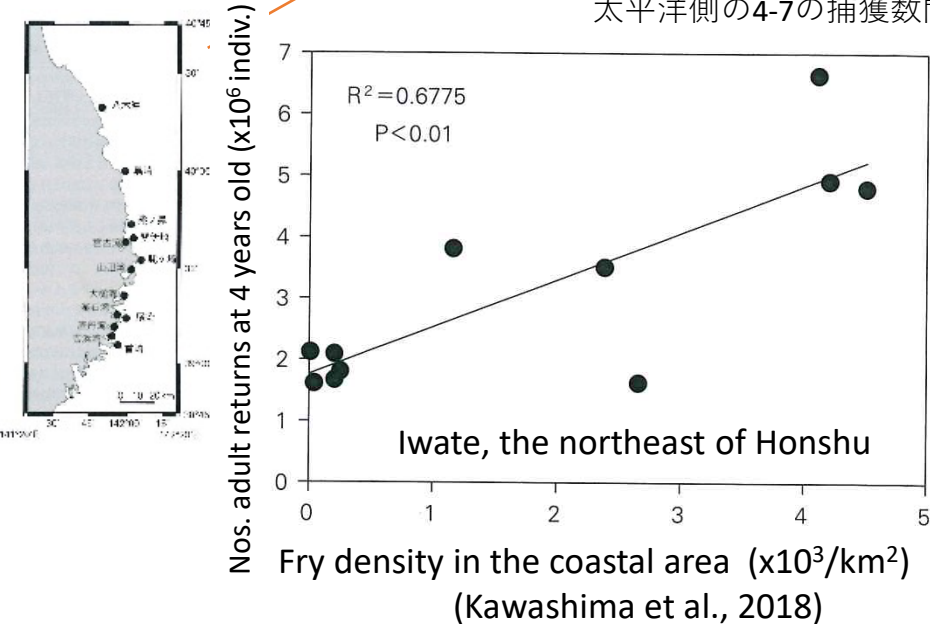


- Returns of adult salmon had declined since mid 2000s and have further declined since 2016.
2000年代半ば以降捕獲数が減少。2016年以降、さらに減少

Changes in Nos. of the returns by year-class in the different sea areas



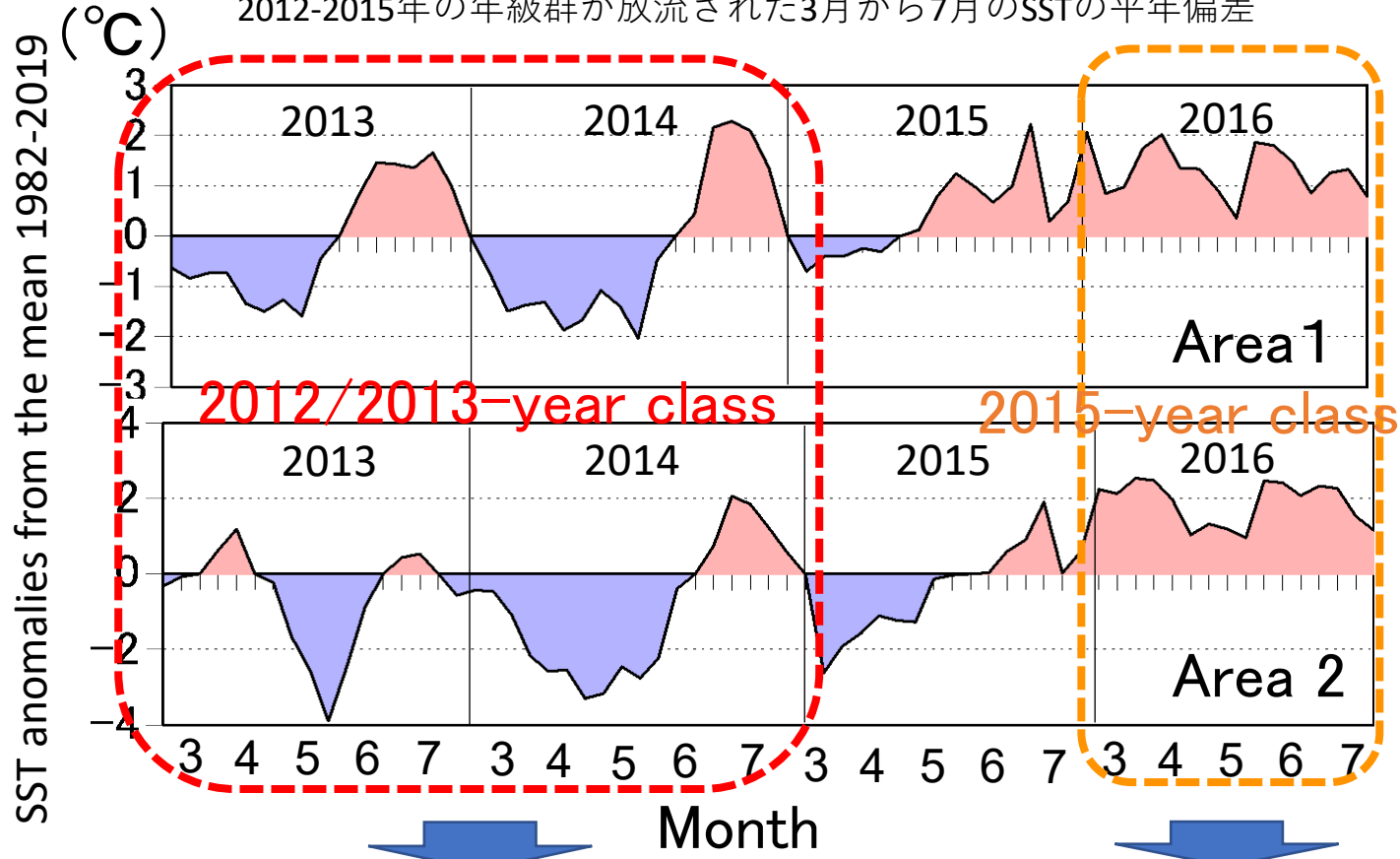
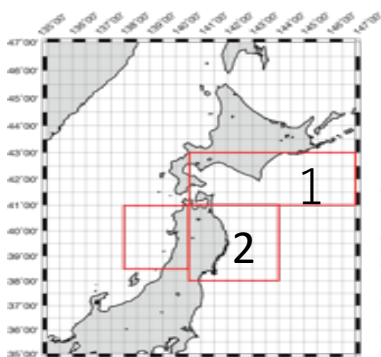
Correlations are found among the catches in areas of 4-7.
太平洋側の4-7の捕獲数間に相関。



- On the Pacific side, variability in return rates is determined by almost the same mechanism
- Year class strengths may be determined in a relatively short period of coastal residency after release.
- 太平洋側ではほぼ同様のメカニズムで回帰水準が決定
- 放流後比較的短期間で回帰水準が決定

SST anomalies in Mar. – Jul. in the years when the 2012–2015 year-classes were released

2012-2015年の年級群が放流された3月から7月のSSTの平年偏差



Lower SST in spring and higher SST in early summer. Drastic change in SST

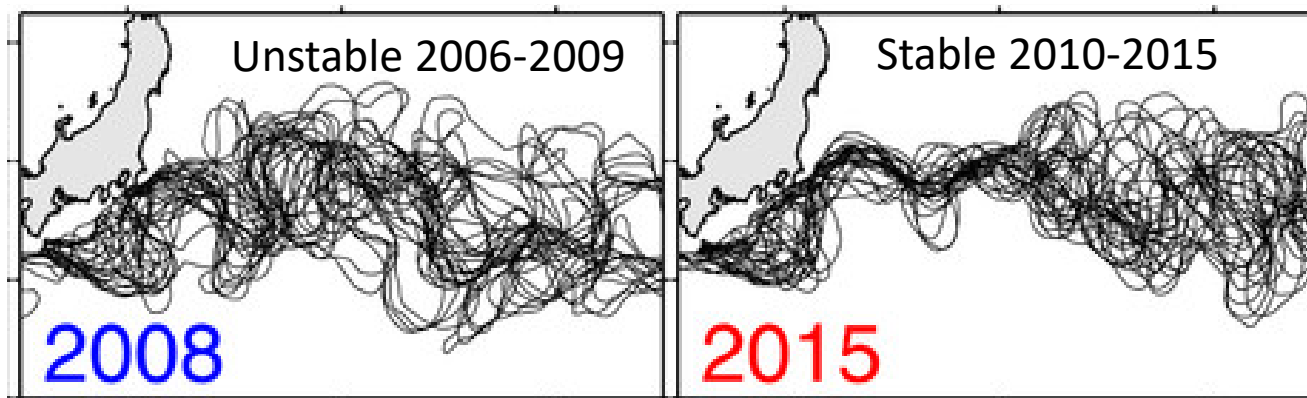
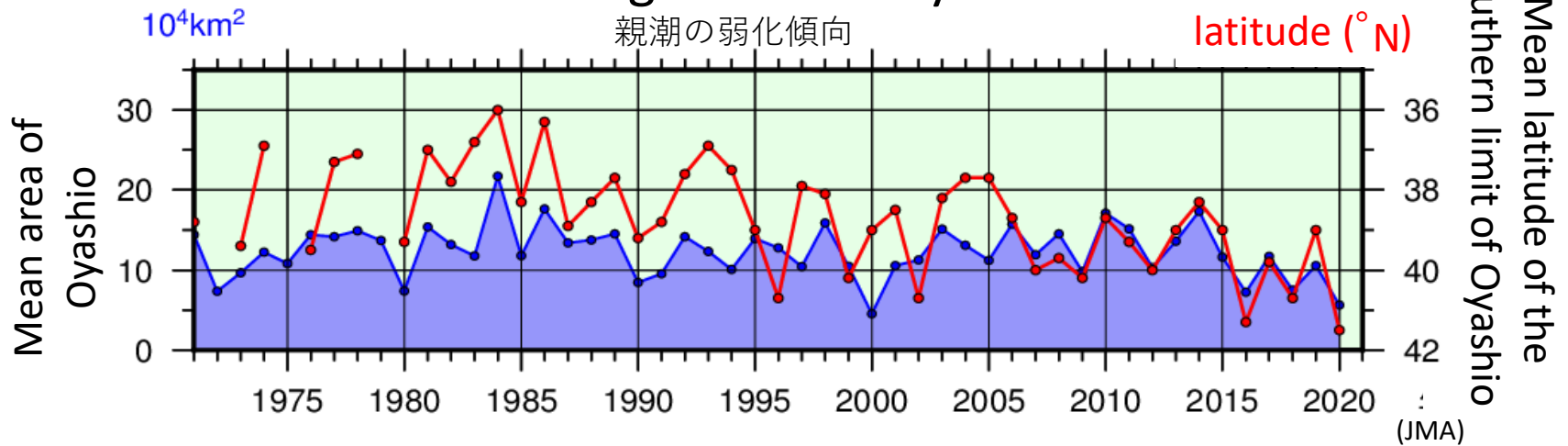
Warmer SST than usual

data : mgd_sst_pac_T(JMA)
him_sst_pac_T(JMA)

Shortening or earlier finish of periods with suitable temperature conditions for salmon fry (5-13 °C) were found in the coastal waters in spring to summer in 2013, 2014 and 2016

サケ稚魚の分布に適した水温条件 (5~13°C)の短縮あるいは早期終了が2013、2014、及び2016年の春～夏の沿岸水域に観察

Weakening trend of Oyashio



(Que et al., 2017)

- The Kuroshio extension (KE) was in the stable states in 2010-2015. KE tended to locate in more a northern area. Since 2017, that tendency has become even stronger.
- A warm core existed off the Pacific coast of Hokkaido in 2010-2016.

黒潮続流は2000-2015年に安定期に入りより北偏傾向。2017年以降さらにその傾向が強まる。
2010-2016年に暖水塊が北海道太平洋岸沖に滞留

Hypothesis on the processes for the recent bad catch for chum salmon

Global warming / Decadal scale climate change

温暖化と10年規模の気候変動



Low SST in winter-spring
冬春季の低水温

• Weakening of Oyashio
• Warm core near the coast
親潮の弱化和岸近くの暖水塊

Changes in timing and shortening of the period with optimum temperature
適水温のタイミング変化と短縮

Inhibition of migration to the Okhotsk Sea
オホーツクへの回遊の遮断

Changes in the food availability (Production, species composition)
餌環境の変化

Deterioration of juvenile growth
幼魚の成長の悪化

Changes in the predators (Distribution, species)
捕食者の変化

Increase in predatory pressure
捕食圧の増加

Warming in the area for homing
回帰過程の水温上昇

Increase in mortality during the way to homing
回帰過程の死亡率上昇

Increase in mortality on the way to the nursery area in Okhotsk
オホーツク海への回遊過程における死亡率増

• Recent bad catches
• Recent decline in the return rate
近年の不漁、近年の回帰率低下

• Various processes relevant to the climate change have acted
気候変動と関係する様々な現象が作用

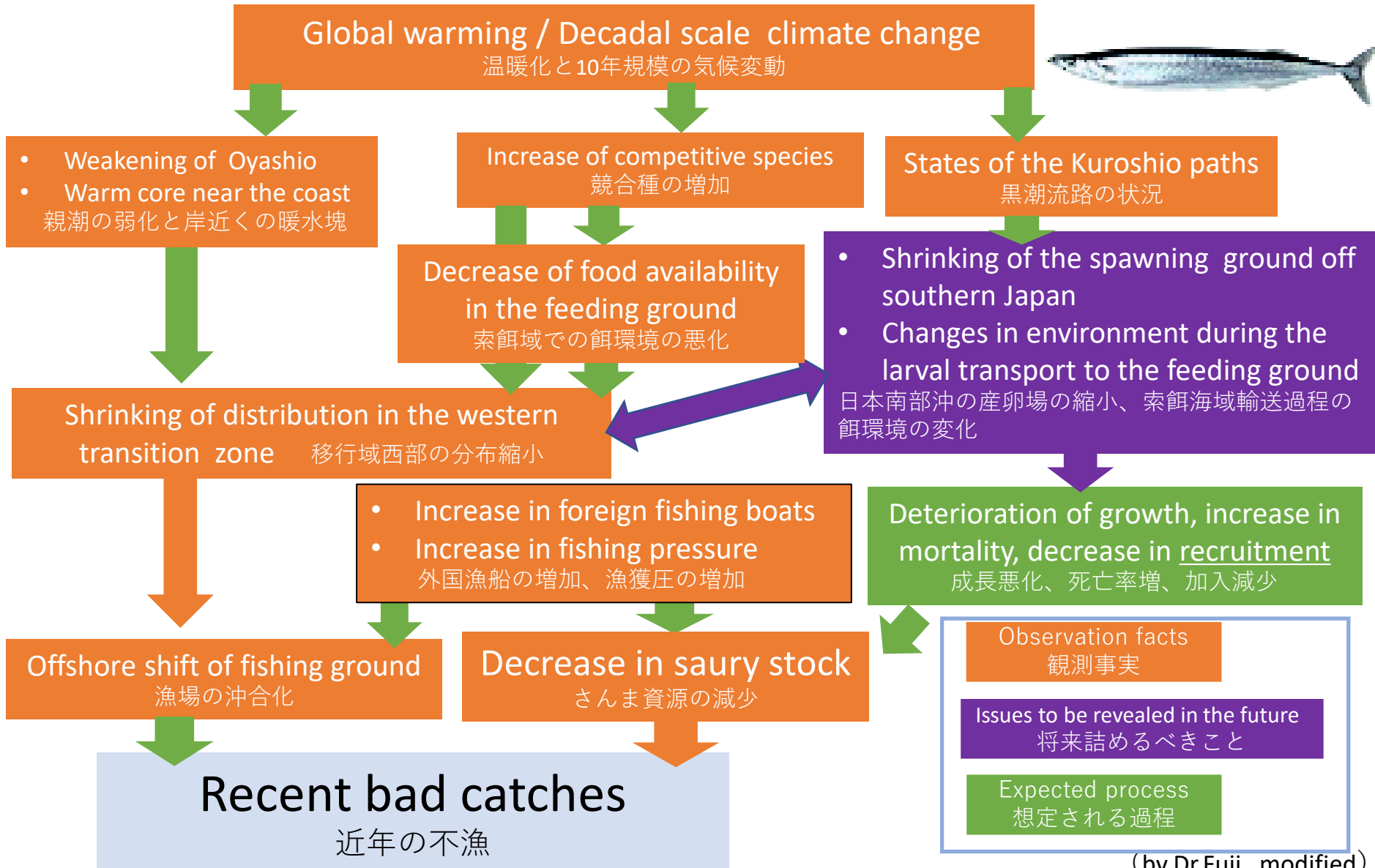
Observation facts
観測事実

Issues to be revealed in the future
将来詰めるべきこと

Expected process
想定される過程

Hypothesis on the processes for the recent bad catch for Pacific saury

近年のさんまの不漁に影響するプロセスについての仮説

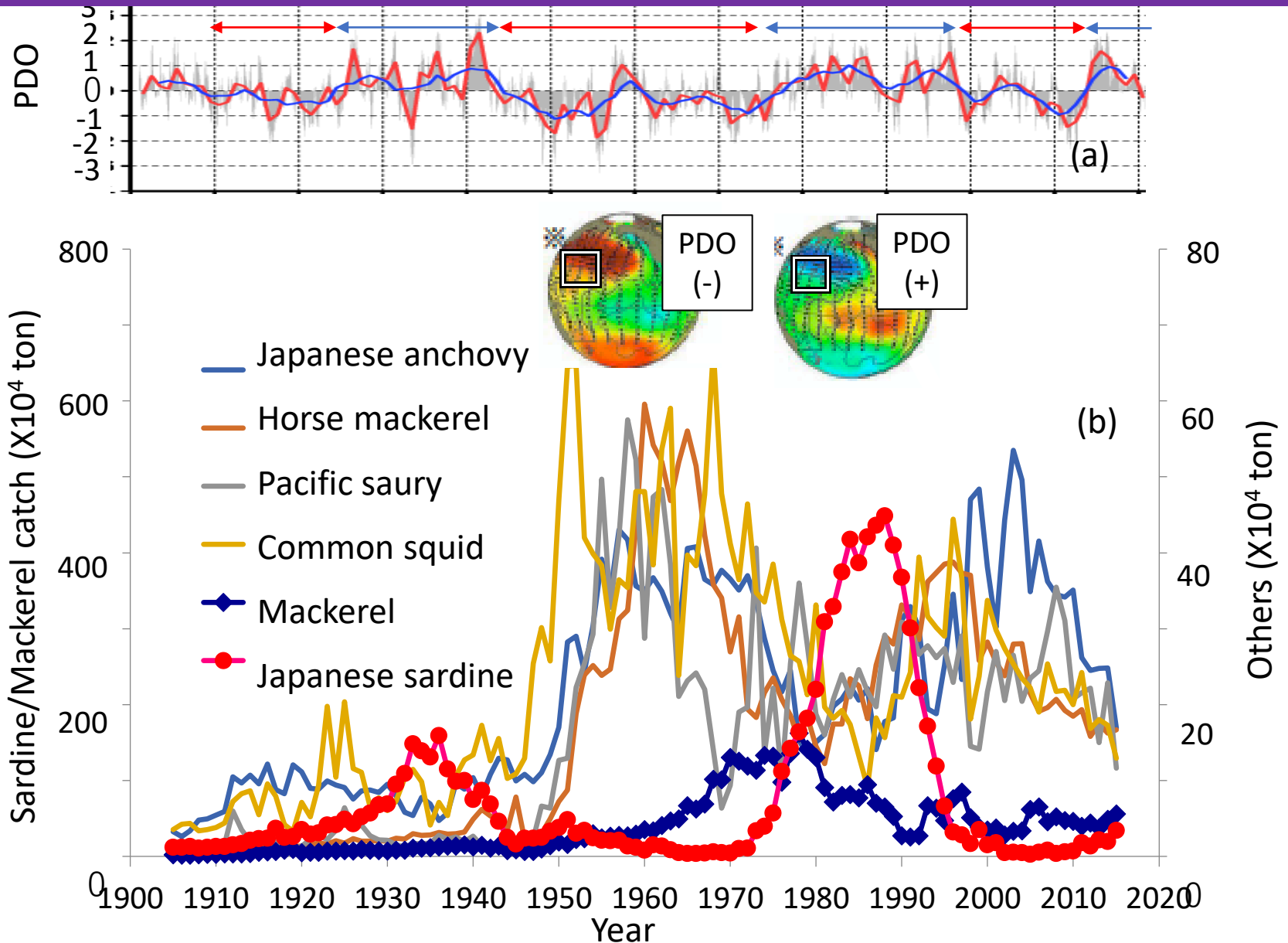


(by Dr.Fuji, modified)

- Various processes relevant to the climate change have acted

気候変動と関係する様々な現象が作用

3 What is the current state of the science and where is it heading?

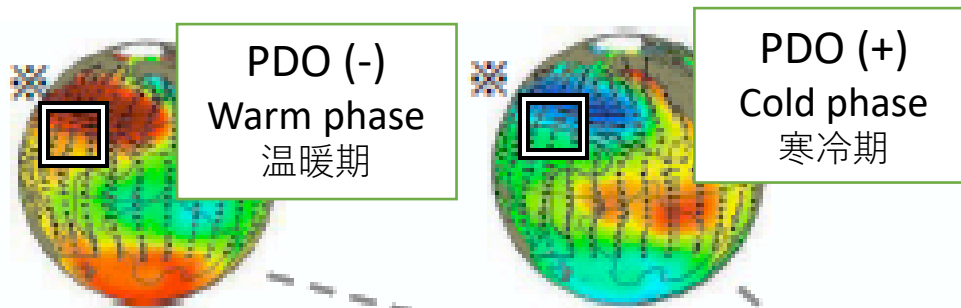


Time series of PDO (a) and catch of the dominant small pelagic fish (b)

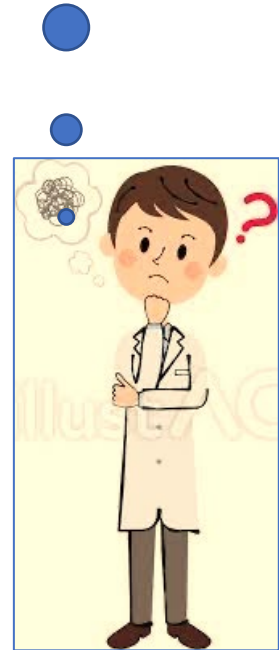
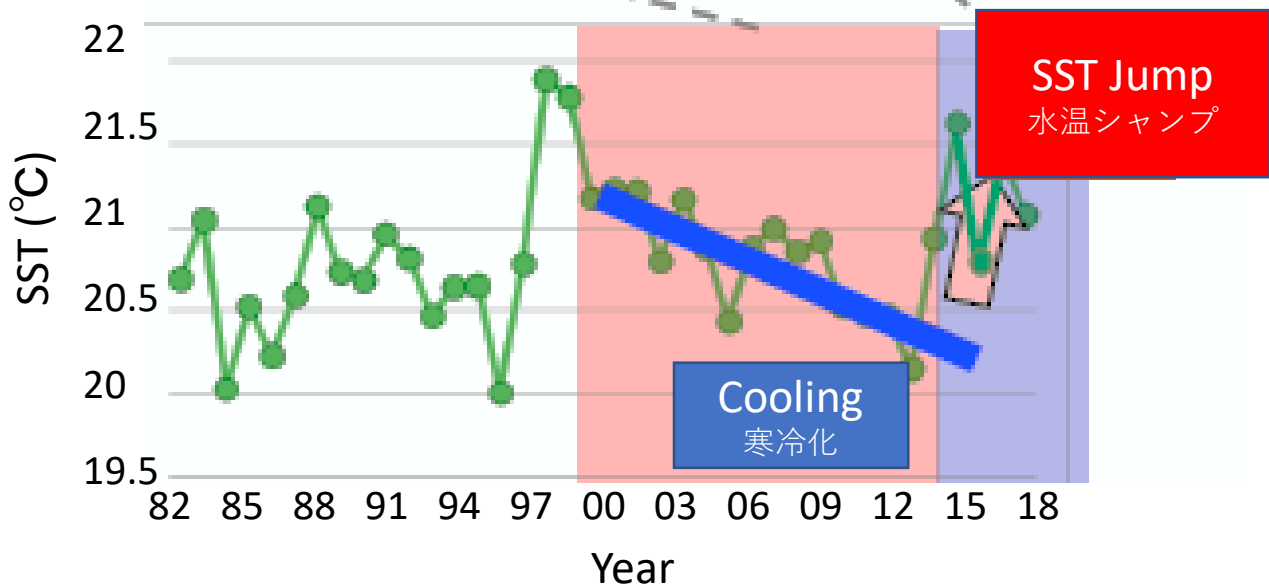
PDO (a) ならびに主要小型浮魚類漁獲量 (b) の経時変化

Since the beginning of the 21st century, the correspondence between the PDO and SST distribution has changed ? ?

21世紀初め頃よりPDOと太平洋の表面水温分布が変化



We may not be able to make use of our past experiences
過去の経験を活かせないかも



Winter-spring SST in the area of 135-160°E , 25-30°N .
東経135-160° 北緯25-30° 海域の冬春季SST

Climate change

- Internal climate variability

内部的気候変動

+
Global warming

地球温暖化

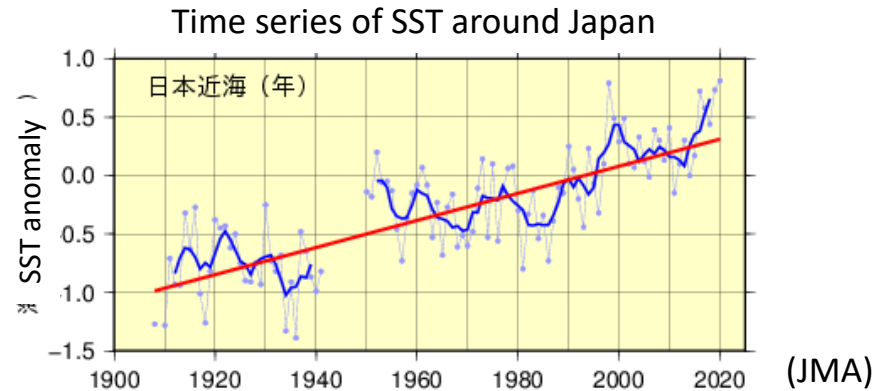
- Internal climate variability

(+ Teleconnection)

テレコネクション

- Marine Heat Wave

海洋熱波



The global warming is an ongoing phenomenon

地球温暖化は進行中の現象

- New types of climate phenomenon

- Changes in the known phenomena

新しい温暖化関連現象や既知の現象の変容が発生する可能性

Ecosystems in the
western north Pacific

西部北太平洋の生態系へ影響

Difficulties to forecast the impact of climate change on local ecosystems

気候変動による生態系への影響を予測の難しさ

4 What are the most critical data gaps that must be filled?

- Difficulties to predict changes in marine environment with climate change
- Difficulties to predict the correspondence of fisheries resources to the environmental change

気候変動に伴う海洋環境の変化を予測する難しさ
海洋環境の変化への水産資源の応答を予測するのは難しさ

Collecting data on recruitment and impacting factors

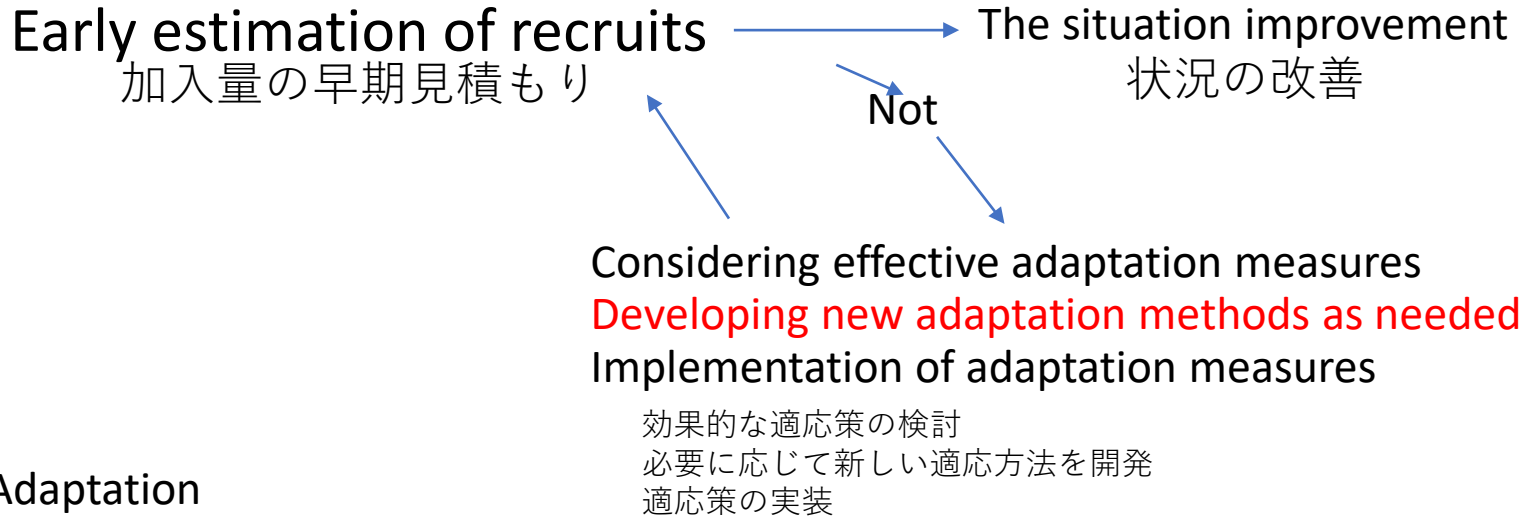
Detecting states and changes in the recruitment **as soon as possible**

加入と加入に影響する要因を把握し、可能な限り早く加入の状態や変化を探知すること

- Is the recruitment improving?
- Does the recruitment remain low ?
- Is the recruitment getting worse?

加入は好転しているのか？低いままか？悪化しているのか？

To adapt to the impact of the climate change



Adaptation

1. Improve the situation by applying new methods
2. Change the fishing targets to the species which is increasing in stock
3. Adoption of other fishing methods, conversion to aquaculture, etc.

1 新しい方法を適用することで状況を改善する、2 漁獲対象を増加している種に変える
3 他の漁法の採用、養殖への転換、など

Scientifically showing how long the current stock situation will last will help fishermen decide what adaptations to take.

どのくらい現在の資源状況が続くかを科学的に示すことは、漁業者がどのような適応策を取るかを決めるのに役にたつ

To adapt to the impact of the climate change

So, we should also promote understanding of the mechanisms based on new scientific knowledge.

最新の科学的知見をもとにメカニズムの理解を進めることが必要。

FRA would like to take advantage of this opportunity for cooperation and information sharing with you to create strategies for climate change adaptation that impact to the fisheries.

FRAは皆さんとの協力や情報共有を気候変動の漁業への影響に適応するのに活かしていきたい。

Thank you for your attention !