General introduction of the stock assessment

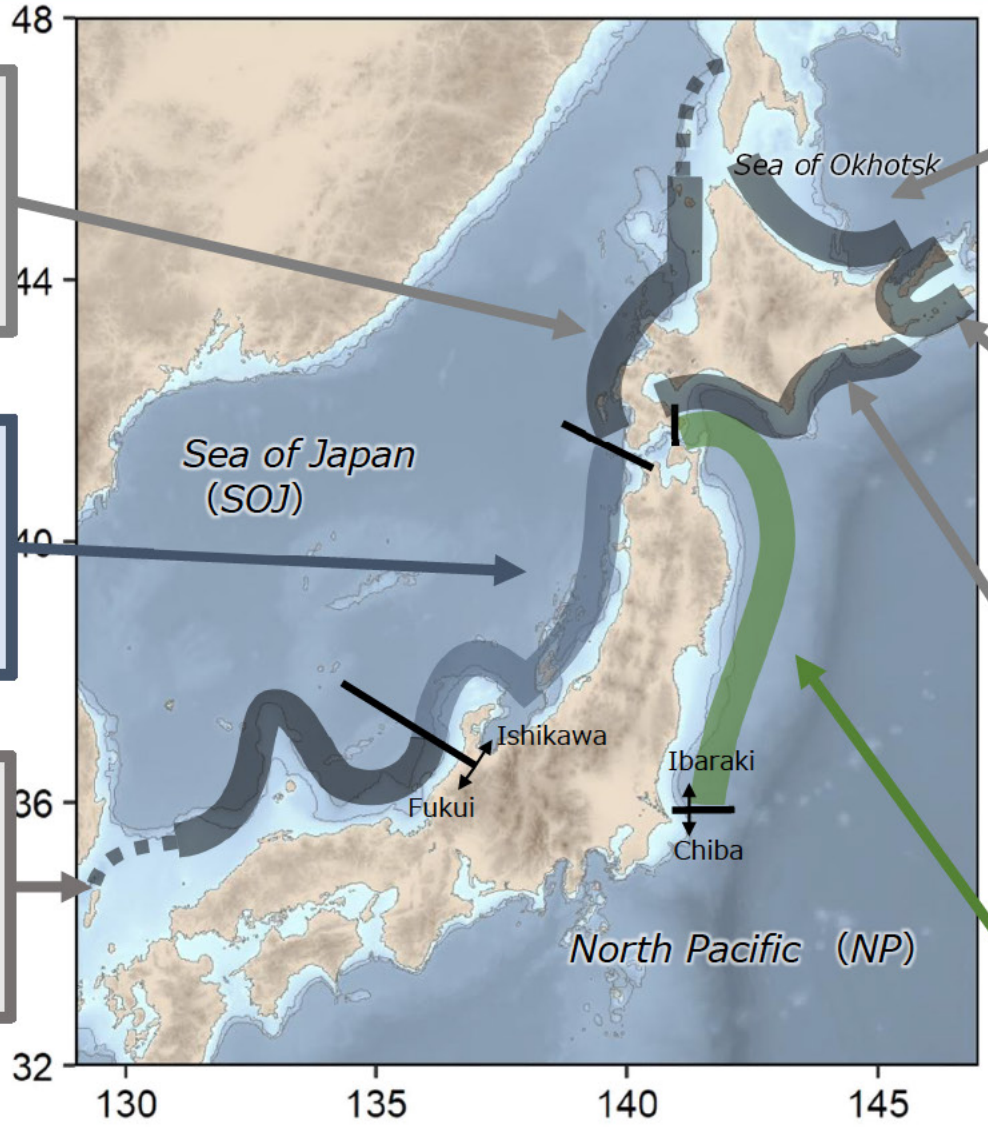
Kay Sakuma
Fisheries Resources Institute,
Japan Fisheries Research and Education Agency

Geographic ranges of the stocks

Sea of Japan
Coast of Hokkaido
C_{2023} : 13,200 t
B_{2023} : NA
U_{2023} : NA

Northern Sea of Japan
Coast of Honshu
C_{2023} : 3,145 t
B_{2023} : 10,100 t
U_{2023} : 28%

Western Sea of Japan
Coast of Honshu
C_{2022} : 481 t
B_{2023} : NA
U_{2023} : NA



Sea of Okhotsk
C_{2022} : 4,900 t
B_{2022} : 17,400 t
U_{2022} : 37%

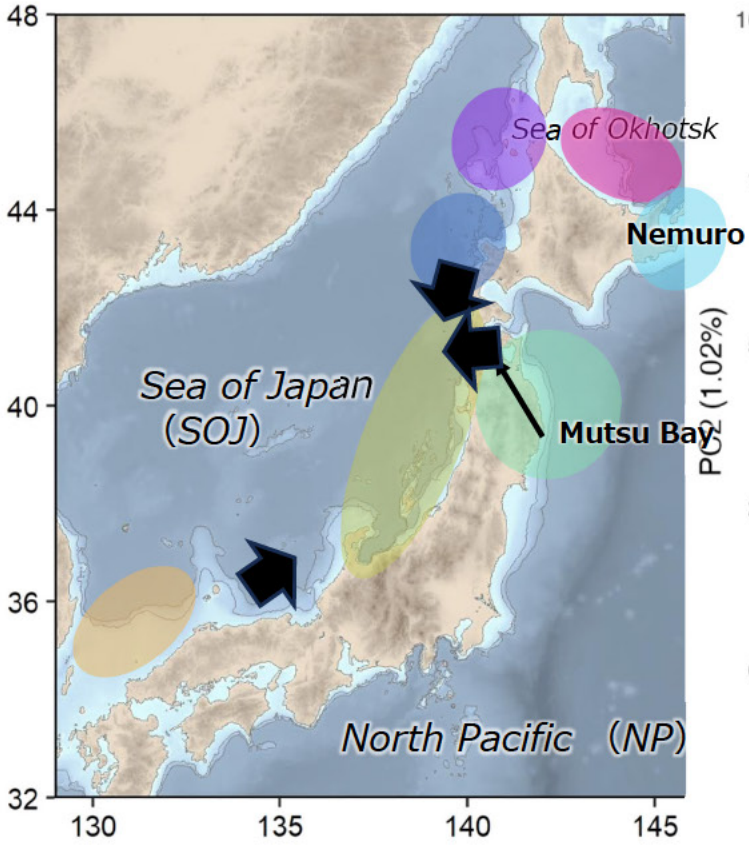
Nemuro Strait
C_{2022} : 3,500 t
B_{2022} : 17,400 t
U_{2022} : 37%

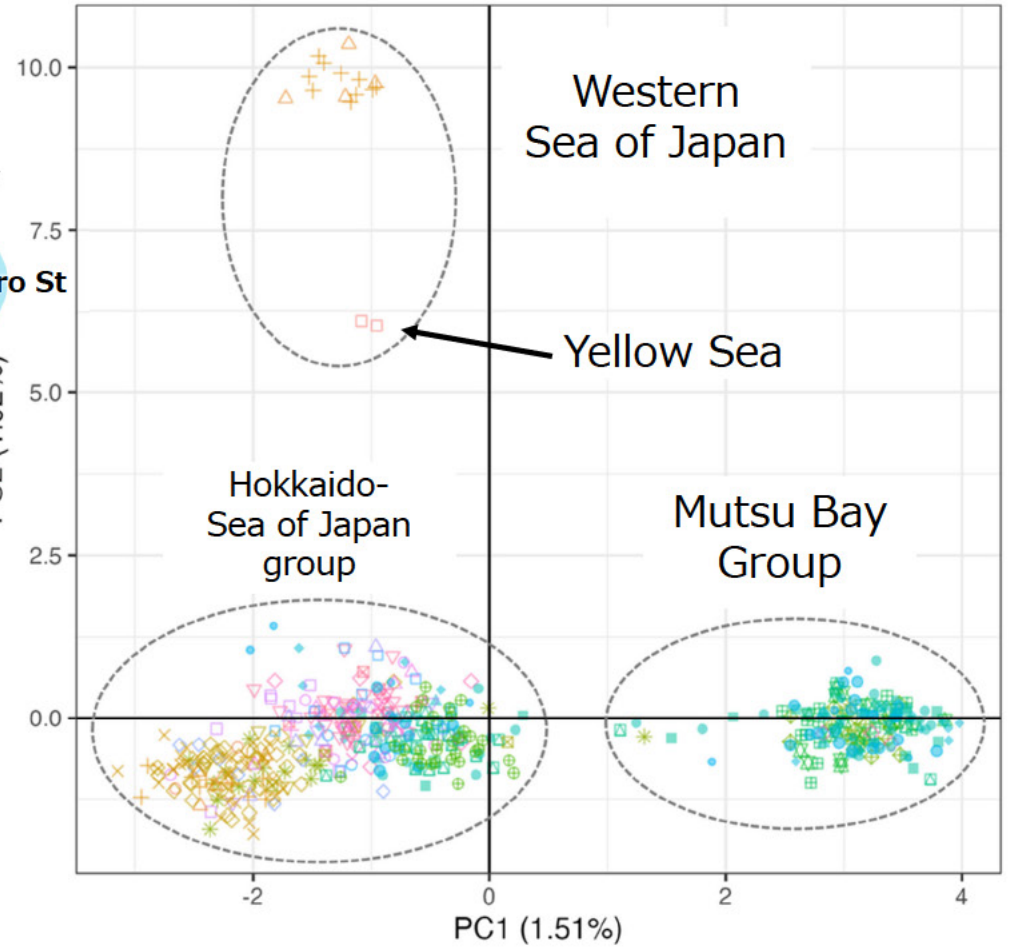
North Pacific
Coast of Hokkaido
C_{2022} : 29,000 t
B_{2022} : 17,400 t
U_{2022} : 37%

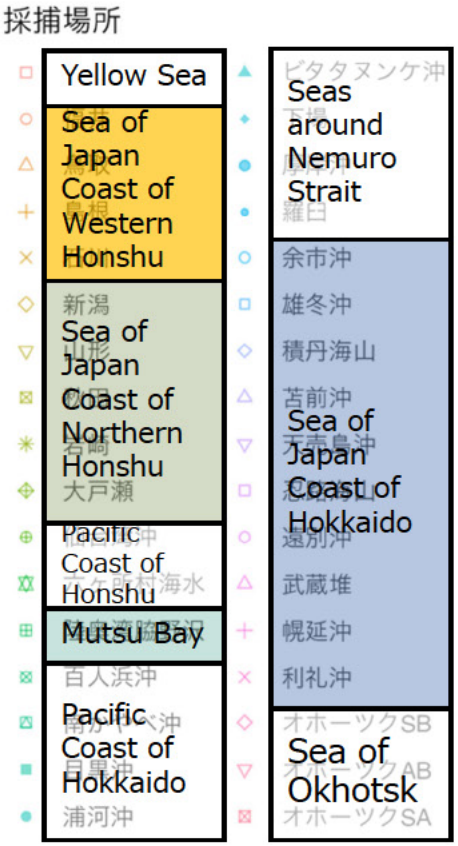
North Pacific
Coast of Honshu
C_{2022} : 6,500 t
B_{2022} : 17,400 t
U_{2022} : 37%

General introduction- Admixture of the populations

Genetic structuring with gene flow (isolation with migration)





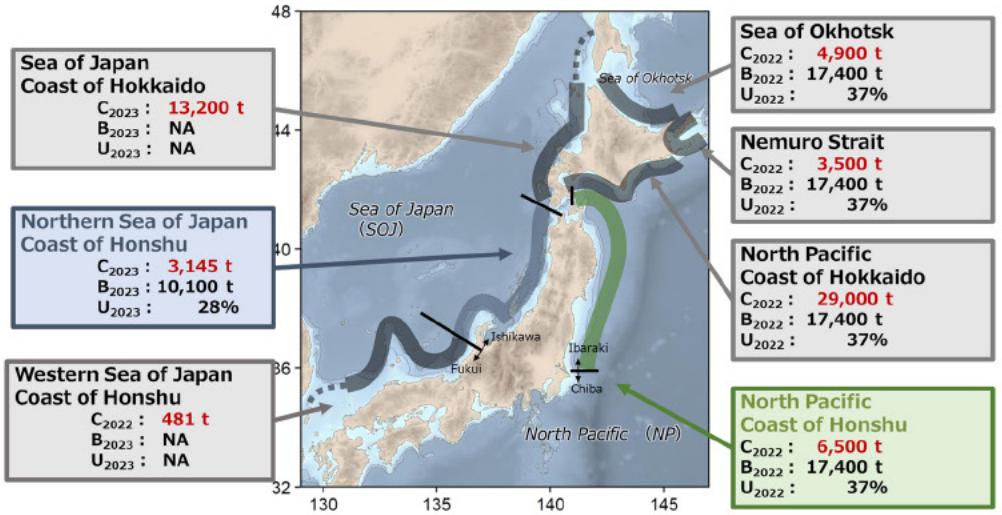


Stock assessment strategy

Stocks	Northern Sea of Japan Coast of Honshu	Western North Pacific Coast of Honshu	✓ Sea of Japan Coast of Hokkaido ✓ North Pacific Coast of Honshu
Models	**Tuned-VPA with Offshore trawler's logbooks**	**Tuned-VPA With Trawl survey-based Biomass**	**Surplus production model**

✓ The four stocks around Hokkaido (Sea of Japan Coast of Hokkaido/ North Pacific Coast of Hokkaido listed amove) are included in the Japanese TAC management (still in applying process?).

✓ The other units (Western Sea of Japan Coast of Honshu, Sea of Okhotsk, Nemuro Strait) are straddling stocks and not included in the Japanese stock assessment.



Northern Sea of Japan stock assessment

Fiscal Year 2023

Kay Sakuma

Fisheries Resources Institute,

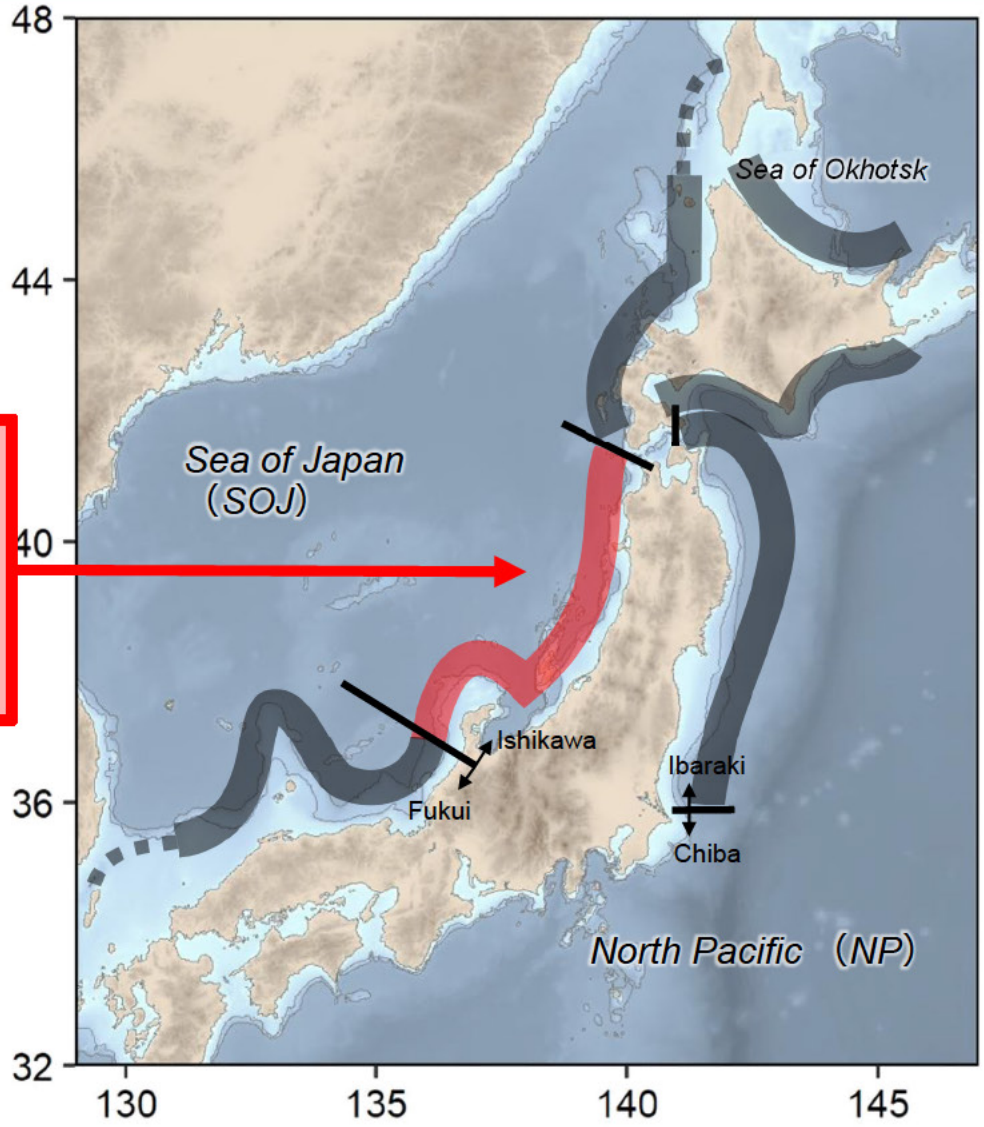
Japan Fisheries Research and Education Agency

Table of Contents

General introduction - Geographic ranges of the stocks

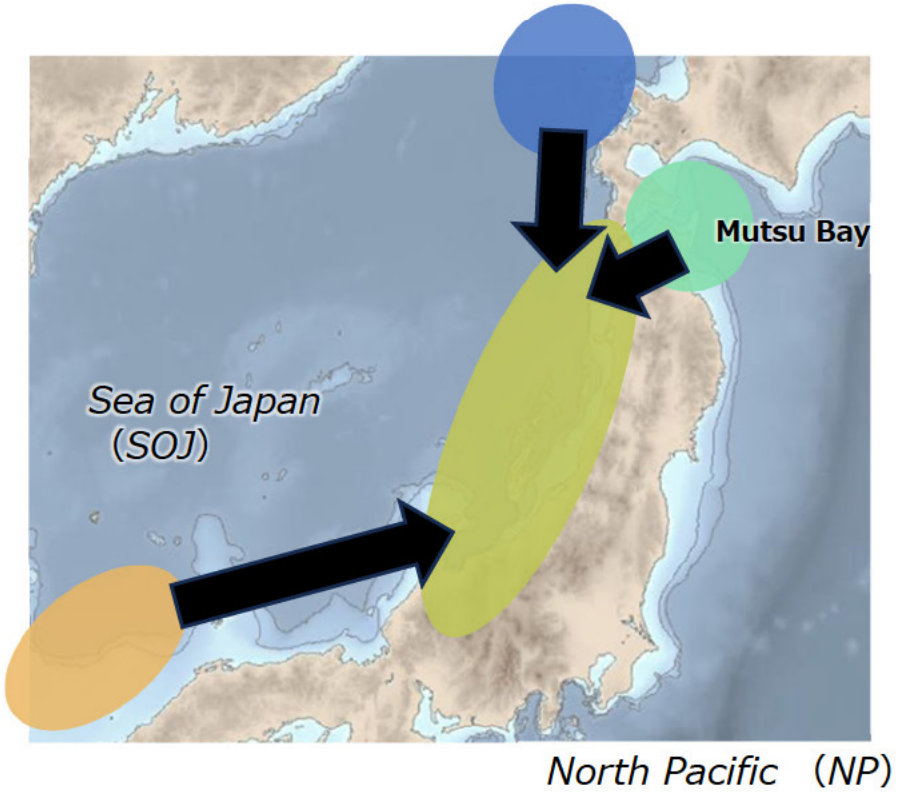
Northern Sea of Japan Coast of Honshu

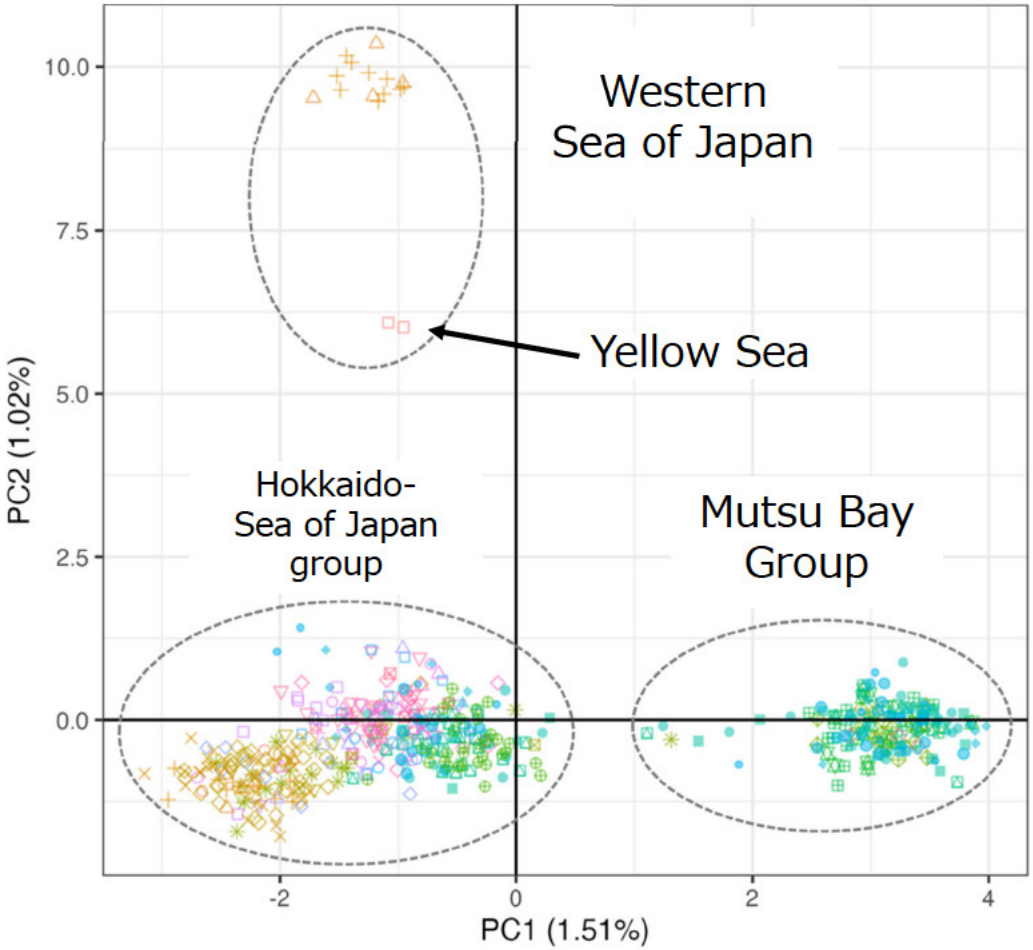
C_{2023} : 3,145 t
B_{2023} : 10,100 t
U_{2023} : 28%



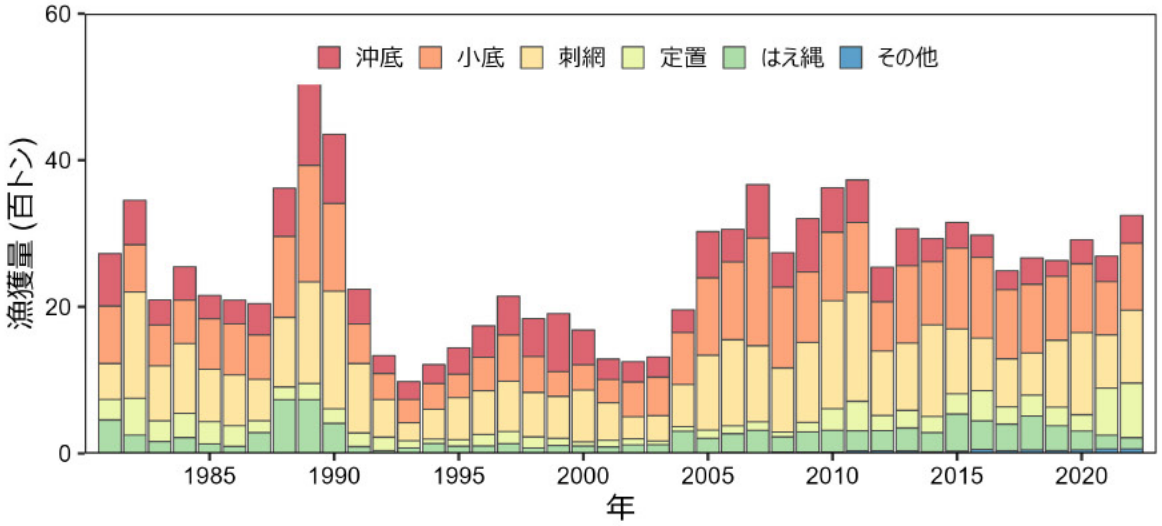
General introduction – Admixture among genetic populations

Genetic structuring with gene flow (isolation with migration)





General introduction – Fisheries of Pacific cod in the Sea of Japan



Large offshore trawl (Danish seiner)
Small trawl (Danish seiner)
Gillnet
Setnet
Longline

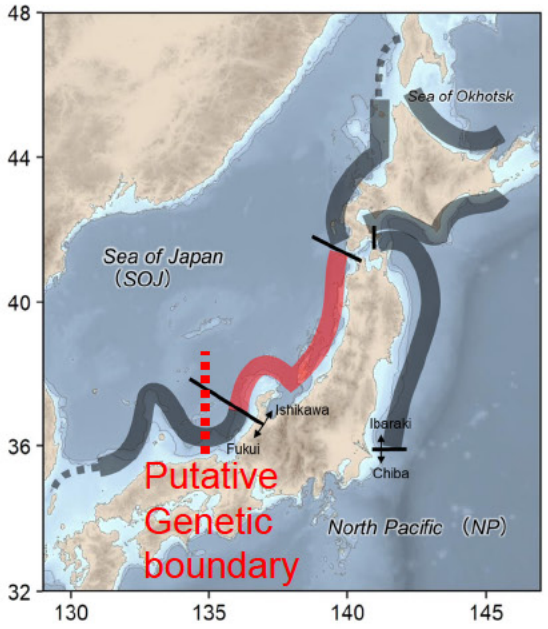
- Historical catch has fluctuated in decadal or shorter terms
- Large proportion of catch is from small local fisheries (gillnet, small trawlers, longliners, <10 tons)
- All the fisheries targets mature male for their milt and a considerable proportion of landing is consumed as fresh fish within days
- Catch statistics are reported as a single category “Tara (Pacific cod)”

Stock structure and distribution

Questions

1) The Pacific cod in the Sea of Japan appears to have an interesting fine scale population structure. During the meeting, please discuss in detail, the evidence for this stock structure and explain how the stock boundaries were developed. For example, looking at the results of Suda et al (2016) and Sakuma et al (2019), it is plausible to define the boundary of this stock around Kyoto Prefecture instead of Ishikawa Prefecture. Also see Supp Fig 8-1.

- Genetic boundary between the western and northern Sea of Japan is located at the central Sea of Japan area along the coast of Hyogo and Kyoto Prefectures and not necessarily corresponds to those between management units.
- Pacific cod landing in Kyoto and Fukui that are not included in the northern stock is fairly limited (0.7% of the total catch)
- Application of the boundary to the administrative, management unit was difficult at the time of applying TAC to the northern Sea of Japan because of various reasons.



Stock structure and distribution

Questions

2) Please show the results and any data from tagging experiments (e.g., Kanno et al 2001)

- Kanno et al. (2001) is not a tagging experiment
- Kanno et al. (2001) analyzed population structure based on phenotypic character (vertebral counts) and trends in local standardized CPUE.

Table 3. Vertebral counts of the Pacific cod in samples caught from 16 locations in the Pacific Ocean and the Japan Sea

Sampling area	Sample size (n)	Vertebral count									Dates of sampling	Sampling gear
		49	50	51	52	53	54	55	56	Mean		
Aomori Japan Sea (a)	87		1	5	34	40	7			52.54	7 Jan.–16 Feb. '97	Trawl net
Aomori Japan Sea (b)	50	1	1	3	24	20	1			52.28	18 May. '98	Trawl net
Ajigasawa off	19			2	2	14	1			52.74	28 Jun. '97	Trawl net
Mutsu Bay	59			4	20	34	1			52.54	1–17 Feb. '97	Set net
Tsugaru Strait	95		2	4	29	54	6			52.61	16 May '97	Set net
Sanriku off	49			1	8	32	8			52.96	31 Dec. '98	Trawl net
Aomori Pacific (a)	136		3	9	23	82	19			52.77	20 Jun. '96	Purse seine
Aomori Pacific (b)	67			8	23	22	12	2		52.66	10–11 Sep. '96	Purse seine
Shimokita off	55			3	21	28	3			52.56	8 Mar. '98	Gill net
Esan off	69		1	1	20	34	13			52.83	5–10 Jun. '96	Shrimp trap
Urakawa coast	27				8	13	6			52.93	25 Jan. '98	Gill net
Shiraoi off	23				6	11	5	1		53.04	5 Feb. '98	Gill net
Muroran off	33				2	13	13	5		53.64	10–25 Sep. '96	Shrimp trap
Hiroo off (a)	51			1	3	20	21	5	1	53.57	17 Dec. '97	Purse seine
Hiroo off (b)	106		1	6	10	31	31	23	4	53.60	9 Sep. '97	Purse seine
Kushiro off	88	1	1	2	8	42	22	12		53.31	7 Oct. '97	Purse seine

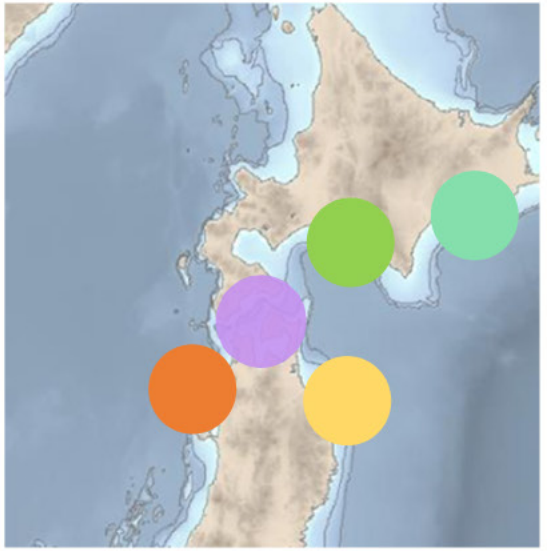
Sea of Japan

Mutsu-Bay

Western North Pacific

Southern Hokkaido

Eastern Hokkaido



Stock structure and distribution

Questions

3) Assuming that there is some arbitrariness of the stock boundary, it is important to investigate the robustness of the assessment results and corresponding management to the stock boundary. Please plot the Prefecture-specific catches of Pacific cod over time from Hyogo-ken to Yamagata-ken (arranging from west to east).

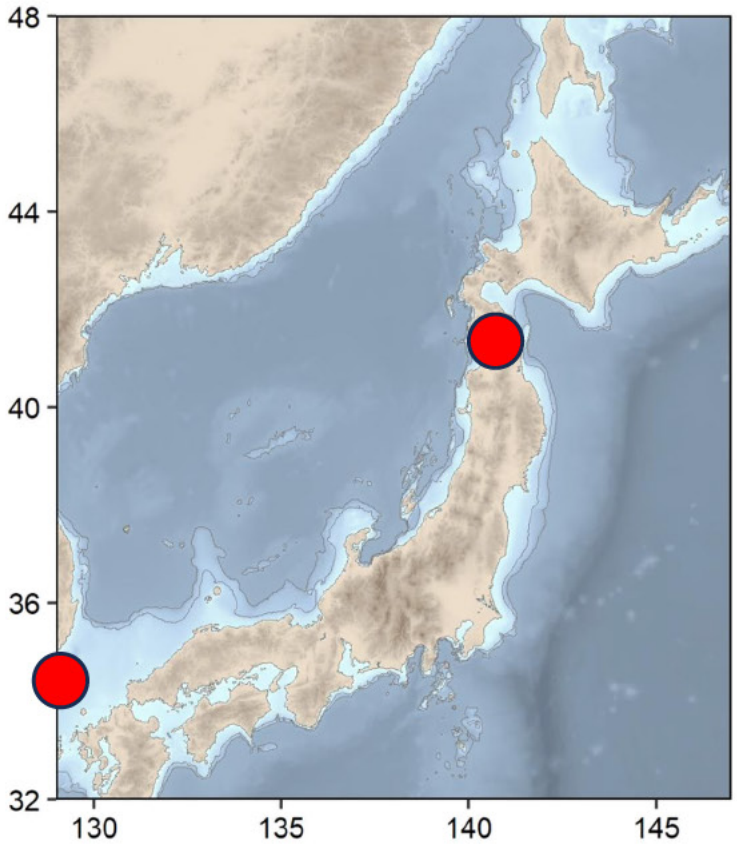
- Migration of Pacific cod is not incorporated because the stock identification technique is currently not applicable.
- We have found genetic population structuring based on these SNPs and will move to exploration of genetic markers that can segregate local spawning groups in near future.

Stock structure and distribution

Questions

4) In Fig 2-1, no spawning ground is identified, does that mean that spawning occurs throughout the entire distribution?

- We think that spawning occurs throughout the entire distribution but with some “hotspots”.
- A large spawning ground was previously known around Noto Peninsula (Ishikawa prefecture) in the Sea of Japan but had reportedly been fully exploited in 1960 to 1970s and is still not recovered.
- Currently Mutsu-Bay is one of the largest spawning ground in Japanese Waters. In the Sea of Japan, South Korean Jinhae-Bay is known but no other spawning ground was reported along Japanese Mainland.
- From larvae or juvenile (age 1-2) surveys (Appendix 7 Recruitment surveys of the stock.), local, small-scale spawning areas are reported off each prefecture, but local fishermen reported that spent fish can be found in a broad range of the local fishing ground.



Stock structure and distribution

Questions

6) I assume that the cohort analysis begins at age 3 because that is the age at which fish begin to be caught by the fishing vessels. Given the age-length relationship used to convert all the length data to age data, are age 0, 1 and 2 fish observed in the other non-fishery datasets? I ask because the boundary of the stock seems to be fairly defined and I was wondering about the potential for the data to only partially represent the total stock.

- Age 1to 3 years fish can be caught by trawl fishery but dis-targeted in the Sea of Japan because of cheap price along the sea.
- Younger fish in Japan is for fishmeat or dried fish, and traded as frozen blocks.
- In the sea of Japan, almost all fish is mainly traded fresh and fisheries market has no sales channels that can deal with small amounts of fish as row materials.
- We think our data can represent the total stock

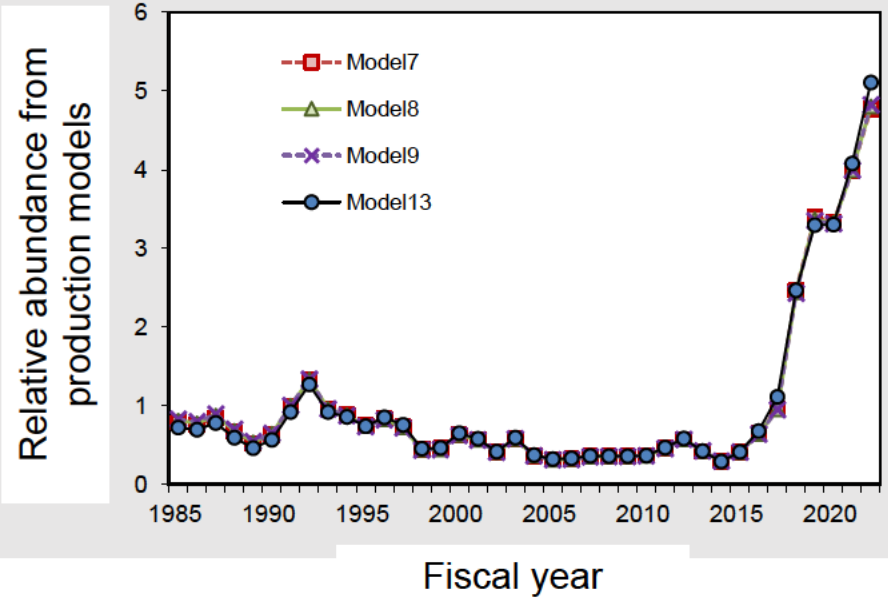
Stock structure and distribution

Questions

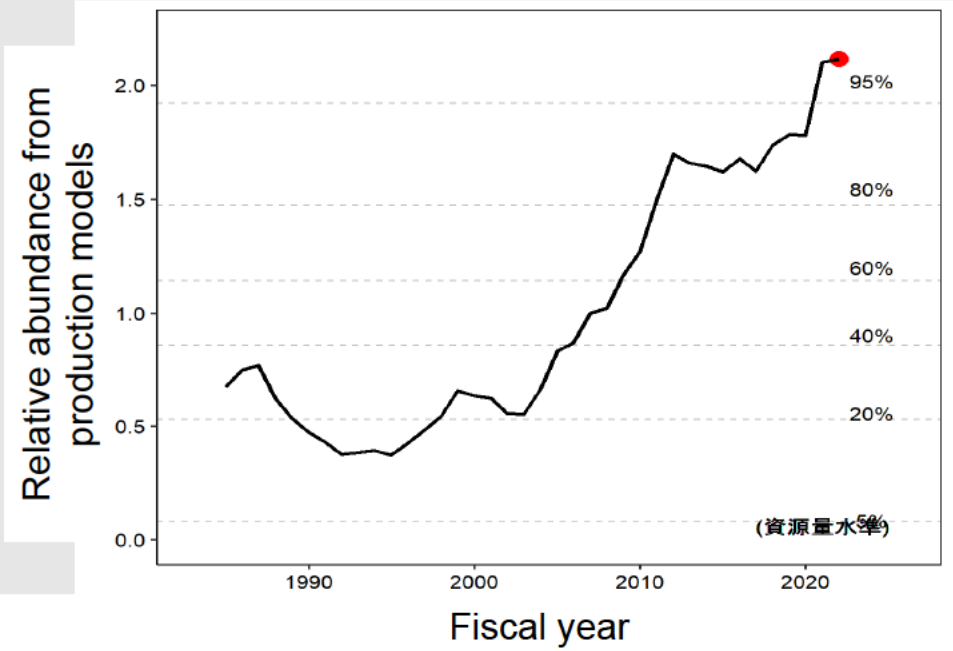
5) How is the Hokkaido stock related to this stock (Appendix 11)

- Hokkaido and Mutsu-Bay Stocks have been growing in the late 2010 and are now at record high.
- We assume that spawners run into the limited spawning areas in the winter season in these stocks, and not a few spawners migrate into nearby spawning areas in neighboring Northern Sea of Japan Stock.

Hokkaido Sea of Japan stock



Hokkaido western North Pacific (including Mutsu Bay)



Biology

Questions

6) There are meta-analytical studies (e.g., Hamel & Cope 2022) relating natural mortality to maximum age that have more species and are more recent than Tanaka (1960). Please discuss the reasons for assuming a fixed M using Tanaka (1960) rather than newer studies with more metadata.

7) Was there consideration of the uncertainty in M?

8) Were there sensitivity model runs for different M values? A simple and reasonable approach would be to develop a posterior for M using several relationships for M and biological parameters, and use the posterior to develop the uncertainty bounds for M and use these for sensitivity runs. Another approach would be to use the M posterior as part of a model ensemble. This would be important also for model projections.

1. Natural mortality was fixed at 0.28. While I understand that M has to be fixed for cohort analyses, did the authors explore the inclusion of age-specific M (in which M for younger ages is high and then declines for older fish)?

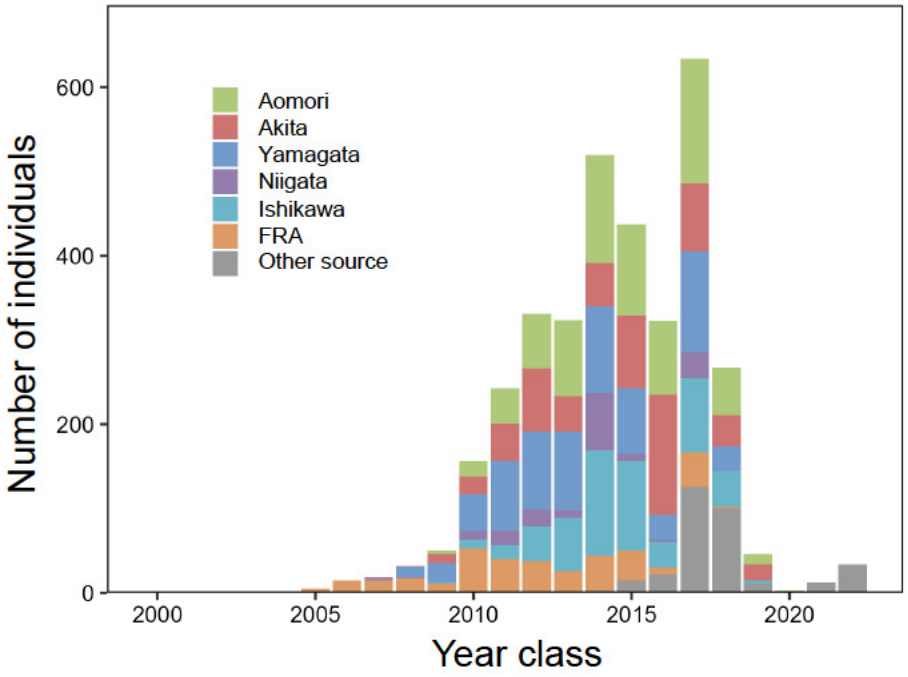
a. Assuming a maximum age of 8 for Pacific cod and using the calculations described in Hamel and Cope (2022), M = 5.40 / 8 = 0.675. If possible, could the authors run the cohort analysis assuming a M=0.675?

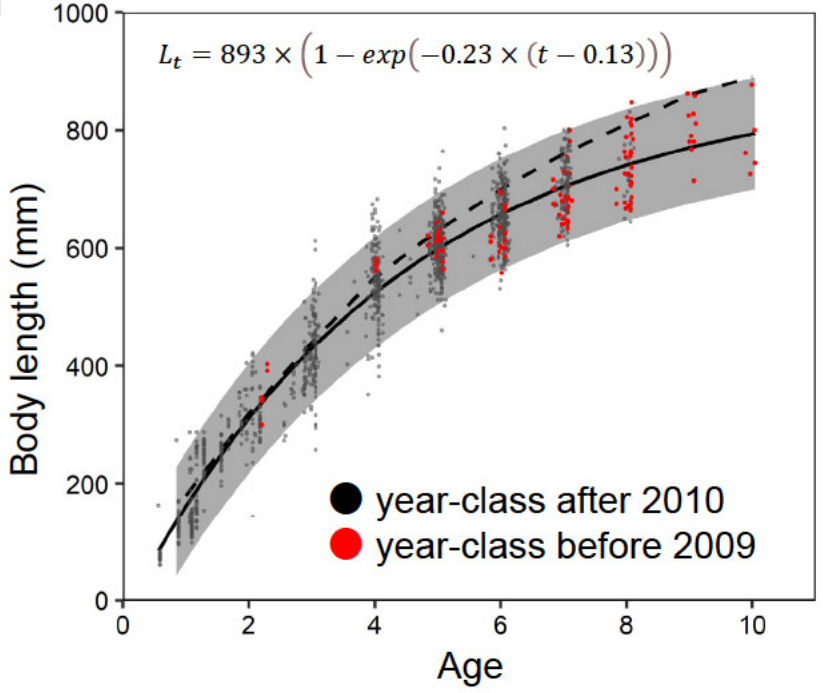
- Currently, uncertainty in M is not considered in the stock assessment. M of 0.28/year is deterministically applied in the VPA by a estimator of Tanaka (1960)
- Maximum age of 9 is based on the results of otolith analysis. (possibly 10 but very rare)
- FRA stock assessment team (Maybe Ichinokawa-san leading?) is now working on this issue with

Questions

9) What was the basis for the growth curves? Please show data.

- Our dataset is based on age from otolith growth ring analysis and body length measurement. We obtained samples from local fisheries market along the northern Sea of Japan and they cover entire geographic range of the stock. Otolith analyses was started in 2016 and we have accumulated aging data for upcoming update of stock assessment in next years.





Data – Catch-at-age

Questions

10) For a cohort analysis, it is assumed that catch-at-age is known. It is important that this is a reasonable assumption. I am unable to review the catch-at-age data because in Appendix 2, there is minimal documentation on how catch-at-age was developed from the catch, size, and age data. Please explain in detail how the catch is converted into catch-at-age in numbers. For example, please show the data used to develop the age-length keys and age-weight keys, please explain how catch in weight is converted to catch in numbers; please explain the size sampling program, please show the size histograms by year and prefecture and the associated ages for several years.

2. The steps involved in converting lengths to ages were not included in the document. Fig. 2-2 shows the age-length and age-weight relationships. This information is very important for a cohort analysis. Please include:

a. The sample sizes of lengths from each data source

b. Sample sizes of ages from each data source

c. Figures of the age (x-axis) and length data (y-axis) at as specific a level as possible. This could be by data source like purse seine landings in a particular region.

d. Description of the steps involved in converting lengths to ages, specifically the reasoning for including a time-invariant age-length and age-weight relationship.

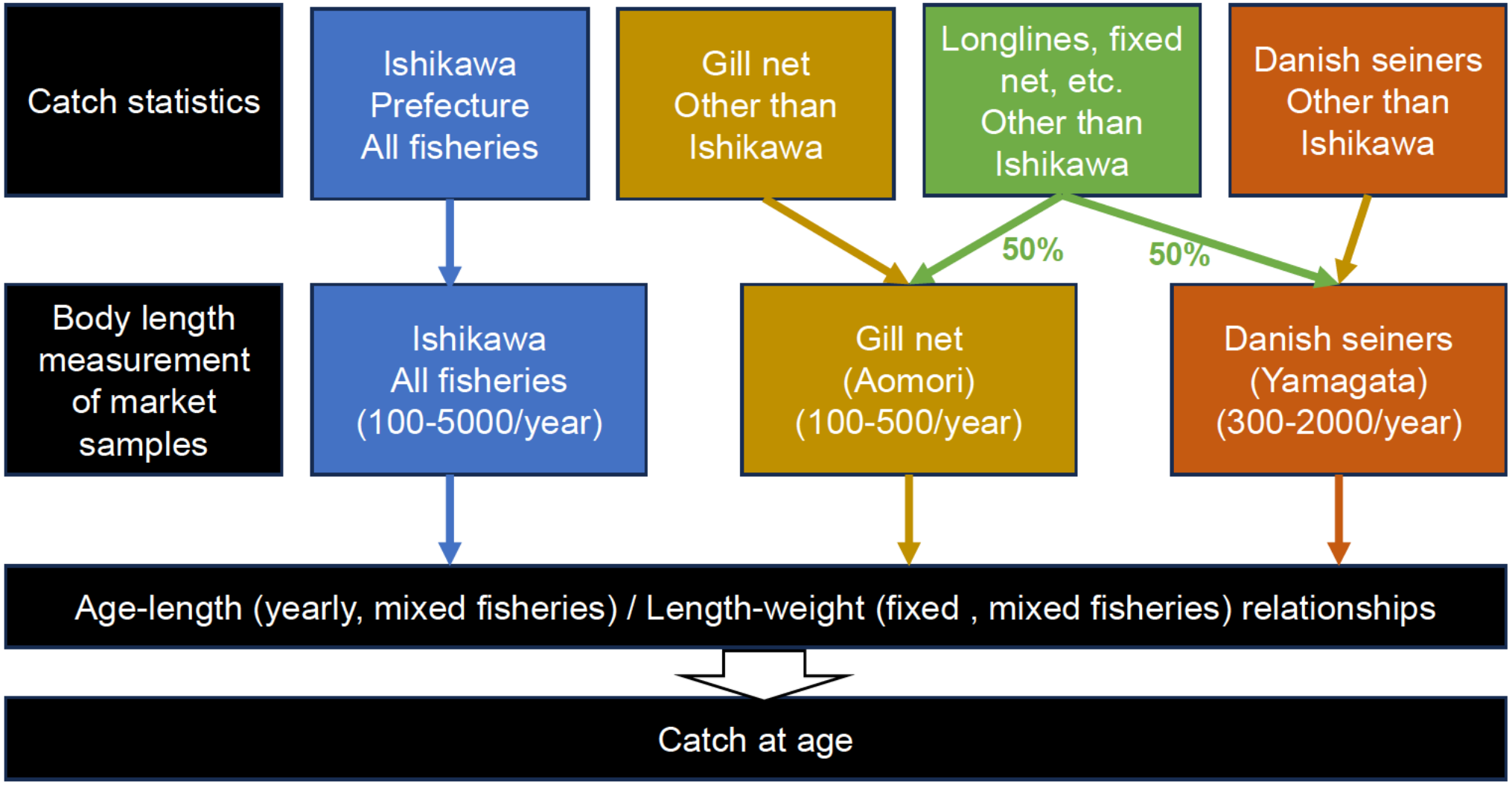
Data – Catch-at-age

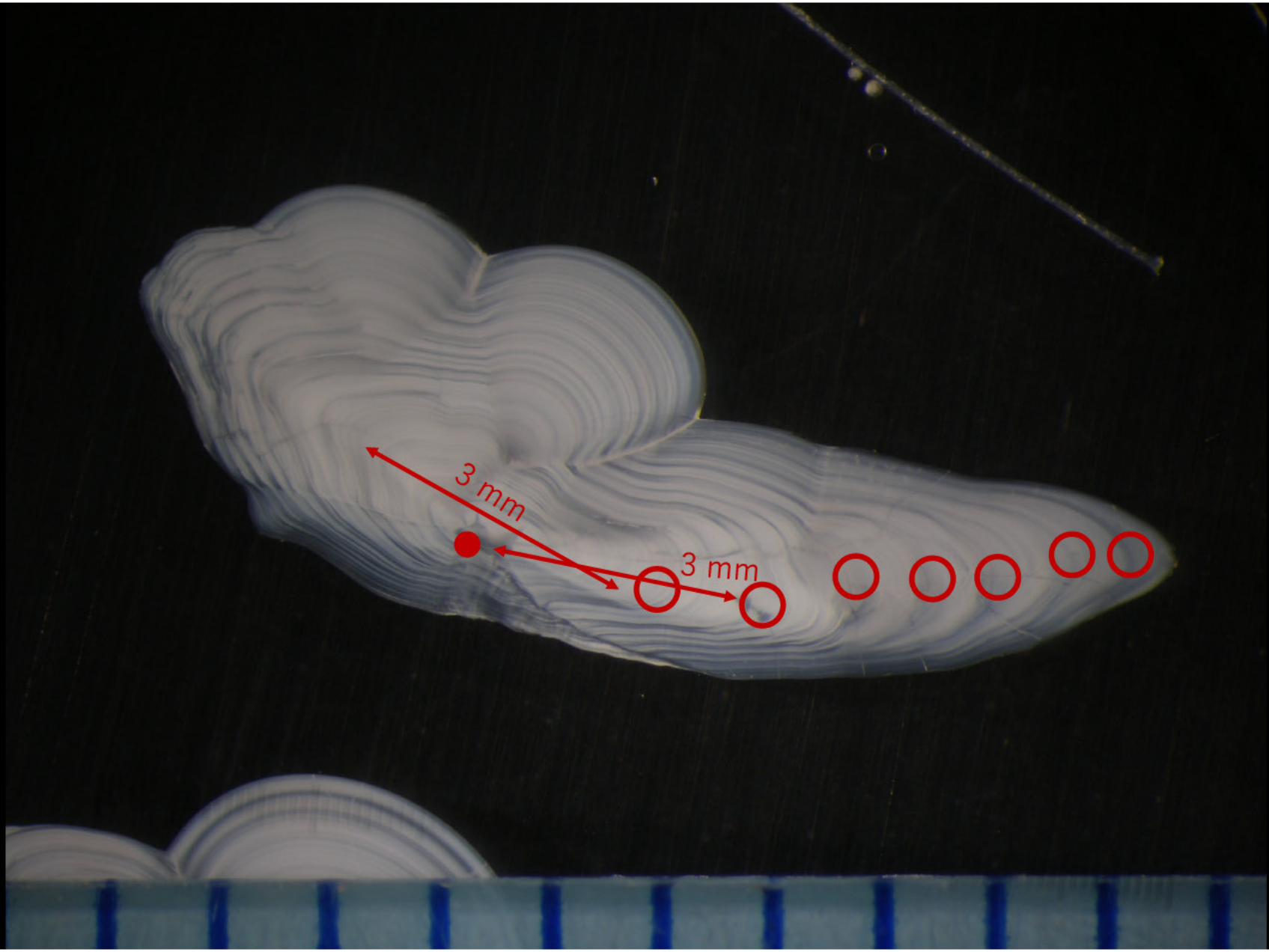
Questions

10) For a cohort analysis, it is assumed that catch-at-age is known. It is important that this is a reasonable assumption. I am unable to review the catch-at-age data because in Appendix 2, there is minimal documentation on how catch-at-age was developed from the catch, size, and age data. Please explain in detail how the catch is converted into catch-at-age in numbers. For example, please show the data used to develop the age-length keys and age-weight keys, please explain how catch in weight is converted to catch in numbers; please explain the size sampling program, please show the size histograms by year and prefecture and the associated ages for several years.

- Our dataset is based on age from otolith growth ring analysis and body length measurement.
- Otolith samples are from local fisheries market along the northern Sea of Japan that cover entire geographic range of the stock.
- Following catch-at-length data is constructed based on market sampling and prefecture-fisheries-wise catch data: “all-fisheries in Ishikawa pref.”, “gillnet + other fisheries *0.5” , “Danish seine + other fisheries *0.5”
- Catch-at-length is converted to Catch-at-age by using yearly age-length key and fixed length-weight relationships.

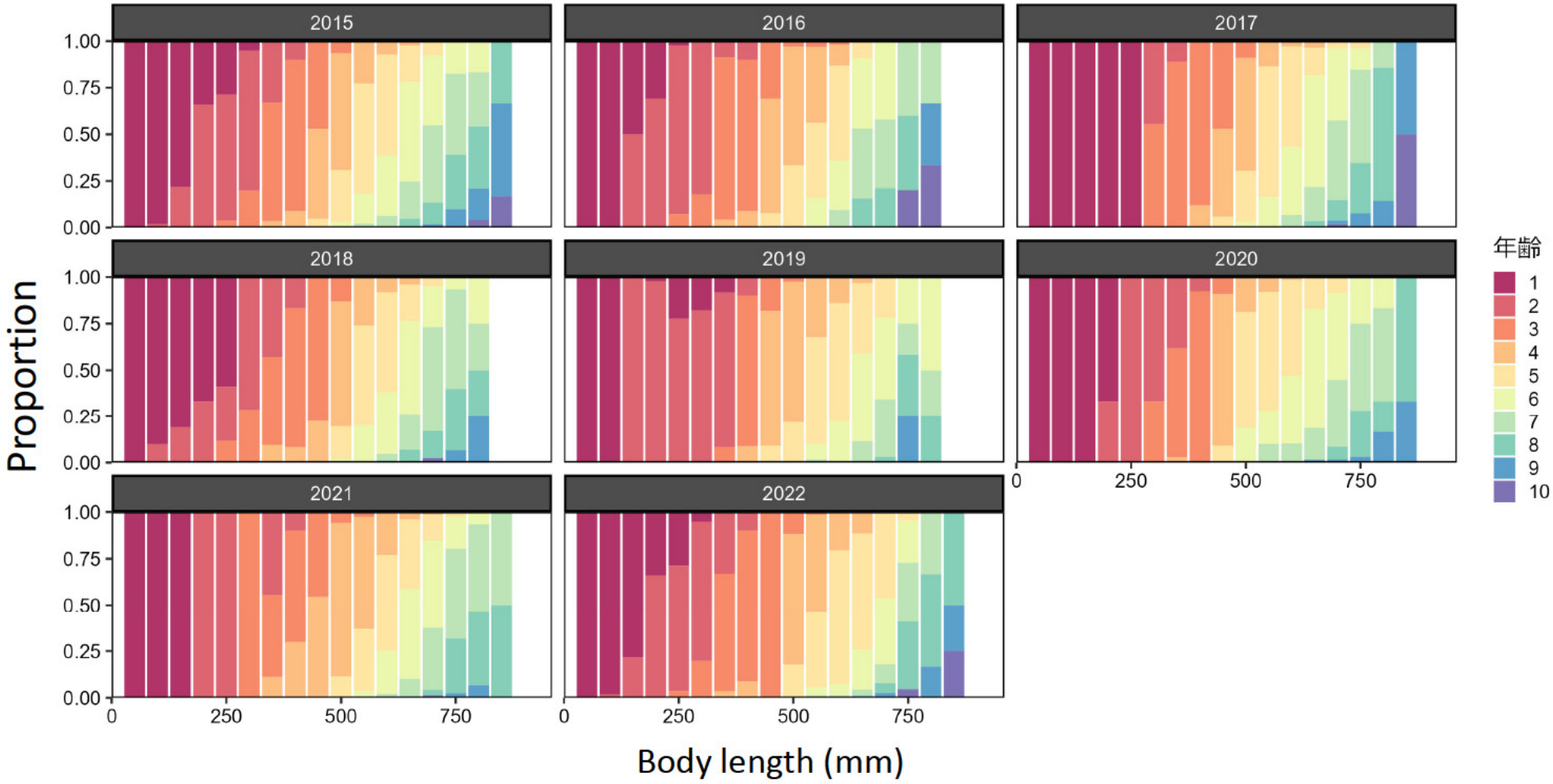
Data – Catch-at-age



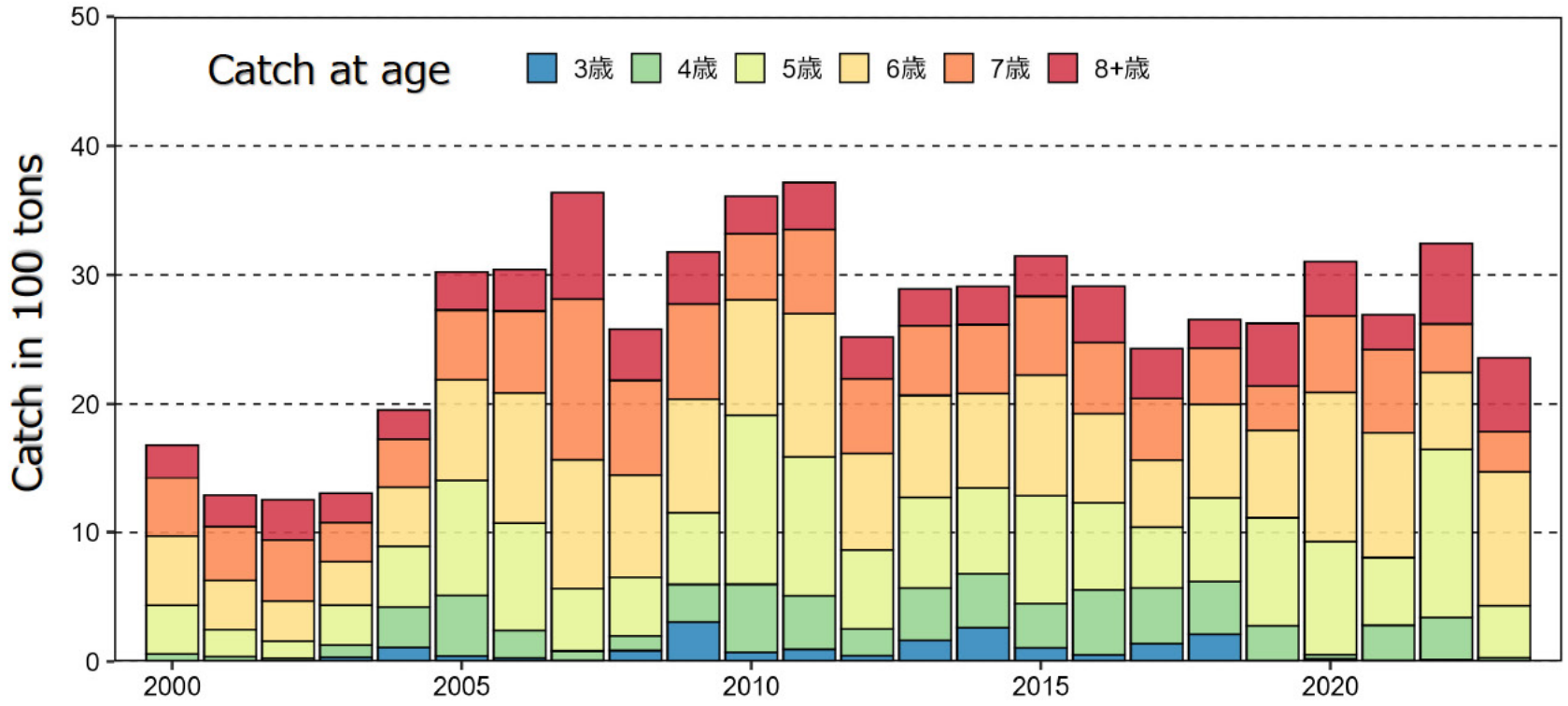

3 mm
3 mm

Data – Catch-at-age

Age-length key

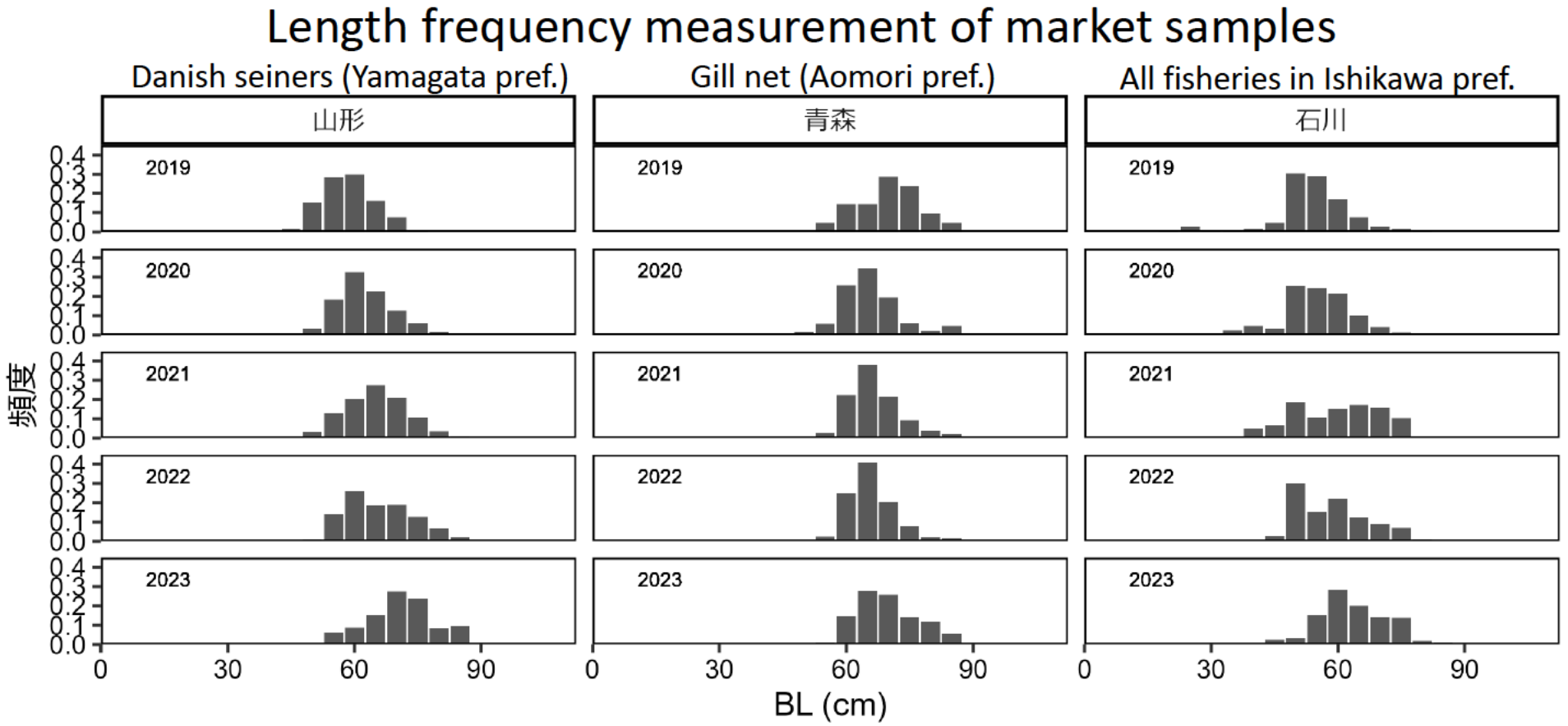


Data – Abundance indices



Questions

13) Please show the size data by year and location, if possible, and overlay the age classes.

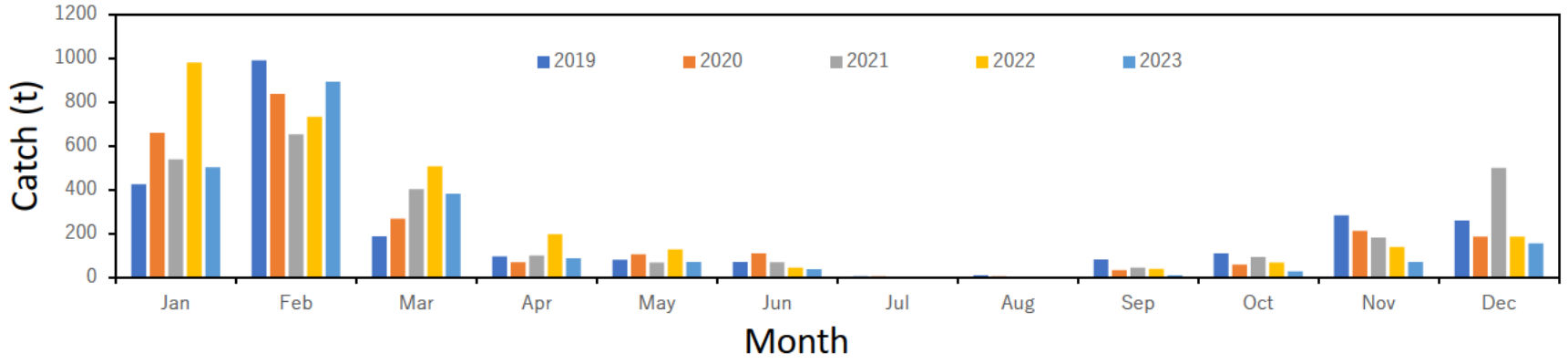


Data – Catch-at-age

Questions

11) Do the age-length, age-weight, and length-weight relationships vary between season, year, & location? Please show data to support.

- We think that age-weight, age-length and length-weight relationships can be vary between years and season as in the western north Pacific stock but currently none of them is considered in the stock calculation.
- Annual variation can be considered in future by implementing hierarchical and generalized von Bertalanffy growth model. I think now we have enough data point to build the model considering annual variation and would try in the next years.
- Seasonal variation may not be necessarily considered because ca., 80% of total catch is in winter. We attribute that growth during the fishing season is negligible.



Data – Catch-at-age

Questions

12) Were there gaps in the size sampling for some years and locations?

- Gaps in our dataset that stem from trends of fisheries catch in the stock.
- Small fish younger than age 3 have not been caught in these years because of the lack of recruitment since 2018.
- Gillnet or set net fishery in Aomori prefectures mainly target larger spawners >60 cm SL (>age 5 fish) and catch data of younger fish has been lacking.

Data – Abundance indices

Questions

14) Appendix 9 states that details of the standardization model and diagnostics are in document FRA-SA2023-SC07-0401. However, that document was not provided. Please discuss that document in detail at the meeting and provide a copy of the document. The current documentation provided is not enough to do a review of the abundance index.

17) In Table 4-1, what are the units and uncertainties around the index values?

- Delta two-step GAM was applied to the logbooks of offshore trawlers
- In the first (zero catch) model, Directed residual mixture model (DRM, Okamura et al., 2016) was used
- Full models are as follows:

logit(proportion of catch) = Year + Month + Prefecture + Fishing tactics + s(Lat, Lon) + s(Lat, Lon) x Year + s(Lat, Lon) x Year +Year x Month

non-zero CPUE = Year + Month + Prefecture + Fishing tactics + s(Lat, Lon) + s(Lat, Lon) x Year + s(Lat, Lon) x Year +Year x Month

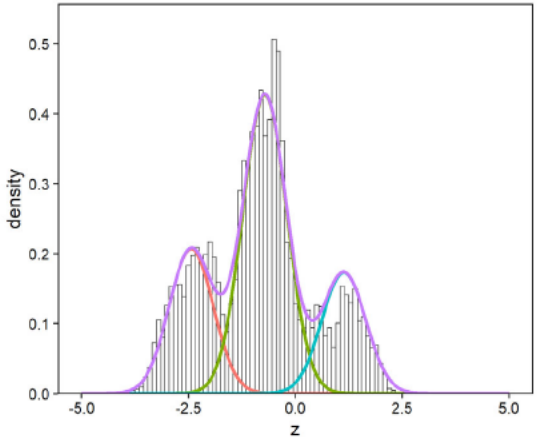
- sCPUE is obtained as a product of non-zero proportion and non-zero CPUE for each fishing grid (0.17° mesh grid), then those CPUEs from the grids that have used at least once since 2000 are summarized into a single value.

Directed residual mixture model

Estimation of Fishing tactics (=which give directed residuals)

(Okamura et al., 2017)

1. Building simple GLM CPUE standardization for main three target species
2. Expressing a proportion of Pacific cod residuals^2 out of sum of residuals^2 by simple GLM with Year, Month and Prefecture (all categorical, with directed residuals)
3. Estimating parameters of the Finite mixture model which explain logit values of the proportion described above, and obtain target variable (fishing tactics specified by a certain GLM)

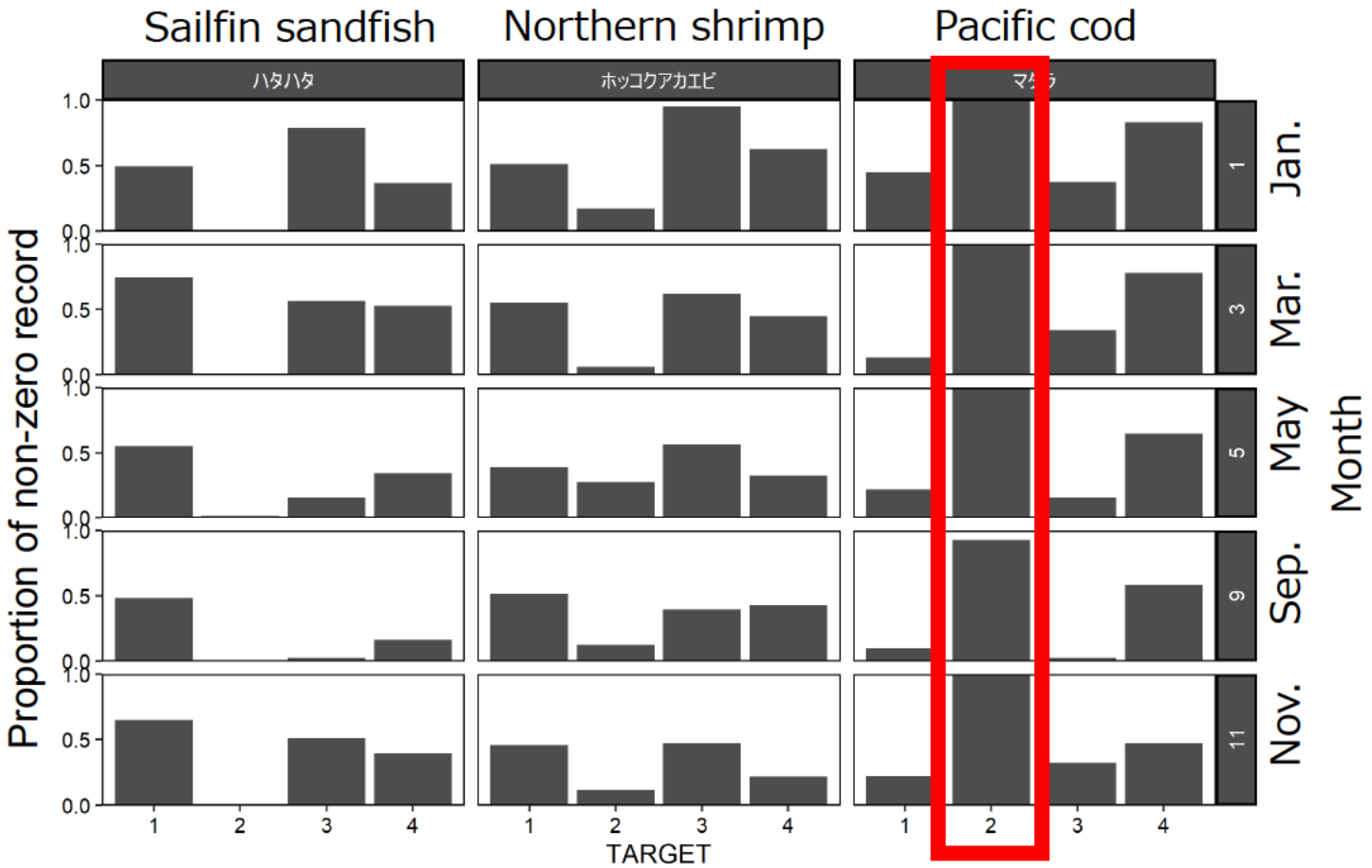


$$(5) \qquad \hat{p}_{s,i} = \frac{\exp(\hat{\nu}_{s,i})}{\sum_{u=1}^{S} \exp(\hat{\nu}_{u,i})}$$

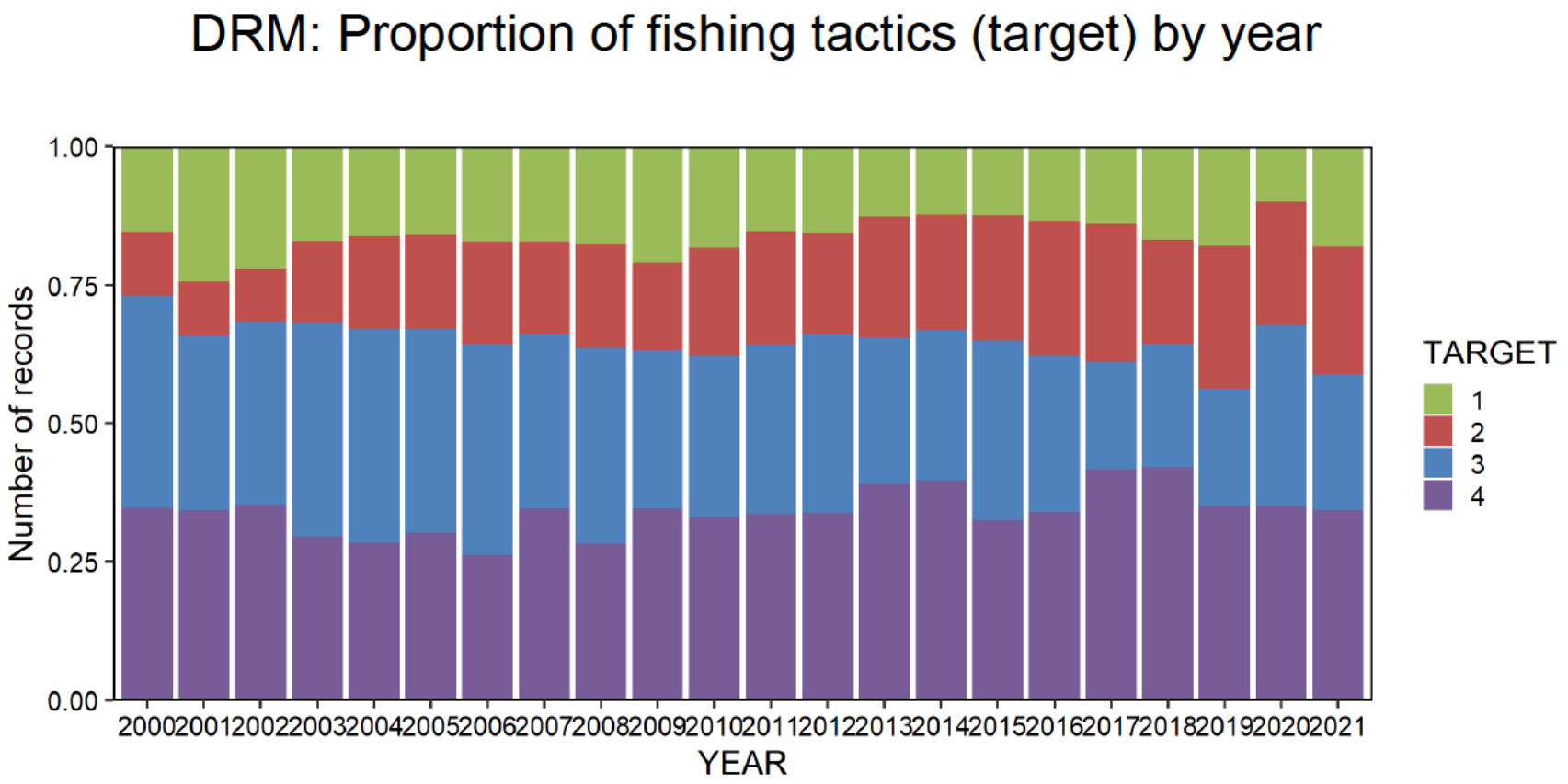
$$(6) \qquad f(\hat{z}_{s,i}) = \sum_{k} \pi_k \phi\left(\hat{z}_{s,i}; \mu_{k,i}, \sigma_k^2\right)$$

Data – Abundance indices

DRM: Proportion of non-zero record for each species and fishing tactics



Data – Abundance indices



Data – Abundance indices

Questions

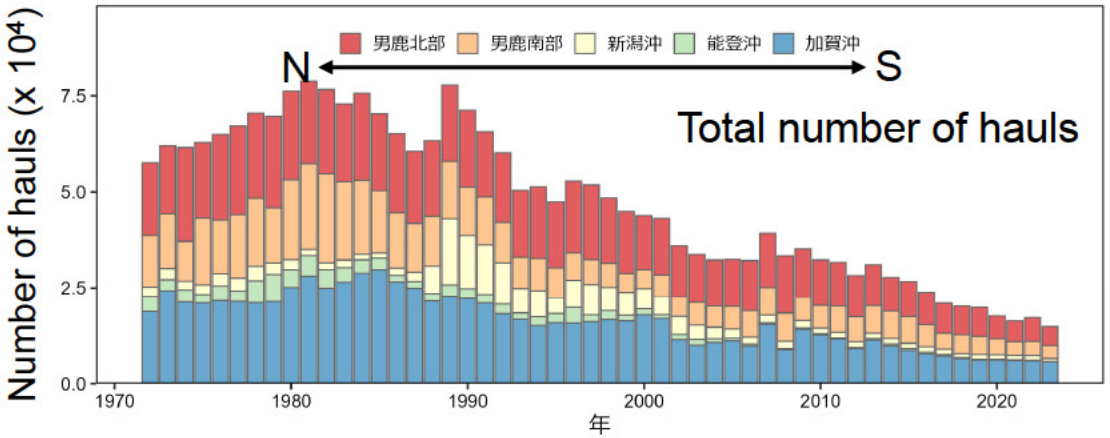
15) In Fig 3-3, the logbook data started in 1972 or so. Why does the index start in 2000? Starting earlier would likely provide more contrast for the model.

- The models using thin-plate splines by years (interaction terms) are so heavy that we could not handle the whole data series from 1972 to the present at the same time.
- Shortening of the data enabled comparison between the models with different combinations of terms.
- Applying spatio-temporal models (e.g., VAST) may be effective

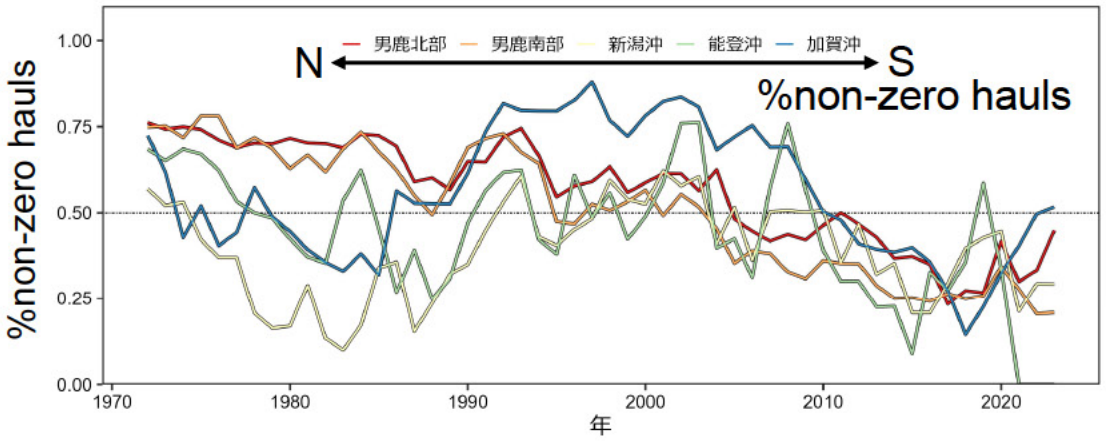
Data – Abundance indices

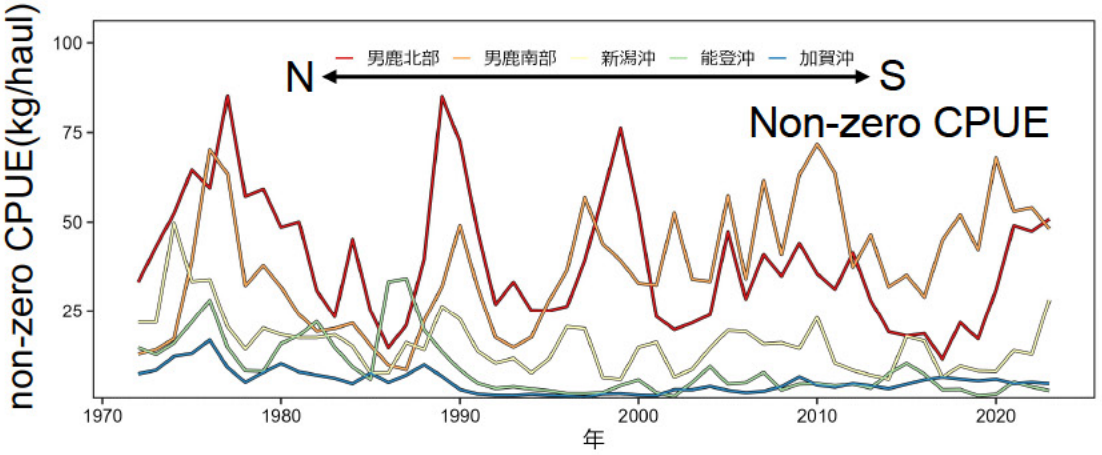
Questions

16) Please plot new figures similar to Fig 3-3 but for the total number of hauls (including zero catches), the proportion of zero catch hauls to total hauls, and the average CPUE of non-zero hauls from 1972.



N Oga





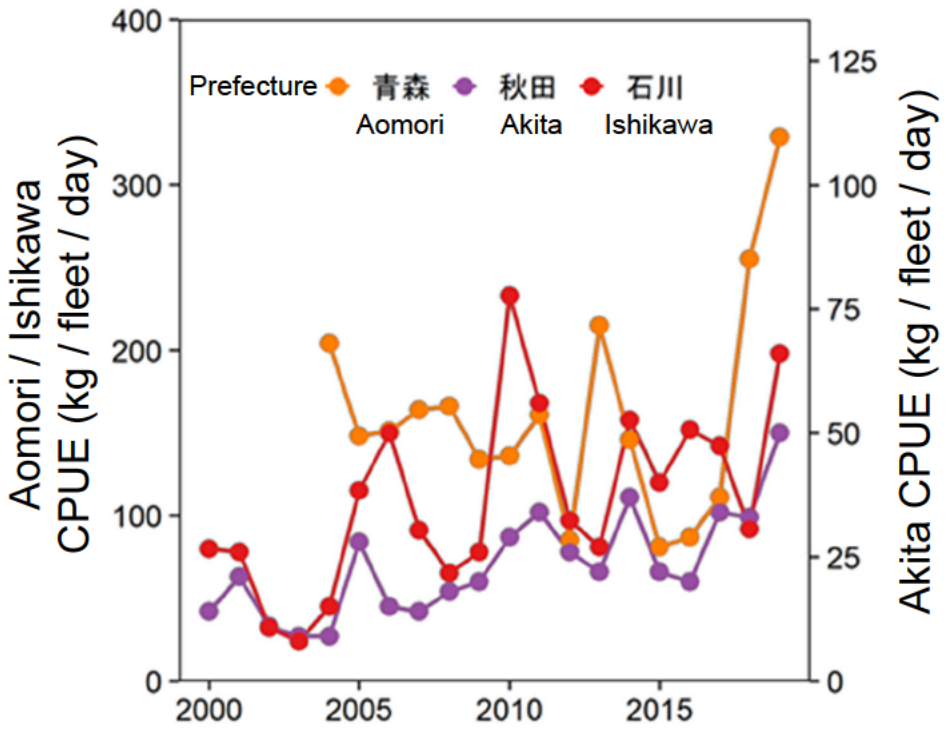
Data – Abundance indices

Questions

19) The report states that there is also CPUE data from gillnetting and bottom trawling. Please discuss these alternative data sets and why they were not used, at least in sensitivity models. Please compare these indices with the main offshore trawling index.

- Gillnetting data and bottom trawling data was once used as alternatives but we could not obtain realistic trends in biomass and F.
- Quality problems of logbooks administrated by local prefecture (Gillnet, small trawlers)

  Lacking or incorrect fishing effort (number of hauls, fishing(dipping) time) and information about fishing area
- Nature of targeting fishery (Gillnet)
- Data format is prefecture-specific and not well-organized, requires data curation first.
- We have to deal with this problem because of number of large vessels is decreasing.



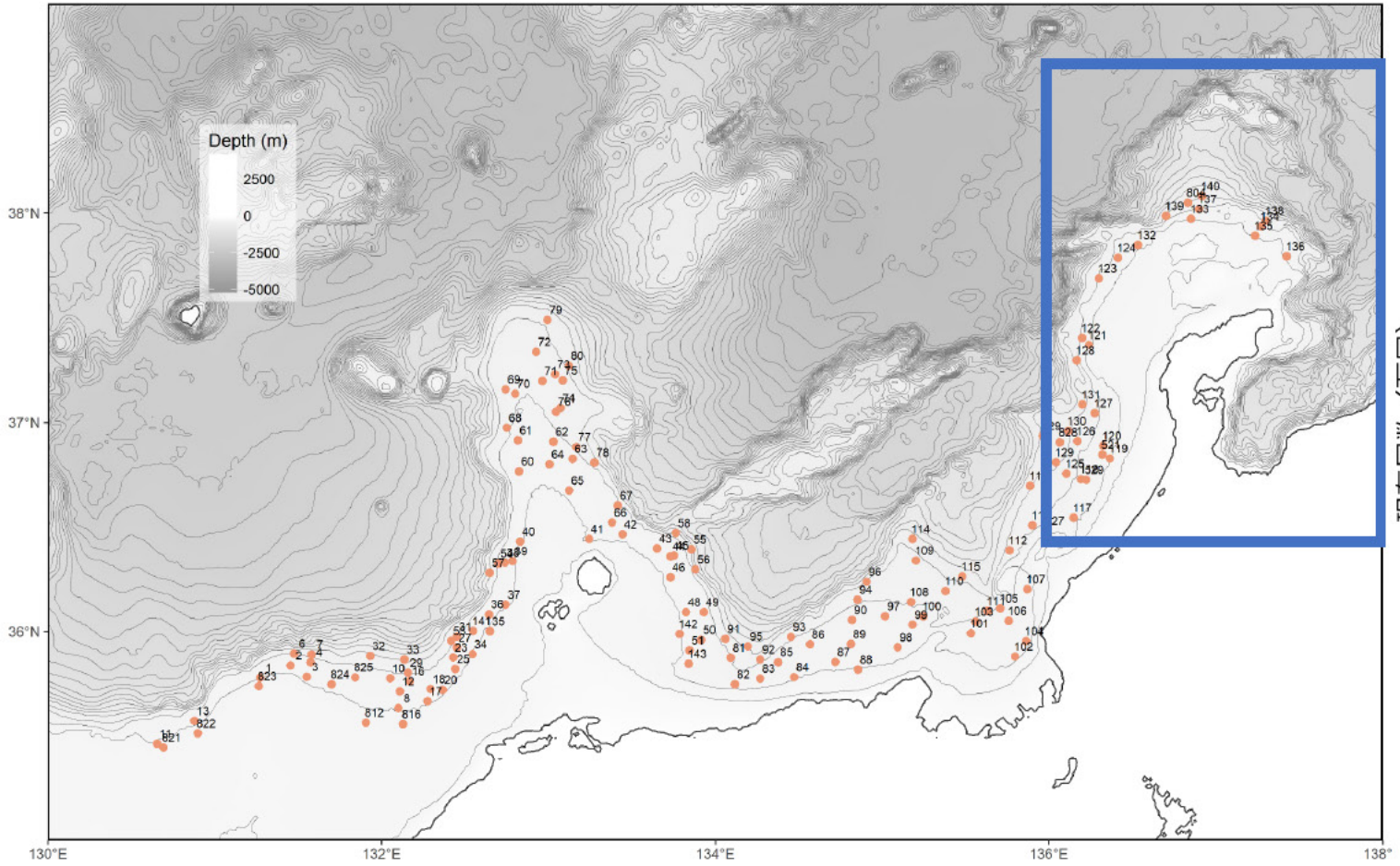
Data – Abundance indices

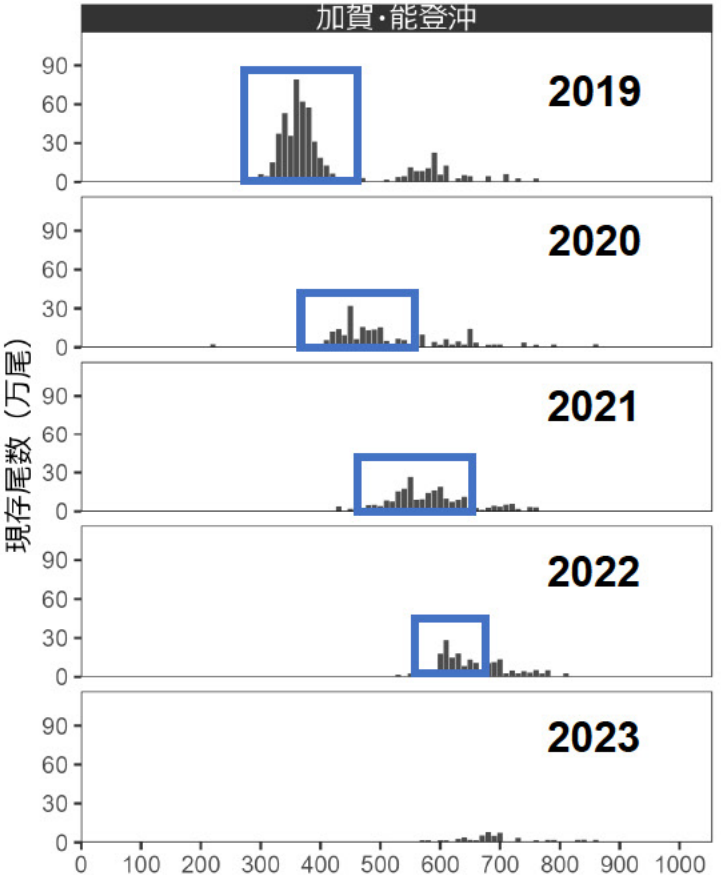
Questions

20) The report also states that there are demersal stock surveys. As far as I remember, indices from these surveys have been used in other assessments. Please discuss these alternative data sets and why they were not used, at least in sensitivity models. Please compare these indices with the main offshore trawling index. Did the higher recruitment index values in 2014 & 2017 correspond to observed cohort strength in the age and adult index data?

- Index from the trawl survey in the western Sea of Japan is partly used in the northern Sea of Japan Pacific Cod stock assessment.
- We have annual survey data from 2013 around Ishikawa prefecture that is included in the northern area.
- The index is largely concordant with the results from the VPA that shows relatively high larval recruitment of 2014 and 2017 year-classes.
- Now thinking about utilizing the larval recruitment index for estimating future recruitment or VPA tuning

Data – Abundance indices





Questions

21) Why does the model start in 2000 when there appears to be earlier data and with better contrast?

- It is because body length composition data is available from 2000.
- Length measurement dataset in early 1990s is desirable because it may provide insight into what was going on during the drastic population change from the past 40 years. Unfortunately, we only have annual catch data by fishery.

Questions

22) Given that the offshore trawl index catches predominantly adult fish and therefore has a selectivity that is either dome-shaped or increasing with age until it reaches an asymptote (flat top selectivity), why does the model (Eqn 7) assume that the offshore trawl index is representative of the total population?

- Previous papers assumed dome-shaped selectivity for cod species.
- We have no information about catch selectivity of each fishery (Danish seiners, gillnets, etc.).
- Sensitivity runs may be required with some assumptions and different models to test robustness of the results
- Tuning against fully mature (4+), old (5+) or all individuals (3+) resulted in the almost similar results when I tried in 2019 or 2020, however it can be because of the flat-top, relatively stable age structure at that time.

Questions

23) Please show a table of the estimated parameters and their uncertainty.3. What was the q_i estimate for the bottom trawl survey based on the sum of squares tuning described in equations 7 and 8 of Appendix 2?

a. Does the estimate of q_i seem reasonable given your knowledge of the survey?

b. Did the authors explore tuning the cohort analysis to any of the other indices of abundance described in the table on page 4 of the document?

- I would like to respond later after checking my VPA script and get the values

Questions

4. Please describe the calculations of selectivity used in the projection. Appendix 1 indicates that selectivity may have been agreed upon at the Research Institute Meeting. If so, please include this description in the document.

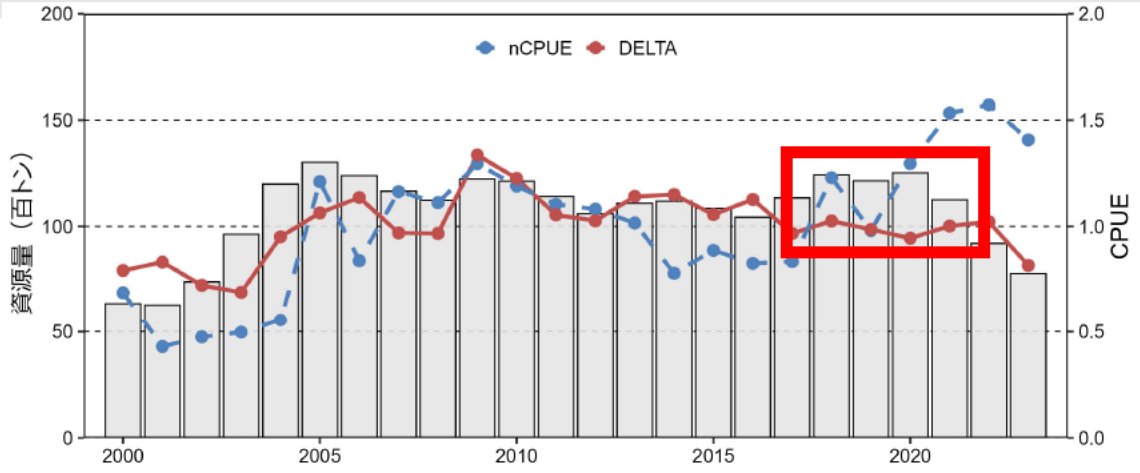
- (Probably The stock assessment team of FRA answered the question?)
- We use the selectivity in the latest year (the year before stock assessment) in the future projection and Fmsy is recalculated via %SPR value in the annual stock assesment.

Questions

24) The index fit is generally good but it is important to note that the fit is worse at the start of the time series when the contrast is highest. This suggest that the good fit may simply be an artefact of the 2000 start year and a period of mostly flat catches and index, and may hide model problems.

9. Supplementary Fig. 2-3; Please include a figure of the model fits to the index data.

- We think that it can be an artefact of the 2000 start year and a period of mostly flat catches and index. Because we only have data from the period of excellent stock status, without terms with low recruitment lasting more than five years, it can result in a hyper-stable? situation. Now the situation is changing and the recruitment level has been low since 2018 yearclass. Then it would be tested in the next few years.



Questions

25) Please discuss Appendix 8. How is this connected to the stock assessment?

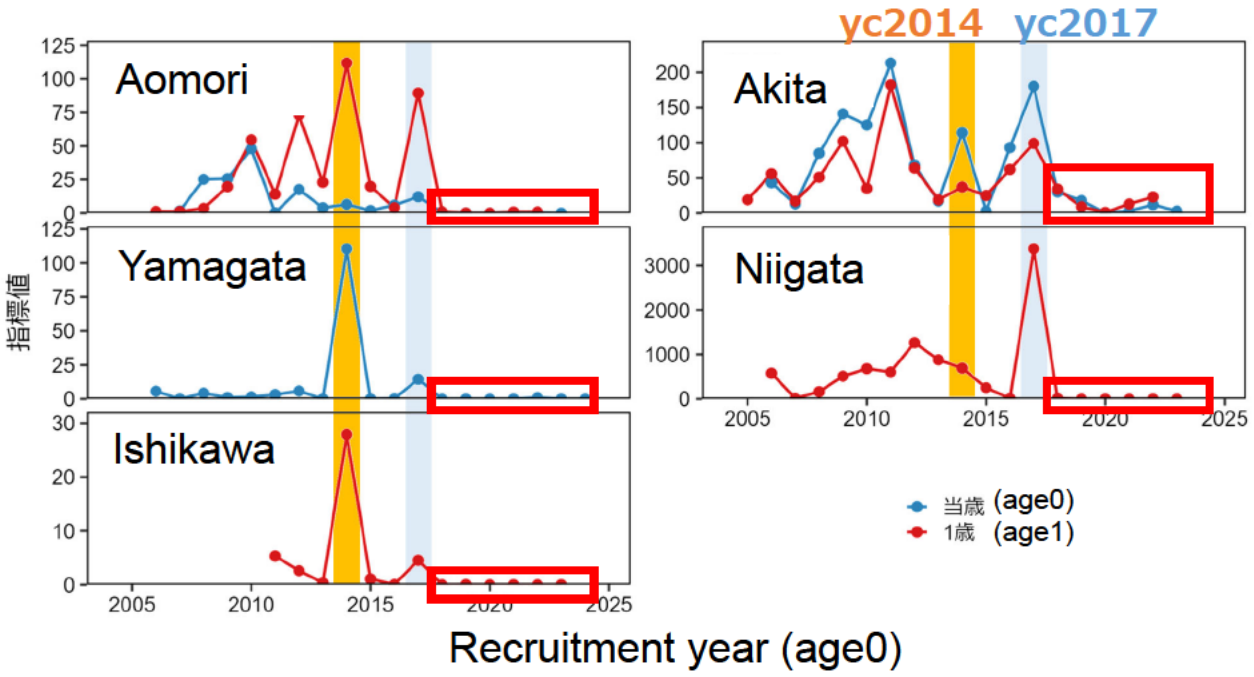
- Because Western Sea of Japan Stock is not set as TAC stock owing to its spawning ground in the Korean Sea off Busan, we only monitored the catch status and offshore trawlers index.
- This stock may be genetically separated by local western Sea of Japan stock and need further review by genetic analyses.

Stock-recruitment

Questions

7. The recruitment surveys are included in the description of the data sets, but there is no subsequent discussion of the data. Do the data from recruitment surveys, for example, align with the recruitment estimates from the cohort analysis?

- We do not use these larval survey indices from prefectural fisheries research stations because of their heterogeneous nature.
- Previous attempt for utilizing these values by simple GLMs and GAMs failed.
- Gears (Otter trawls, experimental and commercial Danish-Seiners, beam-trawl), seasonality (various for each prefecture), region (possible spawning or nursery ground off each prefecture), depth (various depth from 100 to 400)
- Standardizing these values by using custom state-space models can be effective and we are working on this task (~stock assessment meeting in the next February 2025)



Stock-recruitment

Questions

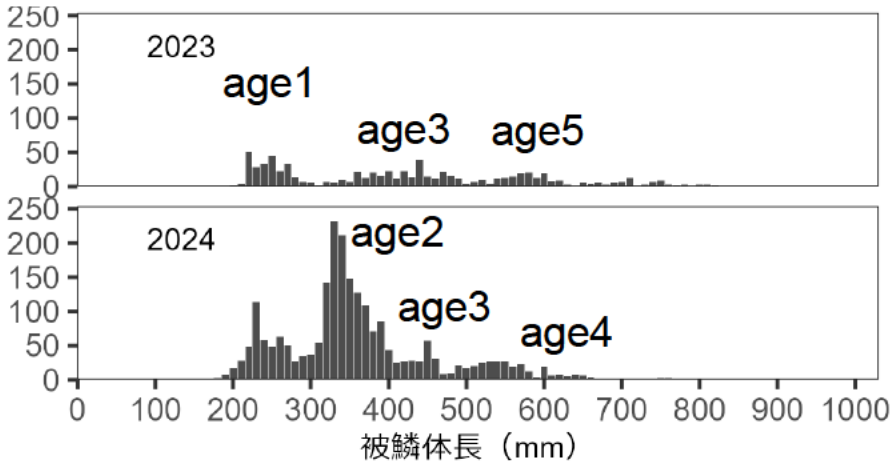
10. Appendix 7

a. Are the data in Supplementary Fig. 7-1 available for lengths?

b. In Akita in 2017, both age-0 and age-1 fish were high. If the lengths and ages were assigned correctly, should there be a one year lag between these peaks?

c. Specifically, what was the length cutoff that separated age-0 and age-1? If the lengths are plotted, do the lags seem to make more sense (for example maybe age-0 and age-1 fish differ by 10-50 mm, and the lag between these peaks are visible)?

- We have no raw data for the Akita 's larval survey but generally age-0 and age-1 fish can easily be distinguished.



Stock-recruitment

Questions

26) Please explain why the hockey-stick SRR was chosen as the base case. How does the hockey-stick compare with the Beverton-Holt and Ricker?

- Hockey-stick had beaten the other two models by SRR model comparison based on AICc in the previous analyses (2019).
- Recruitment of the Pacific cod in the northern Sea of Japan is tightly linked with thermal condition in the hatching season in early to mid March and higher recruitments were observed under the lower bottom temperature
- We therefore assume that recruitment level is apparently independent from SSB (random) but actually controlled by environmental conditions such as local SST.
- We however note that our dataset has few datapoints after 2000 and SRR during the putative record-low catch in the 1990s is not considered.

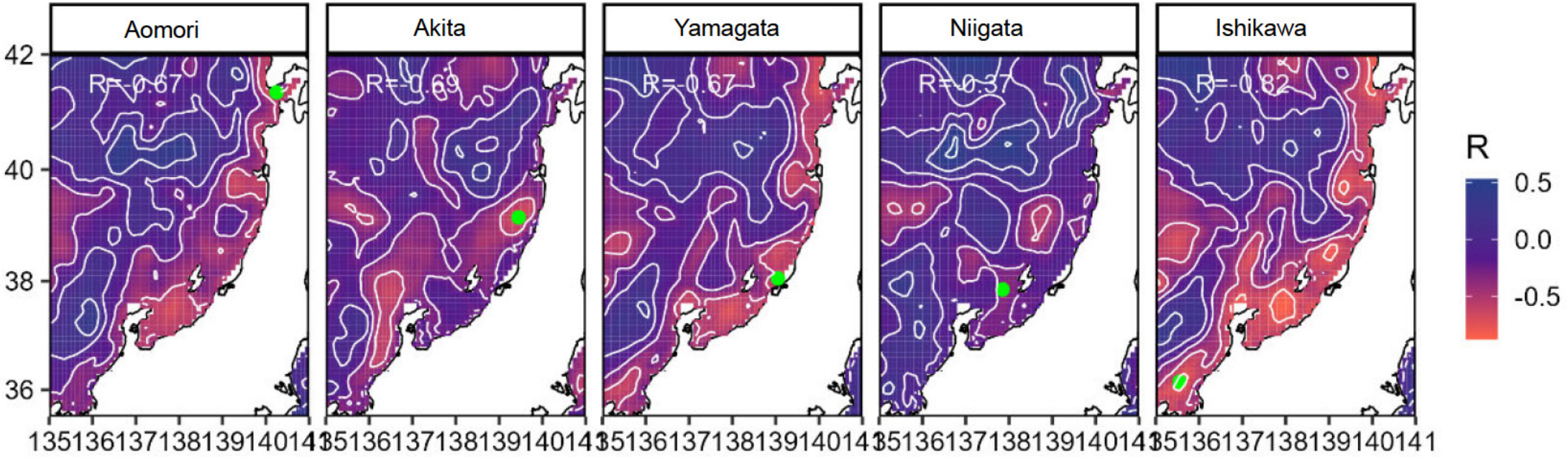
Our recruitment hypothesis

✓The previous study regarding SST and local prefectural recruitment index
(Yamagata prefecture, Ishiko 2002)

we analyzed the modern dataset from all the prefectures in the stock area and re-visited the hypothesis.

Cooling in Spawning season -> vertical mixture -> higher productivity **-> first foraging**

100m-layer average temperature of 1st week of March vs. Local prefectural Recruitment index



Projections

Questions

27) Doing 1 and 2 year projections are important for management. What is the prediction skill of these short term predictions?

- Precision of 2-year projection is directly reflected to the TAC in this stock.

(The upcoming winter fishing season after the summer stock assessment correspond to the first year of projection in this stock)

- Because the main target of the fishery in this stock is mature male for their milt and a considerable proportion of landing is consumed as fresh fish within days.
- Fishing pressure on younger fish than age 4 is fairly low from this reason and precise future projection can be done with fisheries independent surveys on these juvenile fish younger than age 3.
- We are now working on this topic, aggregating, curating and analyzing prefectural survey data (Danish seine, beam trawl and otter trawls).
- We also have otter-trawl survey data off Ishikawa from the early 2010s and, standardizing these heterogeneous survey data hopefully contributes prediction of the future biomass of age 4 or older fish.

Projections

Questions

8. Which ages are included in the F/Fmsy calculations?

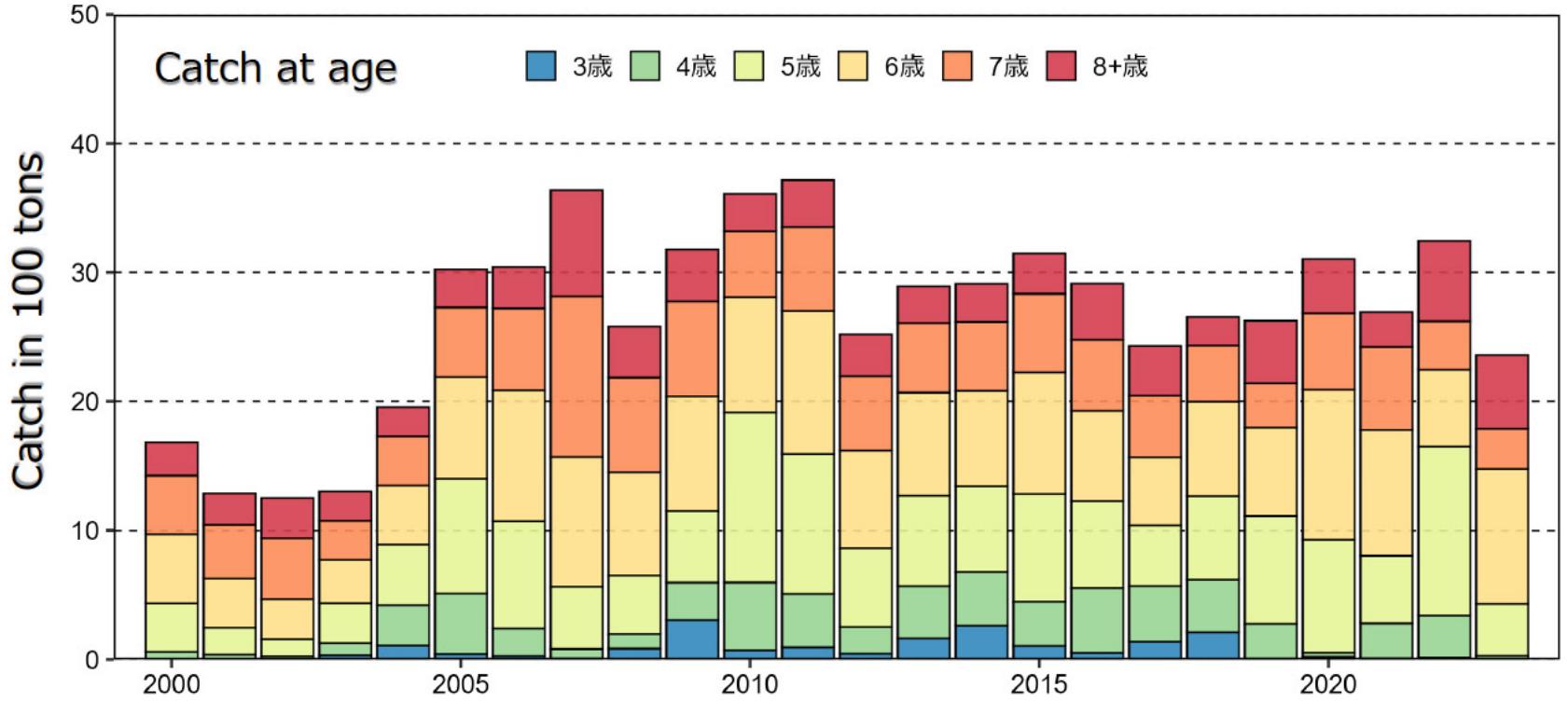
a. I noticed that the F values are the same for age 7 and 8+ I think in all years. I'm curious if the authors have a sense of if these age 7 and 8+ fish are moving outside of the defined distribution grounds? If so, assuming these old fish are removed only by the fishery (rather than moving) will have an effect on the estimated F values and the management quantities like F/Fmsy.

- All possible ages (from 3 to 8+) are included for F/Fmsy calculations.
- Because catch of ages 1 and 2 is negligible, not included in the calculation
- F values of ages 7 and 8+ are the same all the times. It is one of the important assumptions in tuning VPA.

Projections

Questions

27) Doing 1 and 2 year projections are important for management. What is the prediction skill of these short term predictions?



Projections

Questions

28) 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?

- Any uncertainties of Catch-at-age, M and the resultand SSB, R, N-at-age and F-at-age is not considered.
- Currently Japanese stock assessment framework is almost deterministic (but with some exceptions that utilizing state-space models).
- We are gradually moving to consider such uncertainty from catch statistics and surveys but, currently stochastic process is not implemented in the stock calculations other than the randomness of future recruitment.

Projections

Questions

29) How would incorporating more of the above uncertainties affect the assessment results and projections?

- The most realistic way is applying state-space model like SAM. We have also started working on SS but preparation of infiles is somewhat different from VPAs and SAMs and it may need more time to apply.
- Creating 1000 or 10000 dataset considering uncertainty of CAA and doing iterative calculations on these dataset can be another solution?

Others

Questions

30) It is stated in Appendix 11 that “we do not consider migration, in order to avoid the uncertainty associated with overestimation of abundance”. Not sure what this means exactly but in general, a good assessment will provide the full uncertainty of the assessment to the managers, so that they can understand the uncertaintites in the assessment and account for that in the management

11. I appreciate Appendix 11 evaluating the model sensitivity to assumptions about movement. I encourage the authors to continue to include these types of sensitivities in the assessment models. Would management advice be adapted to reflect the uncertainty in this sensitivity analysis?

- Data limitation regarding migrant-catch
- We showed the results from the alternative model with the following migration assumption: 50% of gillnet and setnet catches in Aomori prefecture in the recent years have exploited migrant from the other areas like Mutsu-bay or Hokkaido Sea of Japan with good stock status
- Considering migration lowered fishing mortality of older individuals and have overwritten rather conservative assessment results of the previous years, and probably it is not realistic.
- Stock assessment scientist of FRA (Me) and prefectures discussed, tested several assumptions and we have took the most conservative results.

Others

Questions

31) What are the potential improvements for this assessment?

- Application of more flexible models than VPAs (e.g., SAM and SS)
- Improvement of CAA data by using local dataset from prefectural research stations
- Updating CPUE standardizing models (GAM to VASTs or GLMMs)
- Flexible models for Age-Length, Length-Weight relationships, as well as maturity for incorporating time-variant parameters into the assessment.
- More on sensitivity test using alternative models for various parameters in the calculation
- And more…