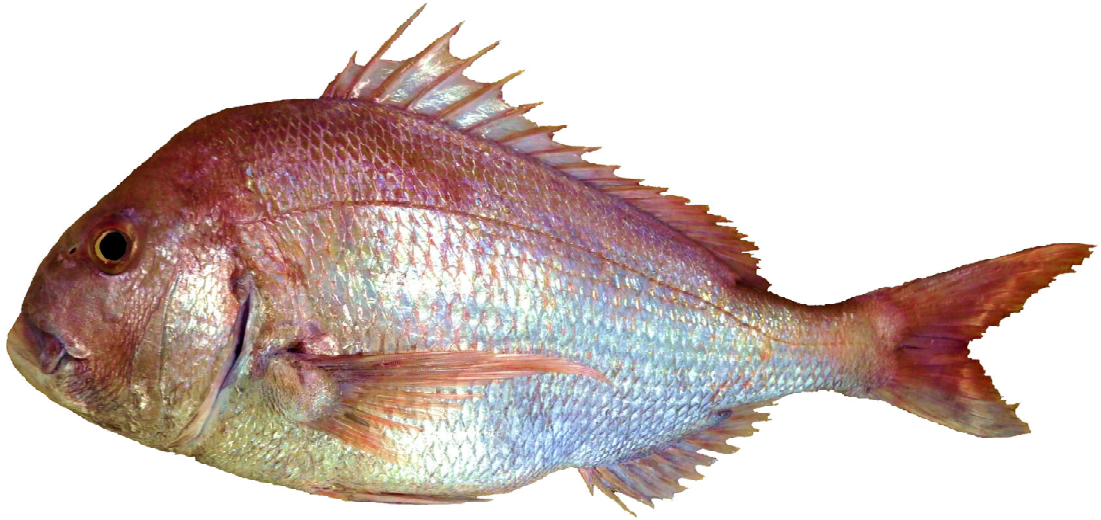
# Central and Western Seto Inland Sea Stocks of Japanese Seabream (*Pagrus major* )



- **Peer Review Meeting for Japanese Fish Stock Assessment, 7-10 November 2023**

# Questions and Answers

Comments from Peter Kuriyama

## 1. Data Sets

a. Please provide sample sizes for the biological composition (lengths/ages/weights) data used in the analysis.
A: Based on 394 samples measured in 2021.

c. I was not able to find Shimamoto 1999 online. Please provide details about the decision to use these M values that decline with age.

14) How were the values, especially M, in Supplementary Table 2-1 obtained? (Comments from Steven L. H. Teo )

A: Shimamoto 1999 determined natural mortality coefficients from existing literature values and ecological characteristics (Natural mortality is higher for smaller fish: Sahara 1987).

佐原雄二1987 魚の採餌行動 東京大学出版会 東京 pp. 1-121.

# Setting Future Projections

- The assessment was conducted using various settings (natural mortality coefficient, maturity rate, average weight by age, and current catch pressure (Supplementary Table 5-1)) based on the reproduction relationship used to estimate F (Fmsy) to achieve the maximum sustainable production MSY at the "Research Institution Meeting on Management Standard Values, etc." (R4, September 2021).
- Two conditions were used in the future projections: without and with seed release.
- In the setting with hatchery releases , the mean number of age-0 stock derived from hatchery releases (2016-2020) of 58,000 fish was used as the future number of fish added from hatchery releases each year.

| Age | Selectivity | Fmsy | F2022 | Average weight (g) | M | Maturity rate |
|---|---|---|---|---|---|---|
| 0 | 0.28 | 0.04 | 0.03 | 77 | 0.39 | 0.0 |
| 1 | 1.00 | 0.15 | 0.11 | 201 | 0.24 | 0.0 |
| 2 | 1.61 | 0.24 | 0.17 | 353 | 0.17 | 0.0 |
| 3 | 2.26 | 0.34 | 0.24 | 534 | 0.17 | 0.5 |
| 4 | 2.79 | 0.41 | 0.30 | 734 | 0.17 | 1.0 |
| 5 | 3.56 | 0.53 | 0.38 | 967 | 0.17 | 1.0 |
| 6+ | 3.56 | 0.53 | 0.38 | 1,526 | 0.17 | 1.0 |

## 2. Ecology

a. Please provide details about the analysis used to determine the age-length values used here.

12) Fig 2-2 shows the average length-at-age and weight-at-length from a study in 1983. Please provide some details of the study. How was the aging done? What is the variability from that study? Can you show the age-at-length data from the study? Comments from Steven L. H. Teo

A: As specimens, Japanese seabream caught in the Teshima area of Kure, Hiroshima, were used. The survey items included age assessment using scales and length and weight measurements. The number of specimens used is unknown.

## 2. Ecology

b. There seems to be a mismatch between the ages included in the assessment (plus group begins at age-6) and the total lifespan of 15-20 years. Are there no data available for fish from age 7-15 or 7-20? Are older fish caught in nearby areas?
A: Older Japanese seabream are caught in the Inland Sea, although not in large quantities. According to measurements to date (n=17591), individuals over 7 years of age account for about 2% of the total.

c. Please provide details about the steps used to develop the maturity ogives.
A: The literature values of Kitajima 1978, based on a sample survey, were adopted.

**3. Fishery Status**

a. Check and correct typos with “steadysteady” in the document.
A: Corrections made.

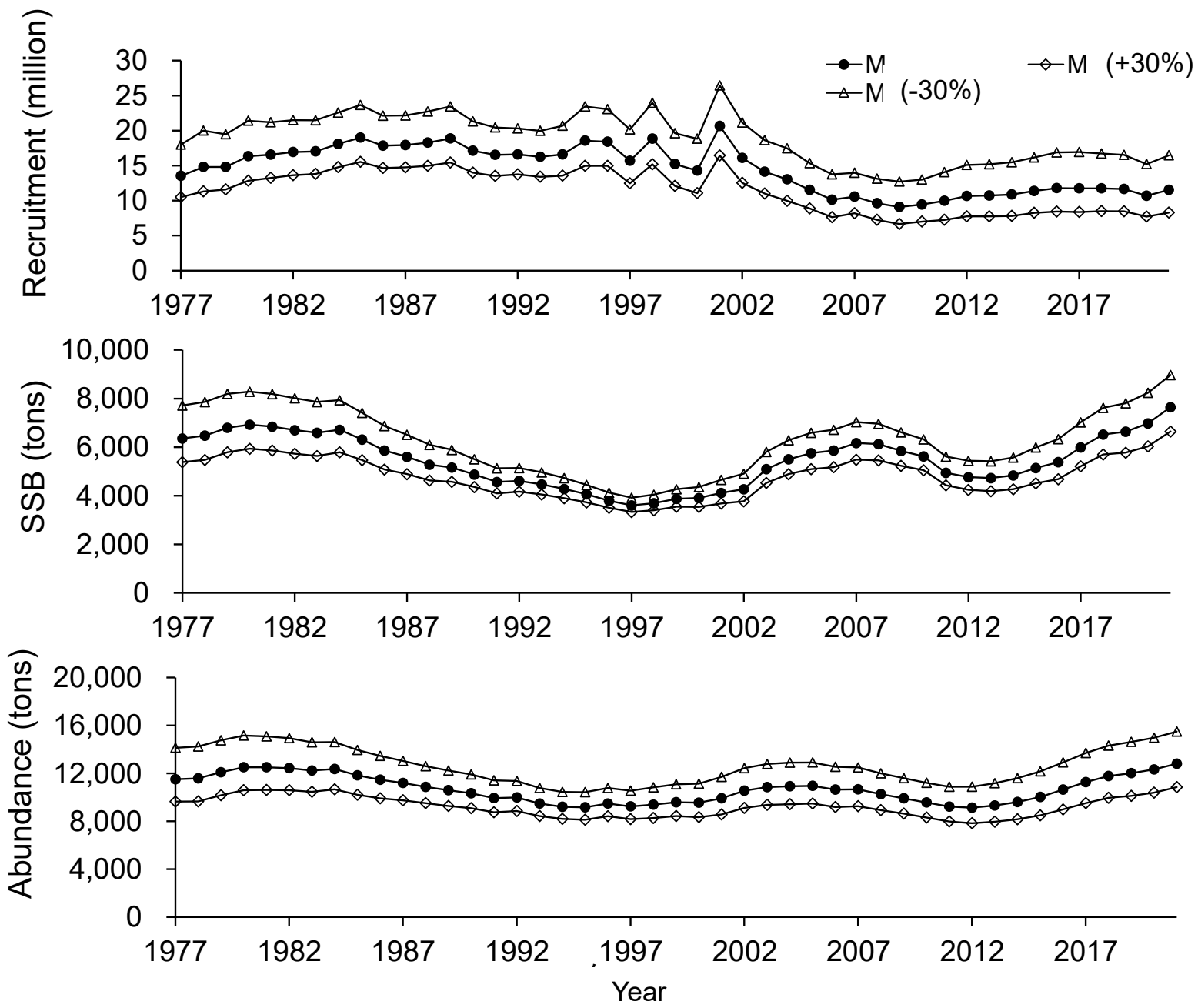
b.Do the Gochi seine and small trawl fishery tend to catch fish of different ages?
A: Landing patterns differ between Small trawl fishery and "Gochi" seine fishery. "Gochi" seine fishery catches only large Japanese seabream and lands them live. In Small trawl fishery, Japanese seabream is not the main target species and relatively small Japanese seabream is caught as bycatch.

## 4. Stock status

a. Please describe some details for averaging based on the past five years of F and recruitment volume. For example, are these years representative of dynamics and why use five years instead of two or three years?
A: A five-year period over which catches are averaged is less sensitive to fluctuations in catches than a three-year period.

b. Please provide some rationale behind shifting M by 30% (as opposed to another percentage) as a sensitivity. Do these changes affect the reference points?
A: Followed specifications of predecessor. Sensitivity analyses were not performed when different amounts of change were used.

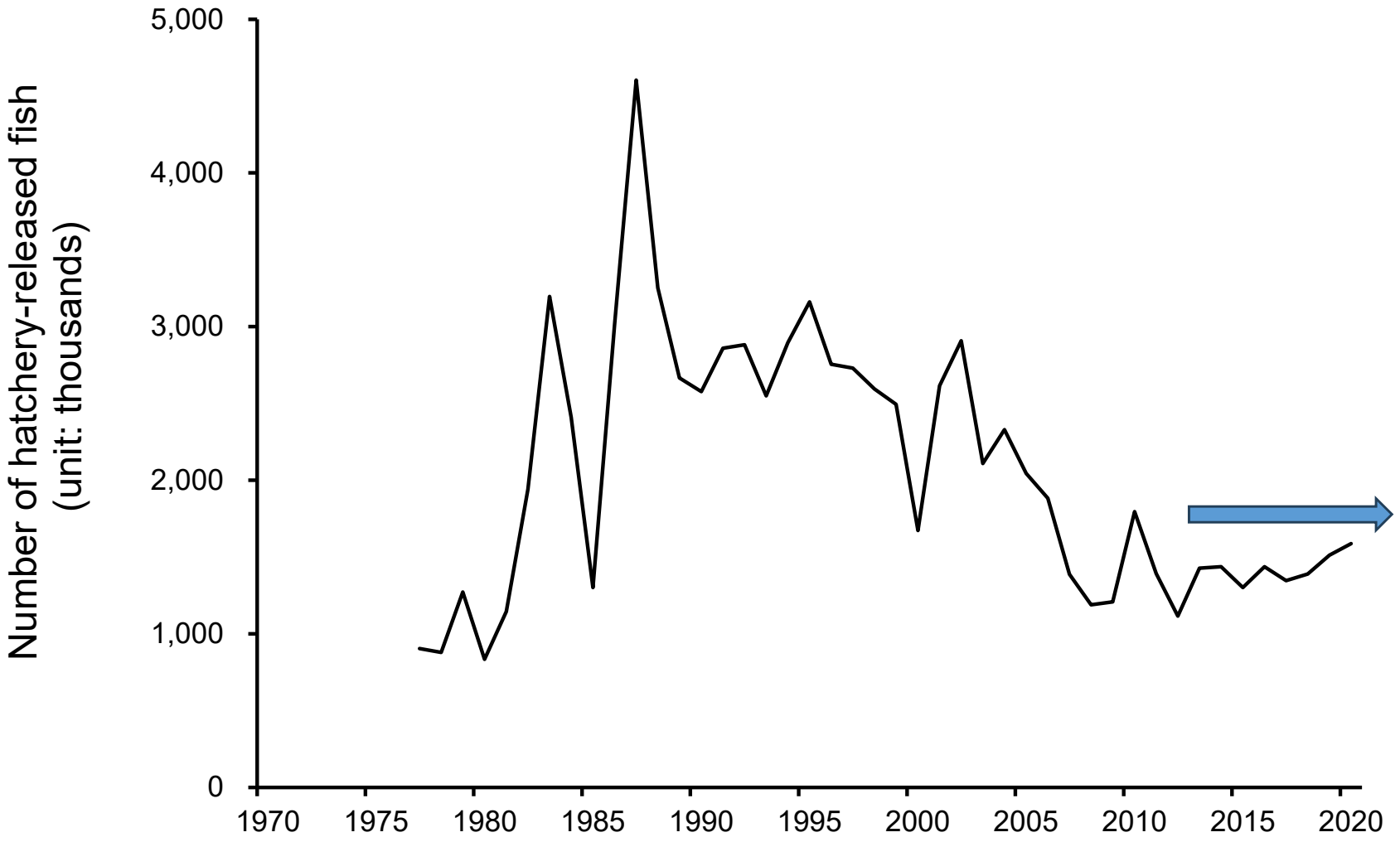
# Trends in estimated results based on variation in natural mortality



## 4. Stock status

c.What factors drive the numbers of hatchery-released fish?
A: Depends on the budgets of fishing organisations and prefectures. As the value of Japanese seabream is low for fishermen, releasing its seed stock is a low priority.

# Number of released fish for the central and western Seto Inland Sea stocks of *Pagrus major*



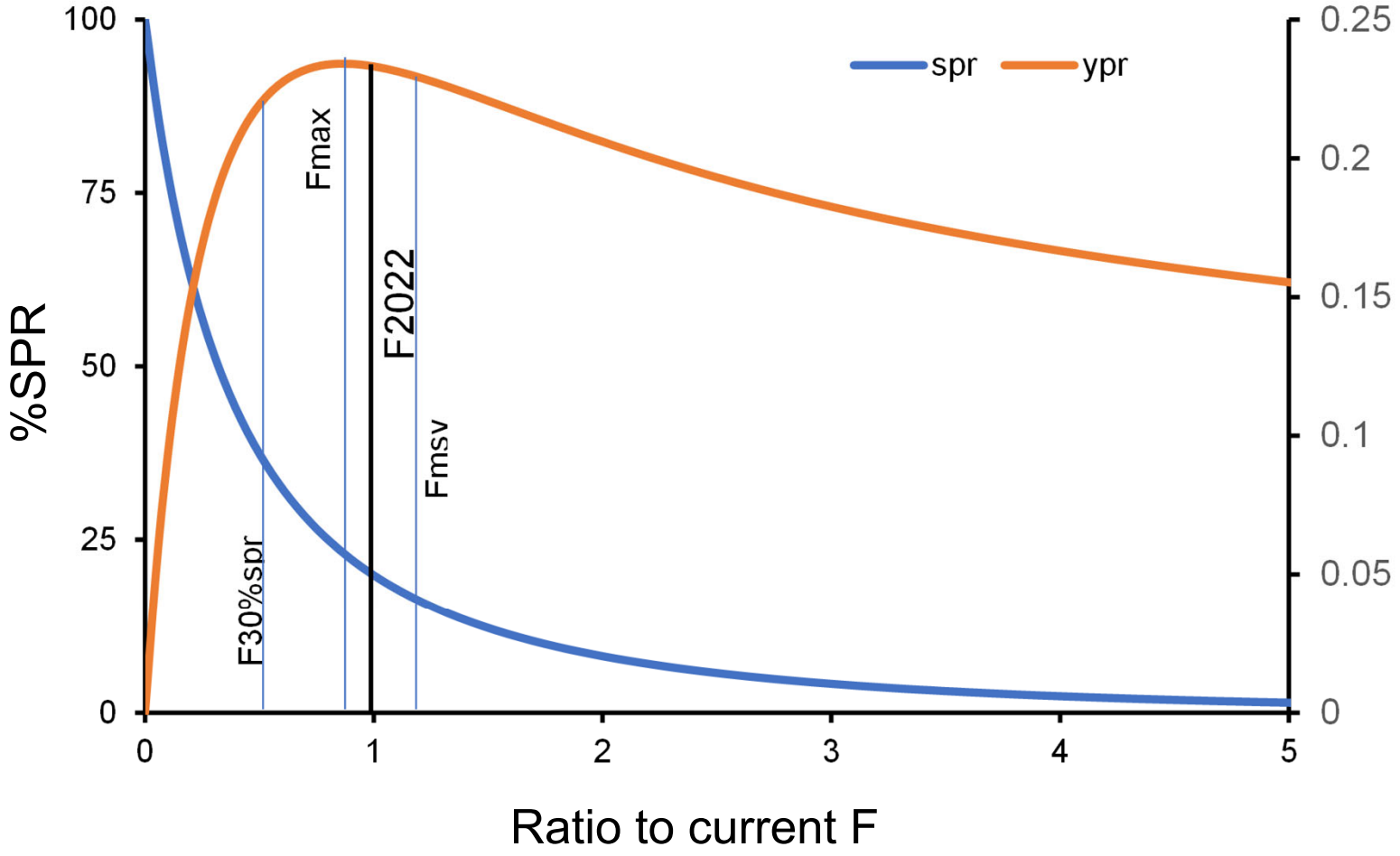
**4. Stock status**

d. Is the goal of the hatchery program to improve recruitment in the wild population? Or is it to provide fish to be harvested as they grow older? Please provide some more details. Also I was not clear if the hatchery fish are incorporated to the assessment.
A: The purpose of seed releases is to add parent fish to natural stocks to increase abundance and increase catches.

See "Overview on the stock enhancement in Japan.“

e. How are the YPR and SPR values used in management?
A: Not used.

# Relationship between current fishing pressure (F2022) and YPR and %SPR

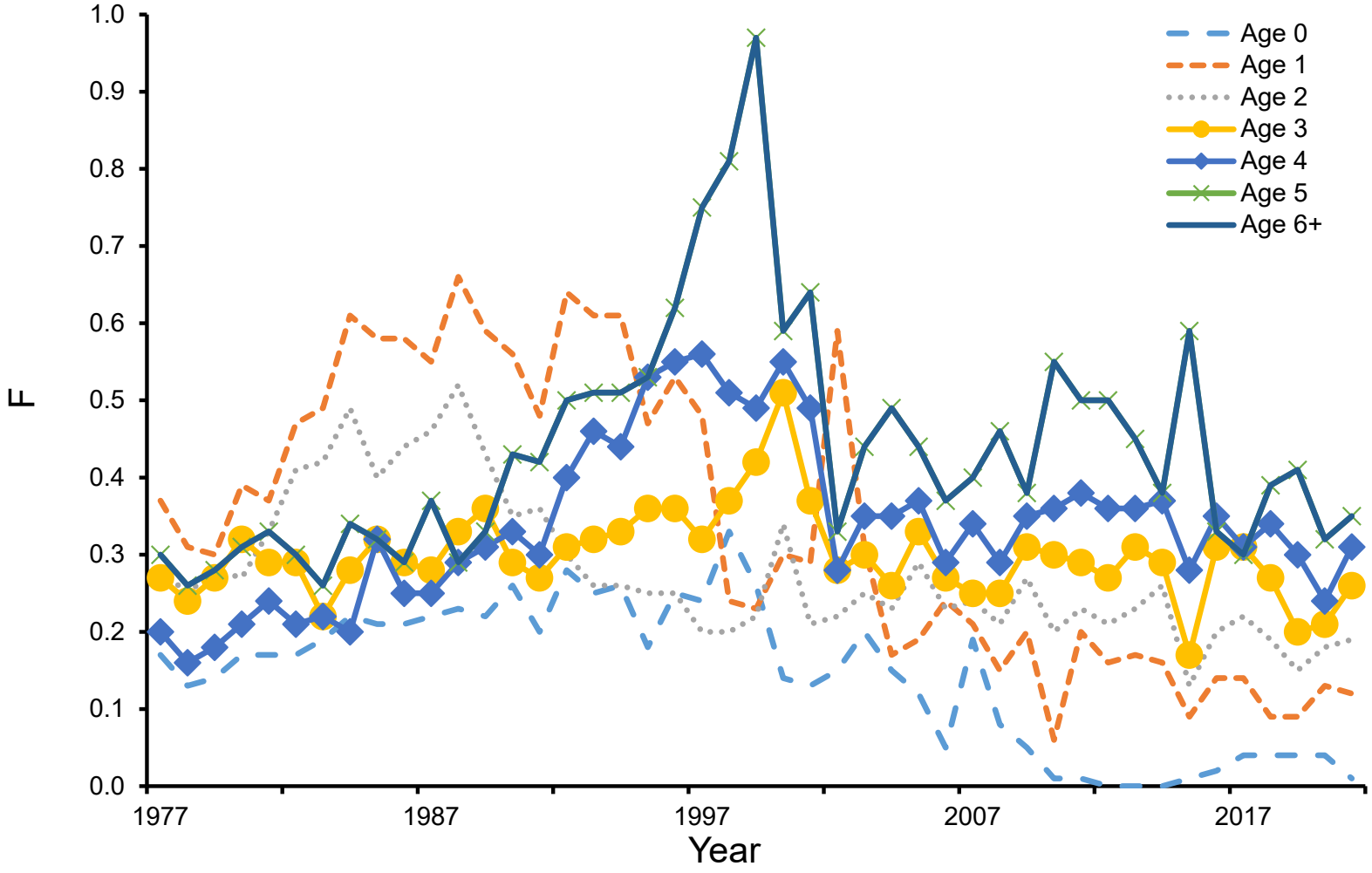



F30%spr < F2022 < Fmsy

**5. Fig 4-4:**

a. The F values for age 5 and 6+ seem to be high relative to the age distributions between 1997 and 2002. I'm curious what you think is driving this pattern because it doesn't look like in Fig. 3-2 that there were high proportions of age 4 fish and then small proportions of age 5 fish.
A: Unknown.

# Changes to fishing mortality (F) at age over time



## 6.Supplementary table 2-1

a. How were these selectivity values calculated? It does not seem that the units could represent the proportion of fish removed at each age. What do these numbers represent?
A: These value is relative to F at age 1.

# Setting Future Projections

- The assessment was conducted using various settings (natural mortality coefficient, maturity rate, average weight by age, and current catch pressure (Supplementary Table 5-1)) based on the reproduction relationship used to estimate F (Fmsy) to achieve the maximum sustainable production MSY at the "Research Institution Meeting on Management Standard Values, etc." (R4, September 2021).
- Two conditions were used in the future projections: without and with seed release.
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**Hatchery releases**

Comments from Steven L. H. Teo

1) Similar to the other demersal stocks, please clarify the general aim for the assessment and management of this stock with regards to hatchery releases versus wild-origin fish. For example, is the primary aim to assess and manage the wild-origin fish? Or is it important to manage the hatchery releases as well?
A: See "Overview on the stock enhancement in Japan.“

2) It was stated that the contribution rate and survival rate of hatchery release were very low. It was also stated that the accuracy of these rates was also low because there is no data collection system. It is unclear how these rates were estimated. Please explain how these rates were estimated. Also please provide the uncertainties of these estimated rates.
A: hatchery releases contamination rate surveys are planned and conducted independently by each county research institute, so the protocols are not standardised. Therefore, it is difficult to compare their respective figures and it is not possible to calculate the uncertainty.

**Hatchery releases**

3) How are hatchery releases identified?
A: The identification of wild-origin fish and hatchery releases is determined by the presence or absence of deformity of the internostril epidermis.
See "Overview on the stock enhancement in Japan.“

4) Were the hatchery-origin recruits considered to be the same as wild-origin recruits?
A: It is assumed that there are no ecological differences between them.

5) Is the recruitment contribution for hatchery releases considered part of the stock and after maturity, part of the SSB?
A: True enough.

6) Hatchery releases, if not captured, can be assumed to contribute to the SSB and future recruitment. Is the per capita contribution of hatchery-origin fish similar to wild-origin fish? How does this affect the assessment and management for this stock?
A: It can be assumed that they behave similarly to wild-origin fish stocks.

## Hatchery releases

7) What is the age and size of the fish that are released? How does this compare to the age and size of recruits?
A: 50-120 mm FL fry are released.
See "Overview on the stock enhancement in Japan.“

8) Are there any regulations on the hatchery releases?
A: Fisheries Agency guidelines recommend the production of hatchery releases produced from parent fish within the same stock.

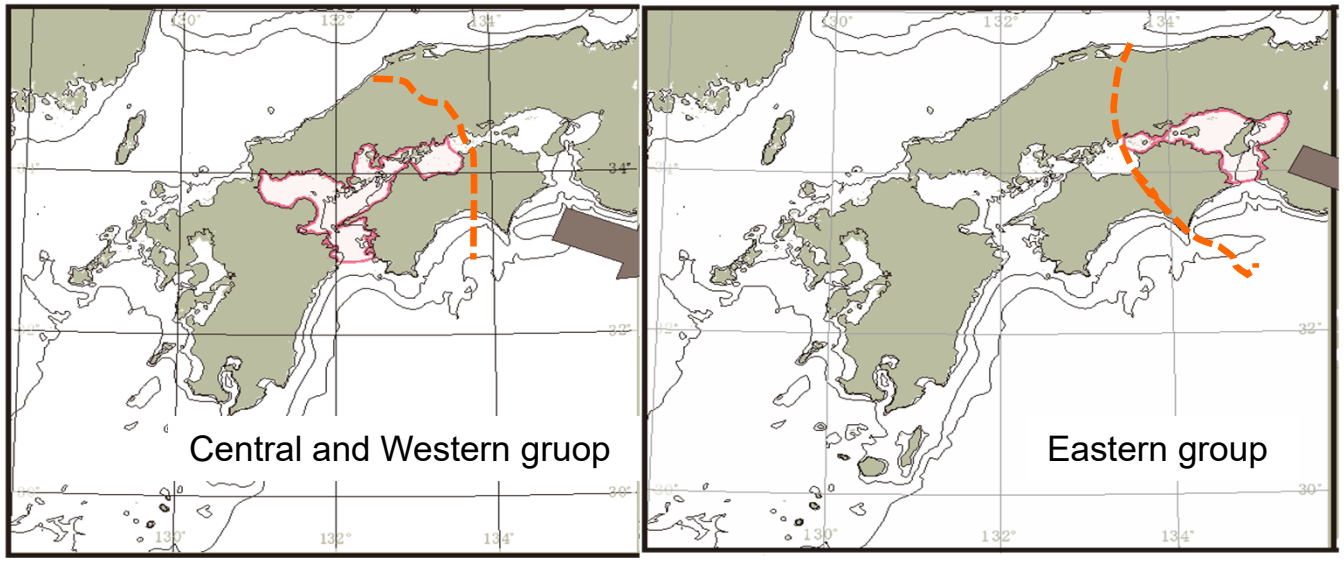
独) 水産総合研究センター・水産庁（2015）人工種苗放流に係る遺伝的多様性への影響リスクを低減するための技術的な指針

9) Japanese seabream is an important aquaculture species and likely have been subject to strong selective pressure in aquaculture. Are the hatchery releases the same fish as the aquacultured fish?
A: hatchery-reared Japanese seabream for aquaculture are supplied by manufacturers with their own unique characteristics, such as growth and anti-pathogenic properties. hatchery-reared Japanese seabream for release are considered not to differ significantly from wild-origin fish , as hatchery-reared fish derived from wild parent fish are released.

## Stock structure and distribution

10) Given the geography of the Seto Inland Sea, one would expect a single stock around the whole Inland Sea. What is the evidence for having a stock only in the Central and Western Inland Sea? Or is the separation due to management units?

A: A follow-up study of releases of labelled fish in the 1980s showed that the eastern Seto Inland Sea Japanese seabream rarely, if ever, migrates to the central and western parts of the Seto Inland Sea. The results of this survey were the basis for the current classification of the stock groups.




瀬戸内海東部マダイ班 (1988) 回遊性魚類共同放流実験調査事業総括報告書第Ⅱ期. 兵庫県水産試験場, 明石, 1-60.

**Stock structure and distribution**

11) Are there Japanese seabream on the Pacific Ocean coast? If so, what is the evidence to separate these fish from the Inland Sea stocks?

A: Japanese seabream is distributed along the Pacific coast south of Hokkaido, Japan.
Japanese seabream  is a less mobile species.
As a less migratory species as an adult, Japanese seabream  is considered to mix little with the Inland Sea stock group and the Pacific coast stock group.

長澤和也(2009)寄生虫を用いた瀬戸内海産マダイの資源構造解明の試み. 2009年度瀬戸内海ブロック資源評価会議資料
海老名謙一(1937)真鯛の系統に関する研究. 日本水産学会誌, 6(4); 179-181.
海老名謙一(1938)真鯛の系統に関する研究Ⅱ. 日本水産学会誌, 7(3); 151-154.
海老名謙一(1940)真鯛の系統に関する研究Ⅲ. 日本水産学会誌, 6(4); 295-297.

# Ecology

## Life history

Spawning grounds — Offshore reef areas

Separated Floating Eggs

↓

Nursery — Coastal seagrass beds and sandy mud bottoms

**Growth** — Juveniles

↓

Slightly offshore seaweed beds and sandy mud bottoms

↓

Wintering spot — Offshore reef areas

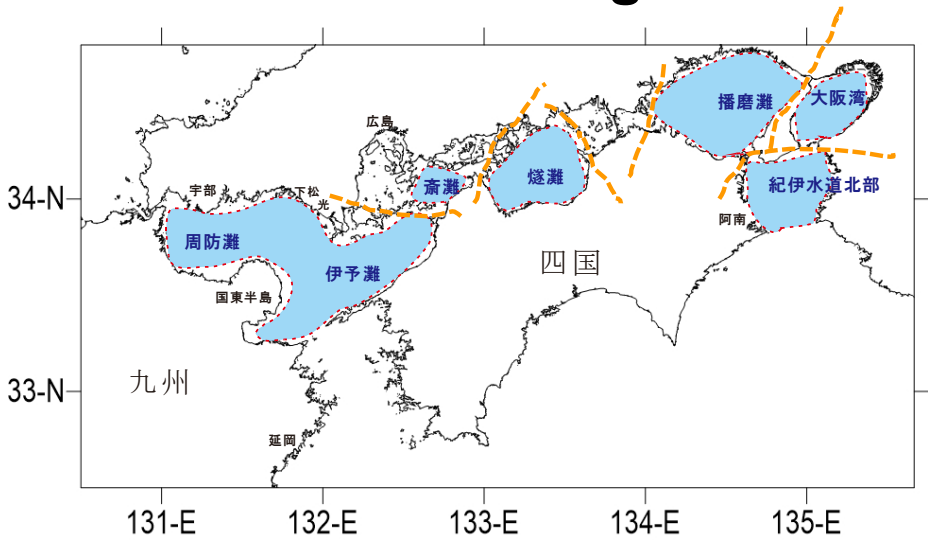
One year after hatching.

↓

**Since then, inhabitants of reef areas**

There is information that they change their habitat according to body size. (Information from fisheries)

## Movement and migration




**After juveniles, they rarely migrate.**

- There is little exchange in populations between geographically demarcated areas (from the internal parasitoid fauna).
- During the winter months, part of the population of Japanese seabream in Osaka Bay migrates to the Kii Channel.

長澤和也(2009)寄生虫を用いた瀬戸内海産マダイの資源構造解明の試み. 2009年度瀬戸内海ブロック資源評価会議資料

## Biology

13) Biological parameters, like growth, of fish often changes year to year, and season to season. Have there been studies on the variability of growth for this stock?
A: There will be no applicable study reports.

## Catch-at-age, Age-length key

15) For a cohort analysis, it is assumed that catch-at-age is known and is typically considered to be an important assumption. Therefore, it is important to understand how the catch-at-age time series was developed. However, it is not clear in the provided documentation how the catch-at-age data was developed. Please explain in detail how the catch-at-age in numbers time series was developed.

17) Please explain how the age distributions were obtained. Were ALKs used to convert length to ages? If so, please show the ALKs. If not, was cohort slicing or some other method used?

1-b Please provide details of the ageing process.
(Comments from Peter Kuriyama )

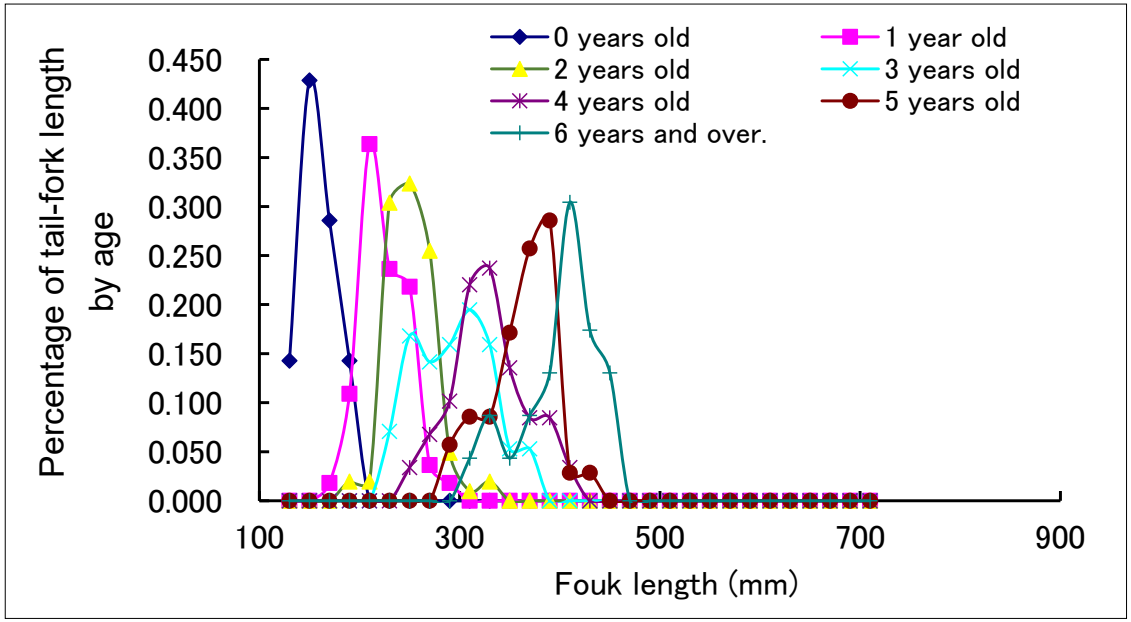
(2) I would like to know the procedure for preparing a detailed CAA.
(Comments from Takashi Yamakawa )

described below

# Age-length key

Measurement data for Ehime and Yamaguchi prefectures in 2021.

FL, BW and age (otoliths)




The mean length and its variance per age of the sample group are used to estimate the length distribution, assuming a normal distribution.

| Age(I) | 0 | 1 | 2 | 3 | 4 | 5 | 6+ |
|---|---|---|---|---|---|---|---|
| N | 7 | 55 | 102 | 113 | 59 | 35 | 23 |
| mu | 156.3 | 221.4 | 248.8 | 293.0 | 325.5 | 371.3 | 412.3 |
| sigma | 19.2 | 24.4 | 21.9 | 42.7 | 36.7 | 28.5 | 30.8 |
| W | 45.36 | 114.59 | 156.20 | 241.41 | 319.33 | 453.35 | 598.74 |

n=394

μ: Average FL

W = 0.066355 * μ^ 2.659592 / 1000

# Age-length key(2021)

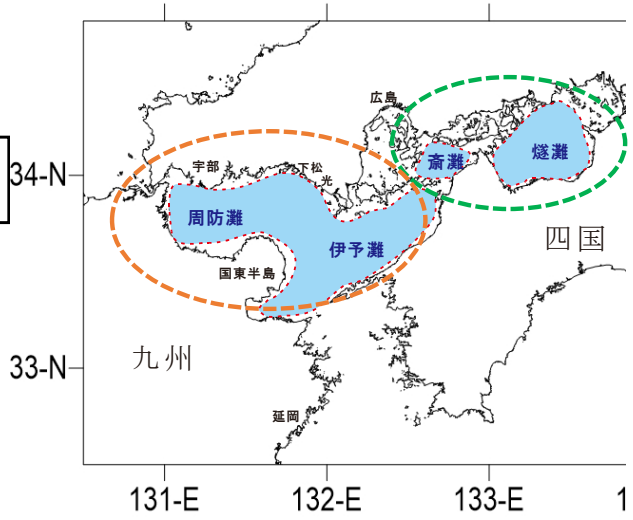
| Length | Age0 | Age1 | Age2 | Age3 | Age4 | Age5 | Age6+ |
|---|---|---|---|---|---|---|---|
| -100 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 120 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 140 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 160 | 0.940 | 0.060 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 180 | 0.526 | 0.402 | 0.072 | 0.000 | 0.000 | 0.000 | 0.000 |
| 200 | 0.000 | 0.949 | 0.051 | 0.000 | 0.000 | 0.000 | 0.000 |
| 220 | 0.000 | 0.387 | 0.497 | 0.116 | 0.000 | 0.000 | 0.000 |
| 240 | 0.000 | 0.293 | 0.435 | 0.226 | 0.046 | 0.000 | 0.000 |
| 260 | 0.000 | 0.073 | 0.509 | 0.283 | 0.135 | 0.000 | 0.000 |
| 280 | 0.000 | 0.047 | 0.127 | 0.413 | 0.264 | 0.148 | 0.000 |
| 300 | 0.000 | 0.000 | 0.018 | 0.351 | 0.398 | 0.155 | 0.078 |
| 320 | 0.000 | 0.000 | 0.033 | 0.271 | 0.403 | 0.146 | 0.148 |
| 340 | 0.000 | 0.000 | 0.000 | 0.132 | 0.336 | 0.425 | 0.108 |
| 360 | 0.000 | 0.000 | 0.000 | 0.110 | 0.176 | 0.534 | 0.180 |
| 380 | 0.000 | 0.000 | 0.000 | 0.000 | 0.169 | 0.570 | 0.260 |
| 400 | 0.000 | 0.000 | 0.000 | 0.000 | 0.092 | 0.078 | 0.830 |
| 420 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.141 | 0.859 |
| 440 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| 460 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| 480 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| 500 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| 520 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| 540 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| 560 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| 580 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| 600 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| 620 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| 640 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| 660 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| 680 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| 700 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |

# Catch At Age (CAA)

The distribution area of SCW Stock is divided into two areas.

Central Seto Inland Sea

Western Seto Inland Sea




Length composition of the monthly catch by fishery type for the fishing ports included in each area.

Small trawl fishery, "Gochi" seine fishery, anglings, Set net fishery, other.

Use the Age-length key to convert to an age composition.

Renewed annually

Annual total

CAA of catches by fishery type by area.

Calculation of CAA weighted by catch per area.

Catch at age(CAA) in the SCW stock.

**Data – Catch-at-age**

16) Was there operational aging done for this stock? If not, was there some sort of length or weight sampling?
A: It has been studied in a sample of some provinces.

18) It was reported that recreational fishery surveys indicated up to 331 tons (8% of total catch) was by the recreational fishery. Was this catch included in the catch-at-age used for the cohort analysis? If yes, how were the catch for the years without surveys estimated? If not, why was these catches considered negligible?
A: Not included. Recreational catch was not taken into account in previous stock assessments.

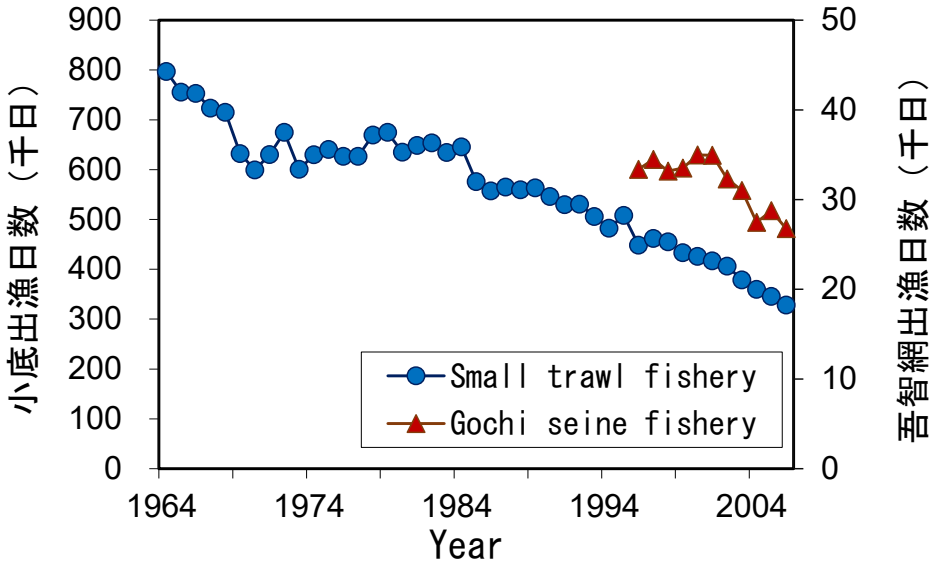
**Data – Abundance indices**

19) Why is there no CPUE data after 2006? Seems unusual.

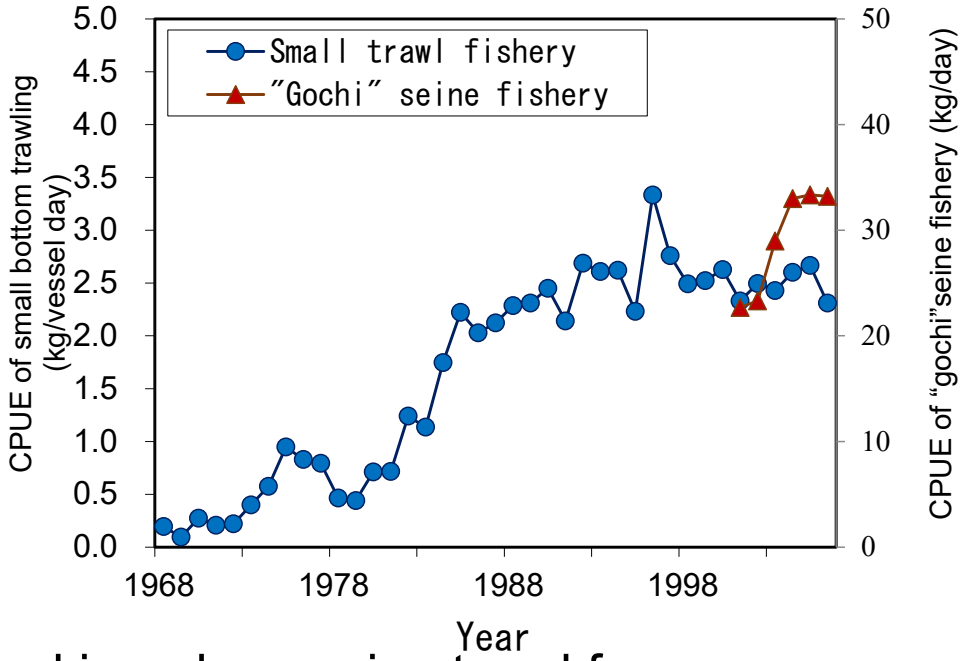
A: Since 2007, the method of collecting Statistics on Marine Fishery Production has been changed by the Ministry of Agriculture Forestry and Fisheries (MAFF) and effort is no longer collected.

# Effort

The total number of vessel days at sea for Small trawl fishery and “gochi” seine fishery (1964 to 2006)




Trends in CPUE of Small trawl fishery and “gochi” seine fishery




Until 2006, the amount of effort remained in a decreasing trend for both Small trawl fishery and “gochi” seine fishery .

In the Seto Inland Sea, fishing effort has also decreased due to a decrease in the number of fisheries operators.

Since 2007, the method of collecting Statistics on Marine Fishery Production has been changed by the Ministry of Agriculture Forestry and Fisheries (MAFF) and effort is no longer collected.

**Models & Diagnostics**

20) It was stated that the model was not tuned to an index. This is unusual. Please explain why this decision was taken.
A: The stock assessment is carried out using only data collected from fisheries. CPUE data collected from fisheries are unreliable and there is no data available for standardisation, etc. to increase reliability.

21) There is a clear retrospective pattern in the model. Is there any understanding of the cause?
A: The reasons are unknown.

**Stock-recruitment**

23) When estimating the SRR, only wild-origin recruits were used. Was the SSB is there a distinction between SSB of hatchery-origin versus wild-origin?
A: It is assumed that individuals derived from population hatchery-origin are also included in the wild-originonce they have grown up.

24) Please explain why the Ricker SRR was chosen as the base case rather than the hockey stick used for the East China Sea stock. How does the Ricker compare with the Beverton-Holt and hockey-stick?
f. Please provide some details why Ricker stock-recruit relationship was used over other relationships. Comments from Peter Kuriyama
A: In the western Seto Inland Sea, the distribution area has expanded into waters where Japanese seabream has not been present in the past. There is circumstantial evidence that the environmental yield capacity of this area is close to the limit.

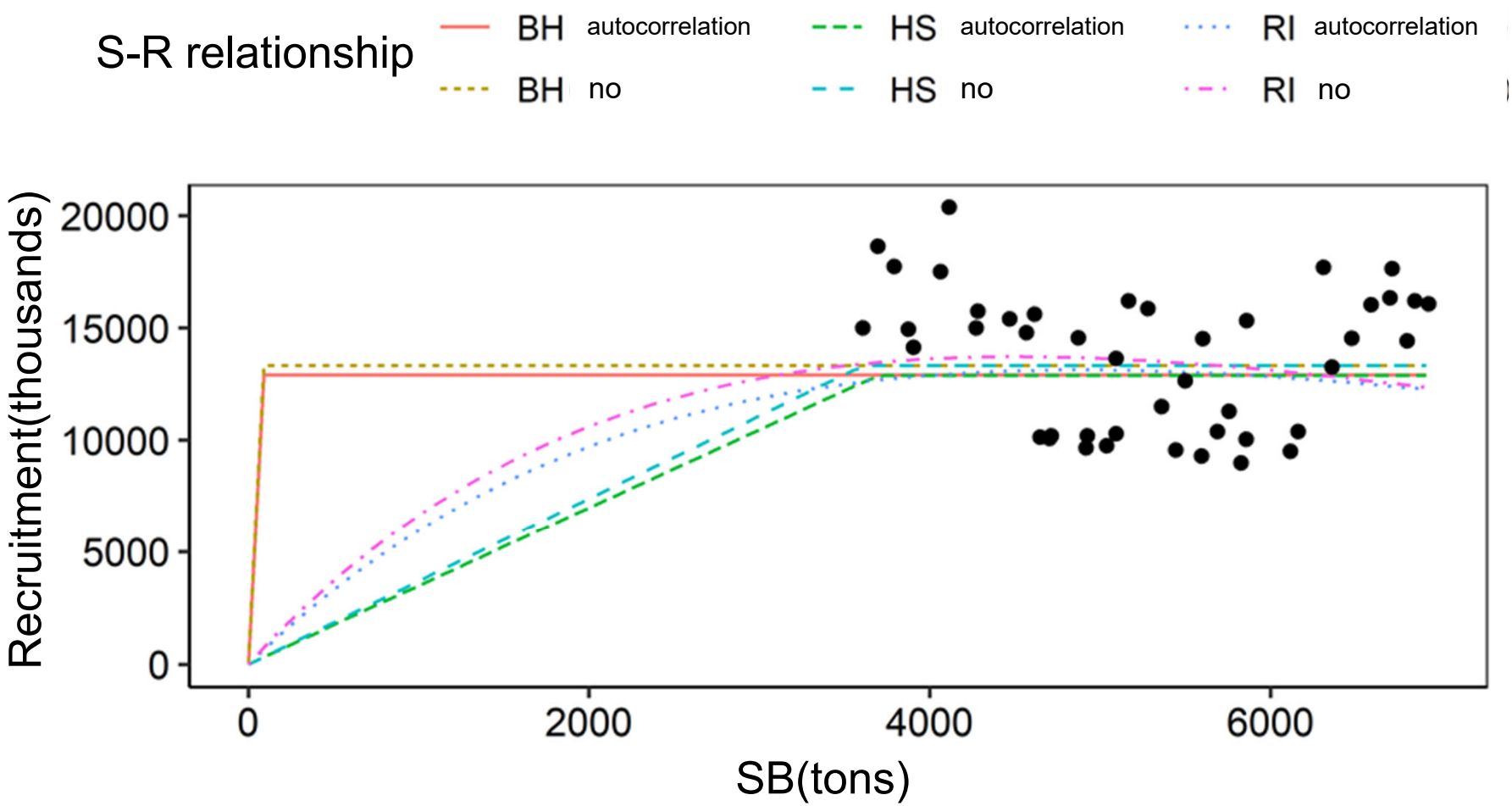
22) Is there a table of all the estimated parameters and their uncertainty?

described below

# Comparison of AICc

| S-R relationship | Optimisation method | autocorrelation | AICc | ΔAICc |
|---|---|---|---|---|
| **Hockey stick (HS).** | Mean Squared Error | L2 | -61.97 | 0 |
| **Beverton Holt (BH).** | Mean Squared Error | L2 | -60.63 | 1.34 |
| **Ricker, RI.** | Mean Squared Error | L2 | -59.74 | 2.24 |
| **Hockey stick (HS).** | Mean Squared Error | No | 2.37 | 64.34 |
| **Beverton Holt (BH).** | Mean Squared Error | No | 2.37 | 64.34 |
| **Ricker, RI.** | Mean Squared Error | No | 5.68 | 67.65 |
| **Hockey stick (HS).** | Mean Absolute Error | No | 11.81 | 73.78 |
| **Beverton Holt (BH).** | Mean Absolute Error | No | 11.81 | 73.78 |
| **Ricker, RI.** | Mean Absolute Error | No | 15.64 | 77.61 |

# S-R relationship methods in each model

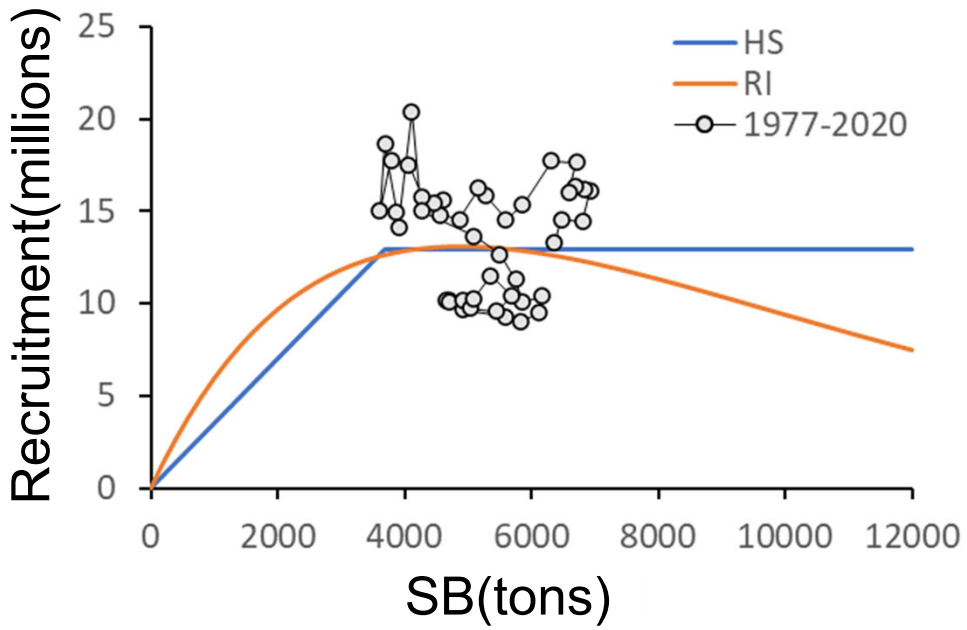



The BH model does not uniquely find inflection points.
The HS and RI models are the subject of the study.

# Comparison of HS and RI

## Comparison of reproduction curves

- Ricker type (RI), Hockey stick type (HS)
- Both least-squares and simultaneous autocorrelation estimation.
- Within the range of observation, the same level of recruitment can be can be expected.

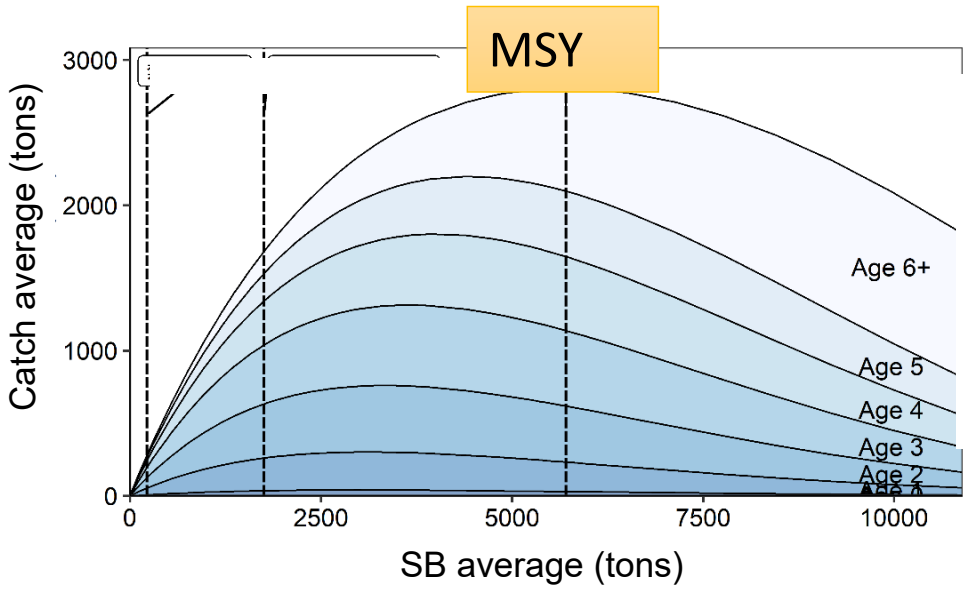


# Comparison of HS and RI

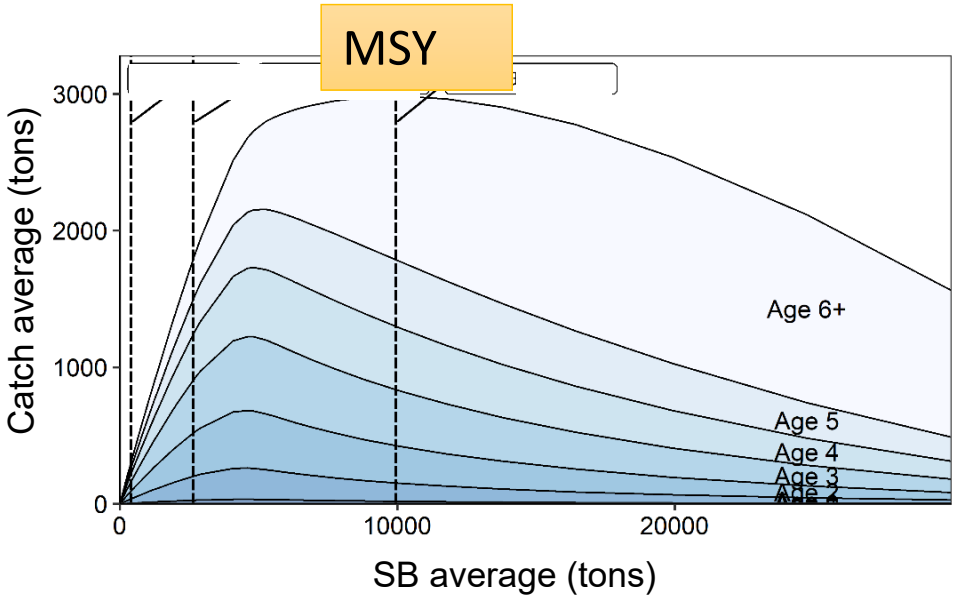
## Catch curves

- At the MSY level, HS is dominated by older fish over 6 years old, whereas in RI, fish over 2 years old are caught relatively evenly.

RI



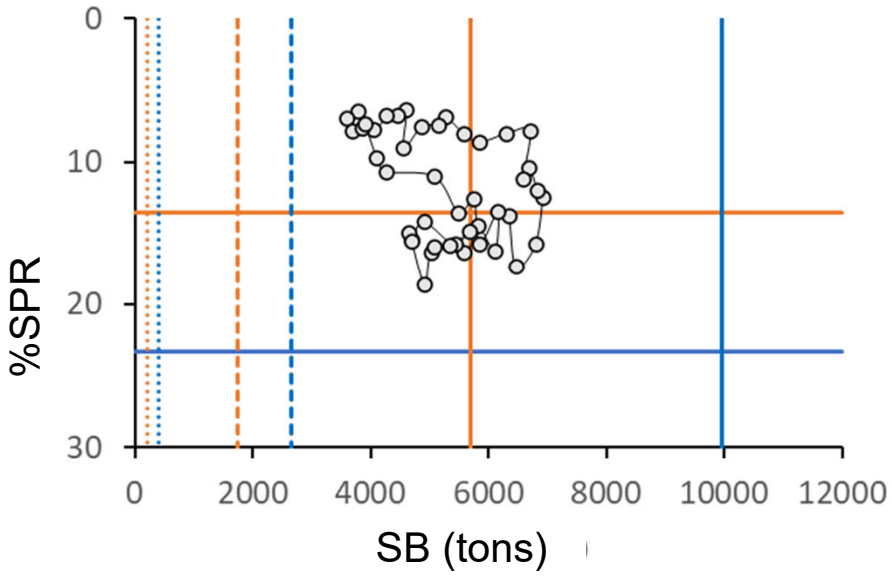

HS

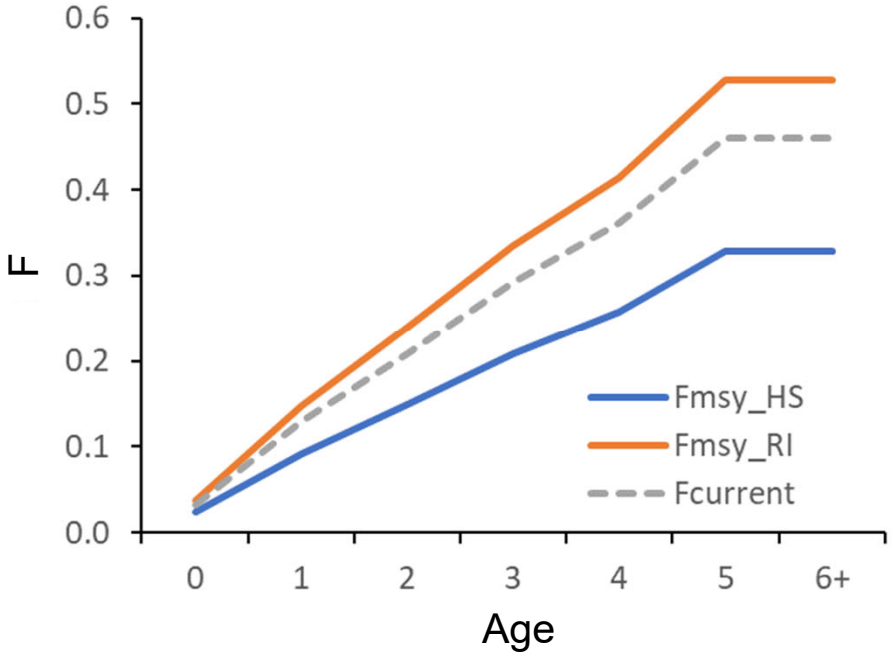


# Comparison of HS and RI

## Reference point and Fmsy

- In RI, the MSY level is around the middle of the historical values.
- In HS, the value of the MSY level is about twice higher than the historical maximum value.
- Fmsy is HS < Fcurrent < RI

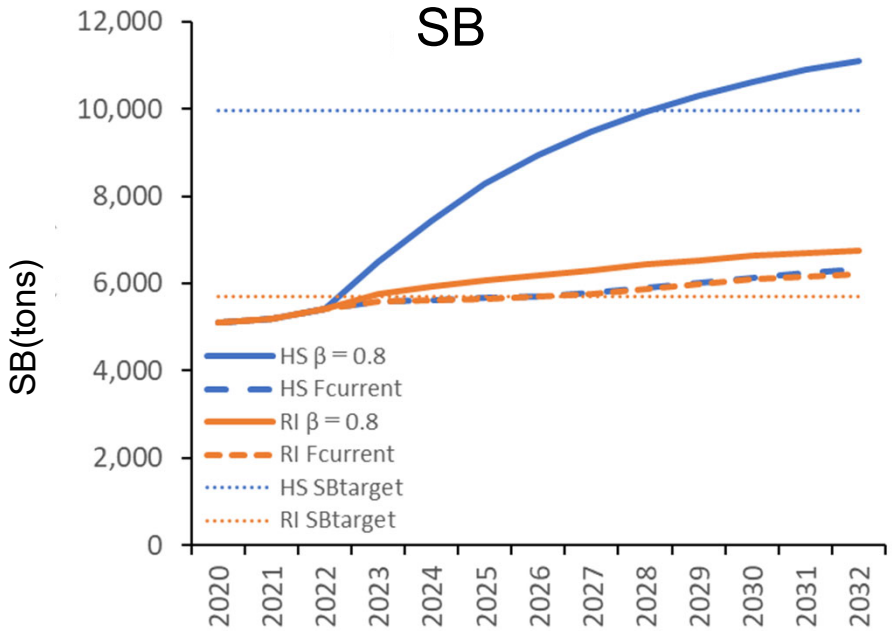


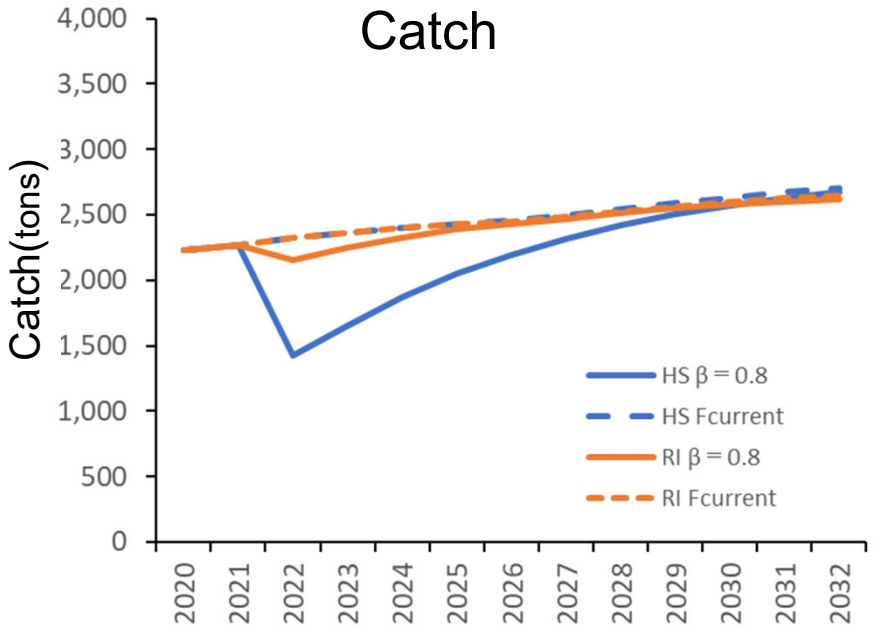



## Comparison of HS and RI

Future projections of catch and SB

- RI: Fcurrent is 0.87 Fmsy.
- HS: In the HS, catch is substantially reduced immediately after the start of management, increasing SB.
- Similarly in both models, SB increases moderately at Fcurrent.



**Projections**

25) Based on the document “Guidelines for HCRs and ABC calculations”, these calculations are supposed to be risk-based and incorporate the uncertainties in the assessment. However, the only uncertainty included in the projections appeared to be the uncertainty in future recruitment deviates. There did not appear to be any uncertainty in the reported stock assessment results. For example, the estimated SSB, recruitment, N-at-age, F-at-age, and SRR did not appear to have any uncertainties associated with them. Were these uncertainties not estimated or not reported?
A: Uncertainties such as SSB, recruitment, N-at-age, F-at-age and SRR are not estimated.

26) How would incorporating the above uncertainties affect the assessment results and projections?
A: Since uncertainty cannot be estimated, the impact of incorporating uncertainty is unknown.

## Others

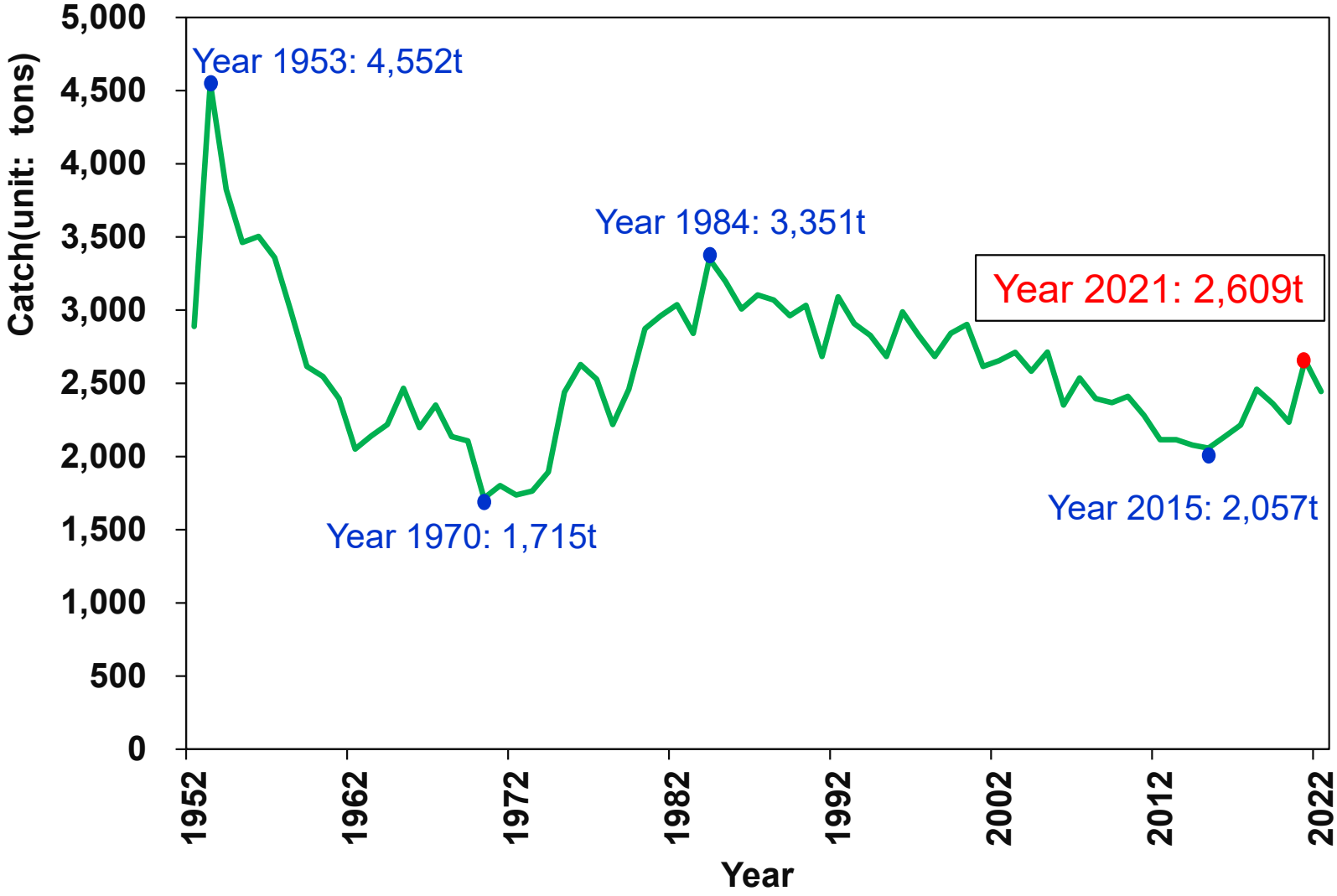
27) What are the potential improvements for this assessment?
A: Improvement of the accuracy of the abundance index. It would be possible to improve the data accuracy of the stock indicator values if sufficient human resources were available.

## Comments from Takashi Yamakawa

(1) We would like to know the changes in catches prior to 1977.

A: Graphs from 1952 were added to the presentation material.

# Trends in catch of the central and western Seto Inland Sea stocks of *Pagrus major.* (from 1952 to 2022)



(3-1) Why was CPUE data not used for VPA tuning?

A: In recent years, small bottom trawl fisheries have not targeted Japanese Seabream  as their primary target species. The catch of Japanese Seabream is due to bycatch. It is unlikely that CPUE collected under these circumstances accurately reflects the stock status of Japanese Seabream . Tuning based on inaccurate CPUE data may result in an approximation of stock abundance, but this is only the result of chance.

(3-2) What kind of data is needed to ensure the representativeness of the sea area?

A: The CPUE data currently available is the total catch of all fishing vessels divided by the total effort.
The accuracy of stock assessments would be improved if catch and effort were aggregated for each fishing vessel and only data from the middle fishing group were extracted for use in the analysis.

(4) I would like to see a sensitivity analysis of the reproduction relationship and SBmsy and Fmsy using the results of the sensitivity analysis of recruitment, parentage, and abundance to the value of the natural mortality coefficient M.

A: We will consider this as a future issue.

(5) What are the causes of underestimation in parentage and abundance estimates?

A: This may be due to underestimation of the number of age-0 fish.

(6) I would like an iso-catch chart with the catch coefficient F on the horizontal axis and the age at which the fishery started on the vertical axis.

A: We will consider this matter in the future based on requests from stakeholders and discussions at the meeting.

# Results of retrospective analysis of SSB, abundance and age 0 stock population