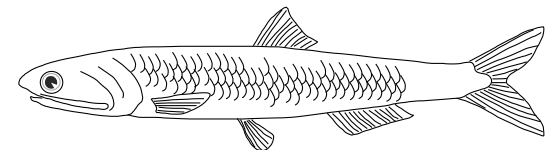
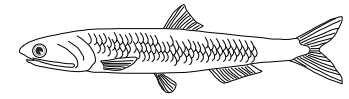


Japanese anchovy
(*Engraulis japonicus*)

Tsushima Warm Current stock



Biology/Ecology



-Stock structure and distribution-

- One of the most important issues for this stock is the stock structure and distribution. Please show the distribution of this stock, as well as distributions of adjoining stocks in the East China Sea and Sea of Japan. Also please show spawning areas and EEZs as well as approximate areas of Japanese and non-Japanese fishing fleets (Steven).
 - > Next slide shows distribution of anchovy. Japanese fisheries have only operated in the coastal regions.
- Roughly what proportion of this anchovy stock might be in the area of focus? (Peter)
 - > No data. However, the catch amounts of anchovy in China and Korea are much higher than that in Japan.
- Are there any studies from Korea and China about the spawning and distribution of these anchovy? (Peter)
 - > Yes. Next Slide shows these.
- Do the distributions in previous question change, especially during “high” regimes? (Steven)
 - > No data. In addition, this sub-population did not be assumed be two regimes.

Biology/Ecology

-Stock structure and distribution-

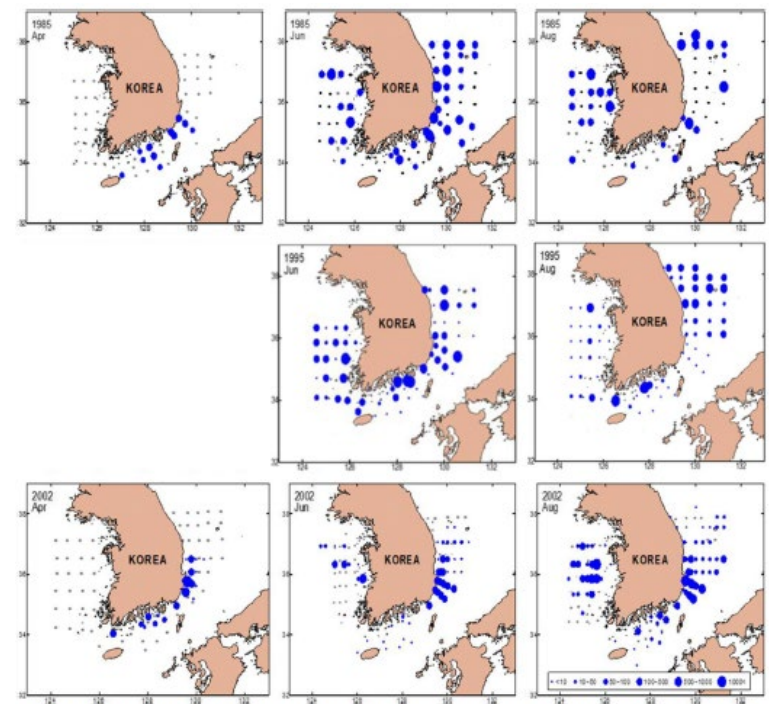
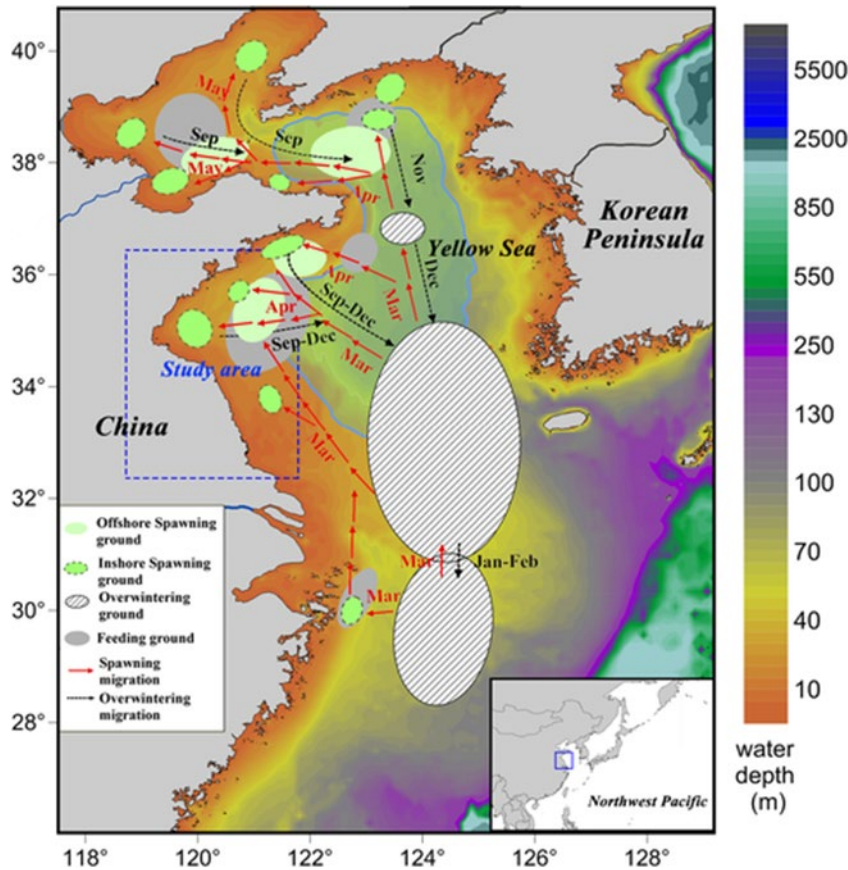
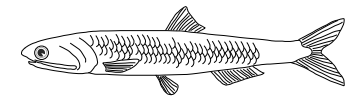
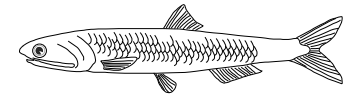


Fig. 4 Spatial distribution (blue circle) of anchovy eggs and sampling stations (dot) in Korean waters during April in 1985 and 2002, and June and August in 1985, 1995, and 2002 (unit of egg density in the legend: Ind/No/m²)

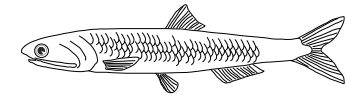
- (Left) Schematic distribution pattern of anchovy in the East China Sea, Yellow Sea and Bohai Sea (Zhang et al. 2021, Fish. Oceanogr.).
- (Right) Anchovy eggs distribution in the around waters off Korean Peninsula (Kim et al. 2020, Fish. Aquat. Sci.).



Biology/Ecology

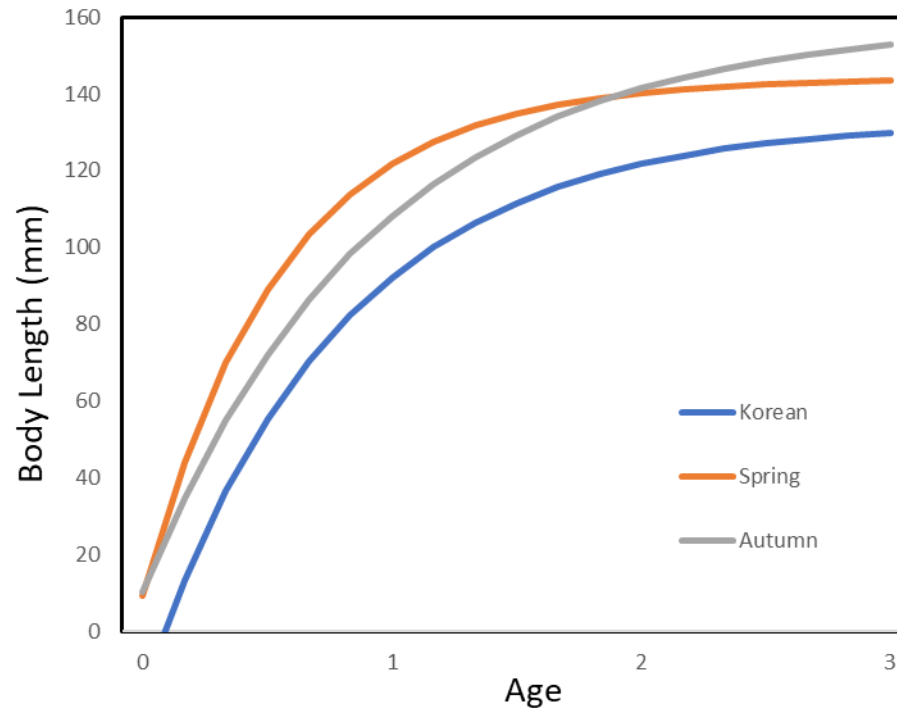
– Growth –

- Please provide some details of the sample sizes associated with calculation of the age/growth relationships. (Peter)
 - > The sample size for growth estimation was 349,812 individuals (Ohshimo 2009).
- It was stated that the otoliths of the stock were too difficult to read. However, the otoliths of the Pacific stock and in the EPO have been read. Please explain what makes the otoliths of this stock more difficult to read. (Steven)
 - > After the peer review for Japanese sardine TWC sub-population, the age reading based on the otolith was succussed. Then, we have some plans for age determination by otolith in the future.
- Are there available data for fish older than age 2? (Peter)
 - > There are no fish older than age 2 in this region.

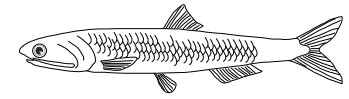


Biology/Ecology

- Growth -



- Comparison of growth model between Korean and Japanese waters.

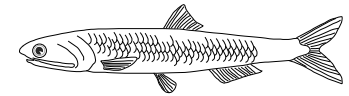


Biology/Ecology

- Maturation and mortality -

- It seems that some age 0 fish can be capable of spawning. Anchovy can be 9 cm within 6 months of hatching and mature individuals of 8.5 cm have been found in Wakasa Bay. Were there any new maturity data that may have been used for this assessment? For example, have data from the different fisheries been aged and maturity state assessed? (Peter)
 - > Yes. A part of age-0 fish that was born in spring cohort can spawn in early winter. However, early winter is not main spawning season, and the hatched larvae may be not survived. In addition, age-0 fish cannot spawn at 1st January. Therefore, spawning stock biomass is not included age-0 fish.
- The M-at-age for this assessment is not very clear. Was it 1.0? And was it the same for all ages? (Steven)
 - > The M values of all the other fishes will be evaluated in the future. The values was same all ages in this study.

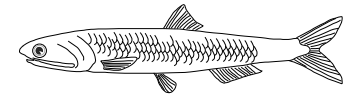
Data



- Fisheries and statistics -

- Just to clarify East China Sea landings from Pacific-based (Japan and Korea?) vessels were included but East China Sea landings from non-Pacific (China?) based vessels were not included?
 - > Stock assessment data is available only Japanese data, not China and Korea.
- How were shirasu included in the FY 2020 assessment? Just out of curiosity.
 - > The assessment process was same.
- We have a similar issue for Pacific sardine in the US West Coast where Mexico lands fish but the US does not have any ability to limit Mexican catches. I think from an assessment perspective, it may be better to assess the population with all available data even if there will be no ability to limit other countries' landings. Has this kind of assessment been considered in the past or might it be possible in the future?
 - > Yes. We can evaluate our assessment model if the available data will be incorporated into our model.

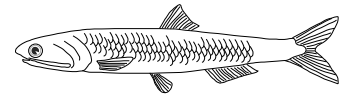
Data



- Fisheries and statistics -

- Might it be possible to collaborate with Korean scientists to develop a joint metric of fishing effort and CPUE? The vessels entering Nagasaki-ken are a majority of the Japanese landings?
 - > Japanese scientists need to collaborate research or assessment. The landing amount in Nagasaki-ken (prefecture) is about half of the total landing of anchovy TWC sub-population.
- I see in Supp. Table 9-1 that including South Korean catch does not change the status of the stock.
 - > Yes. Because the catch size (CAA) is assumed to be same with Japanese size (CAA).
- Do Korea and China also harvest shirasu?
 - > There are no information about body size in both countries.
- Are older fish harvested by Chinese or Korean vessels?
 - > There are no information about body size in both countries.

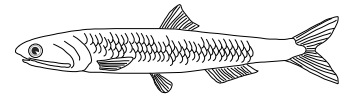
Data



- Fisheries and statistics (Steven) -

- It was stated that Chinese and Korean catches were not included in this assessment. However, it is critical that all catches of a stock are included in a VPA model. Several reasons were provided in the document but more detail is required. Please explain in detail why it was considered reasonable to exclude Chinese and Korean catches from this assessment.
 - > The catch amounts in China and Korea can be applied; however, the value in China is delayed a year. In addition, body size and age compositions are not applied, it is very serious problems.
- Why is the catch of shirasu not included in the assessment? If you wanted to, how can it be included? The shirasu fishery is an interesting question for population dynamics models, and we can discuss more at the meeting together with the Pacific stock.
 - > Maybe discussed with the Pacific stock. Tsushima warm current stock is included in assessment as sensitivity test. In addition, the assessment results including shirasu fishery were already introduced to stakeholders.

Data

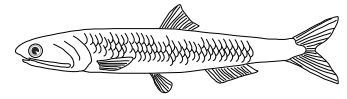


- Catch at age -

- It appears that aging was not done for this stock. Please explain in detail how the growth model and ALKs were developed without age data. It is especially important to show that the cohorts are very clear from the length data and relatively consistent between years. (Steven)
 - > The longevity and growth rate of anchovy is short and rapid, respectively. Then, age determination can be conducted; however, evaluation based on the otolith is need in the future.
- Please use this length-only method to develop alternative ALKs for the Pacific stock, and compare it with the observed ALK using aging data. (Steven)
 - > CAA in 2020 was calculated using Pacific ALK, and both results were compared (next slide).
- Are the same ALKs used for all years and regions? (Steven)
 - > Yes. However, evaluation is need.

Data

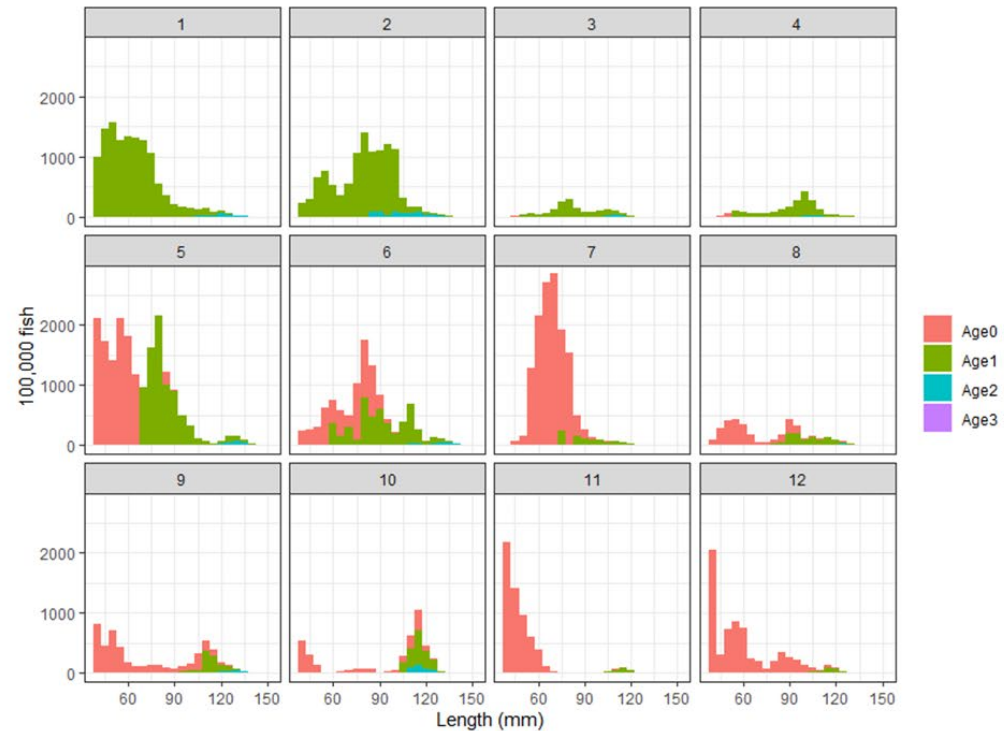
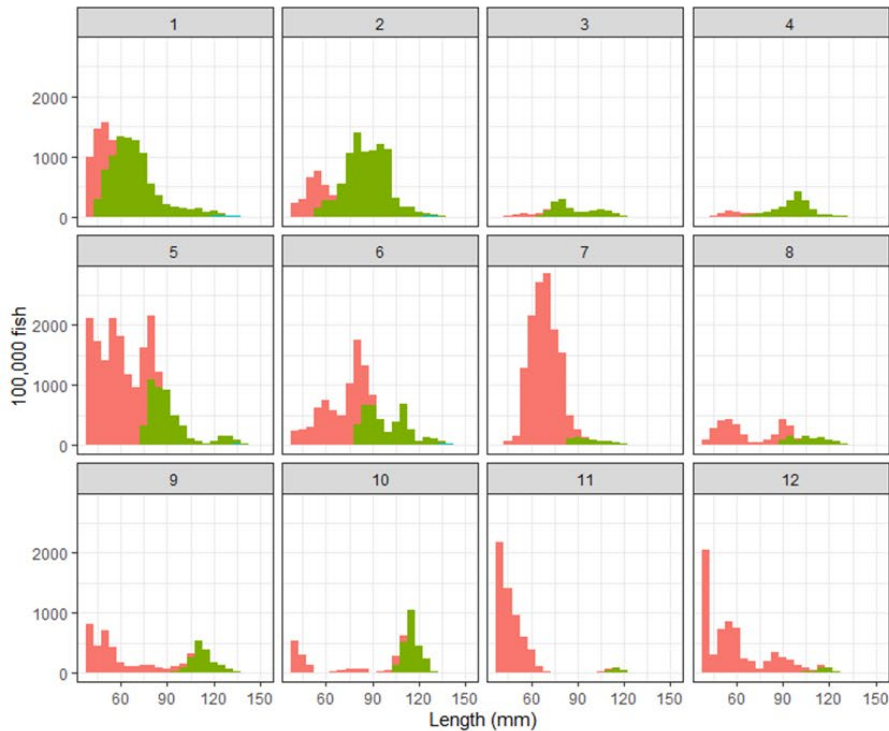
- Catch at age -



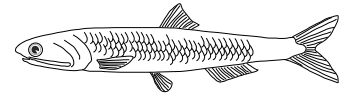
ALK	ECS	Pacific
Age0	59,447	49,956
Age1	36,100	43,695
Age2	180	2017
Age3	0	60

Tsushima WC ALK

Pacific ALK



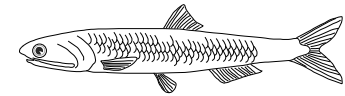
Data



- Catch at age -

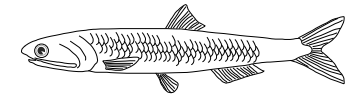
- For the growth estimation, there are measurements from a high number of individual fish (349,812). If these data are broken up by month and cohort, are there different age-length patterns for each cohort? (Peter)
 - > The data are broken up by month, but not cohort. Then, we cannot check the differences for each cohort.
- Data from the East China Sea, Western Sea of Japan and Eastern Sea of Japan were used for the age-length keys. I assume that these were data from only Japanese vessels in order to be consistent with the rest of the data handling? Please clarify. (Peter)
 - > Yes.

Data



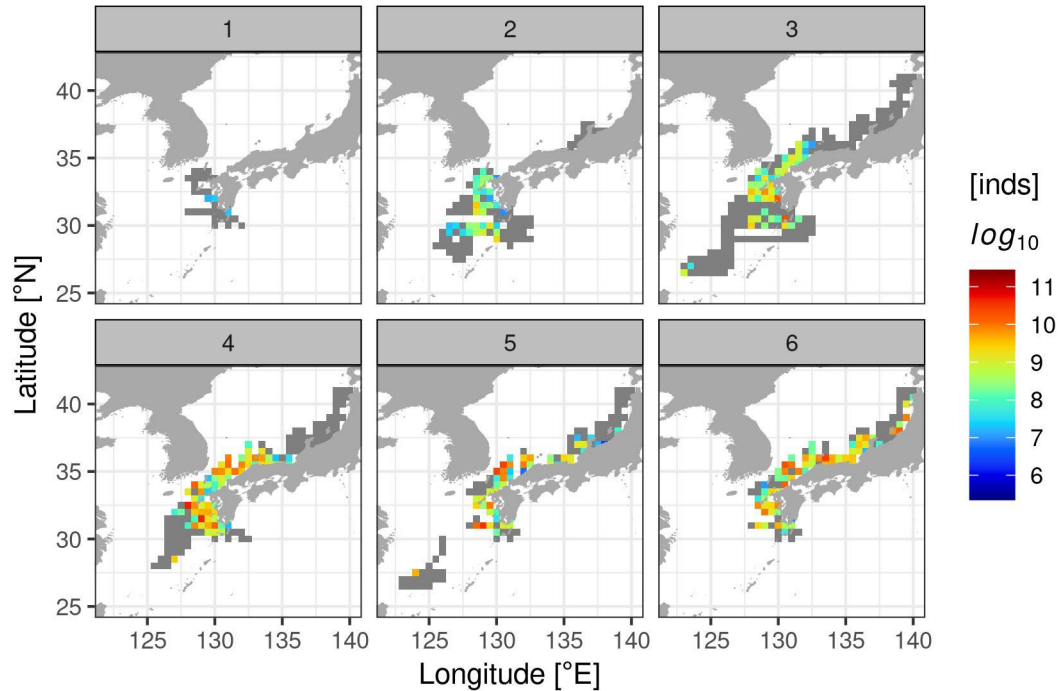
- Indices, CPUE -

- There is no documentation on how the spawning volume index was developed. Please explain in detail (see Pacific stock documentation and questions).
 - > Basically, the methods for estimating egg abundance are same with Pacific stock.
- Given the well-known problems with purse seine indices, why use the purse-seine index? Especially when the index has no contrast and an egg-based index is available.
 - > Anchovy is caught mainly by mid-small powered purse-seine fishery in Japan. Therefore, we think this index must be applied for stock assessment; however, its will be evaluated in the future.
- It appeared that there were juvenile surveys that were available but not used. Why?
 - > Yes, juvenile surveys have been conducted. But, the area of the juvenile surveys is not coincided to the fisheries area. Evaluation for applying the surveys data is need.



Egg survey

2021



Juvenile surveys have been conducted in the East China Sea and Sea of Japan since 1970th.

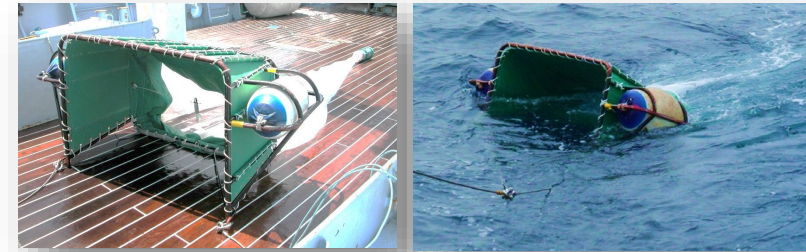
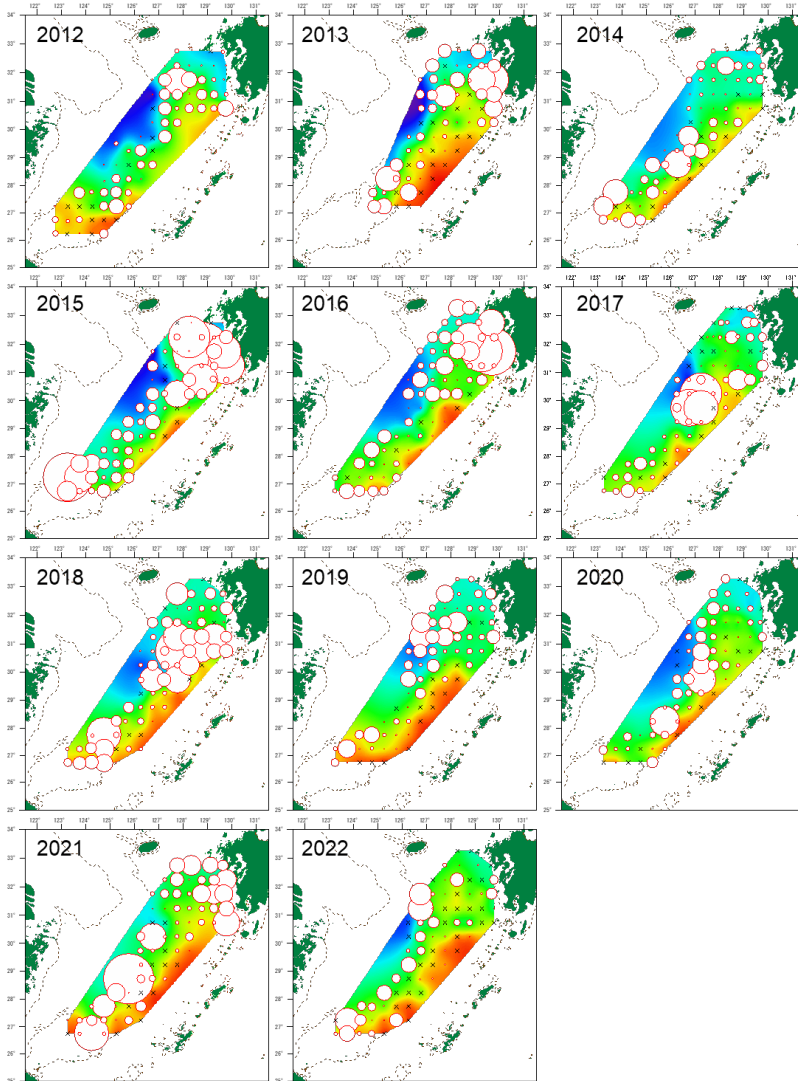
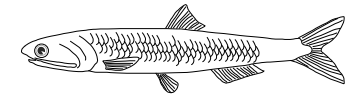
Main survey periods were during March and June, these periods were coincided with spawning periods of small pelagic fish in these areas.

Egg surveys have been conducted in the coastal waters in the Sea of Japan and East China Sea.

Net mouse diameter is 0.45cm, and mesh size is 0.33mm. The net was towed vertically, and the maximum depth was 150m.

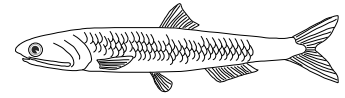
- Samples were fixed by 1% formaldehyde quickly, and the eggs were sorted by each species.

Juvenile survey



- Juvenile surveys have been conducted in the East China Sea in spring since 2001.
- Net mouse size is 1.35X0.75m, mesh size is 1mm. The net was towed for 10minute and 3.5knot.

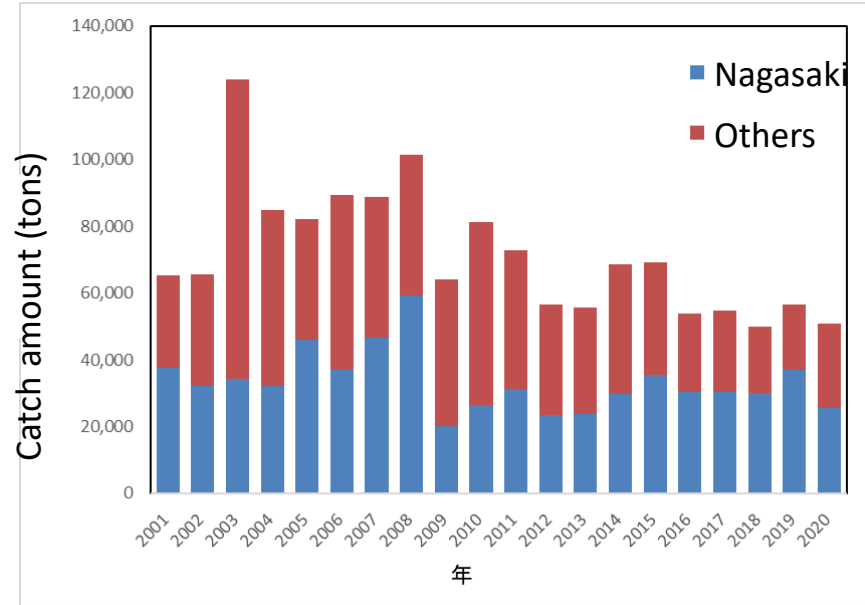
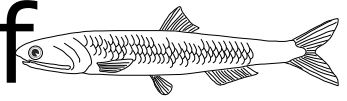
Data



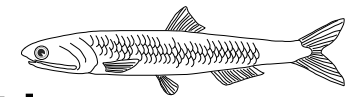
- Indices, CPUE -

- Please show the operation area and ports for the small-medium purse vessels used for the tuning index.
> Next slide shows the operation area.
- How many hours or days are the trips for the small-medium purse seine vessels, and how many sets do the small-medium purse seine vessels per day?
> Basically, the operation is one-night.
- Why are non-zero catch data excluded from the purse seine index?
> The annual fractions of zero-catch were almost stable. We can calculate the delta-lognormal CPUE standardization, and these results were almost same.
- Are there acoustic surveys for coastal pelagic species in the East China Sea and Sea of Japan?
> Yes. However, these data are not applied.

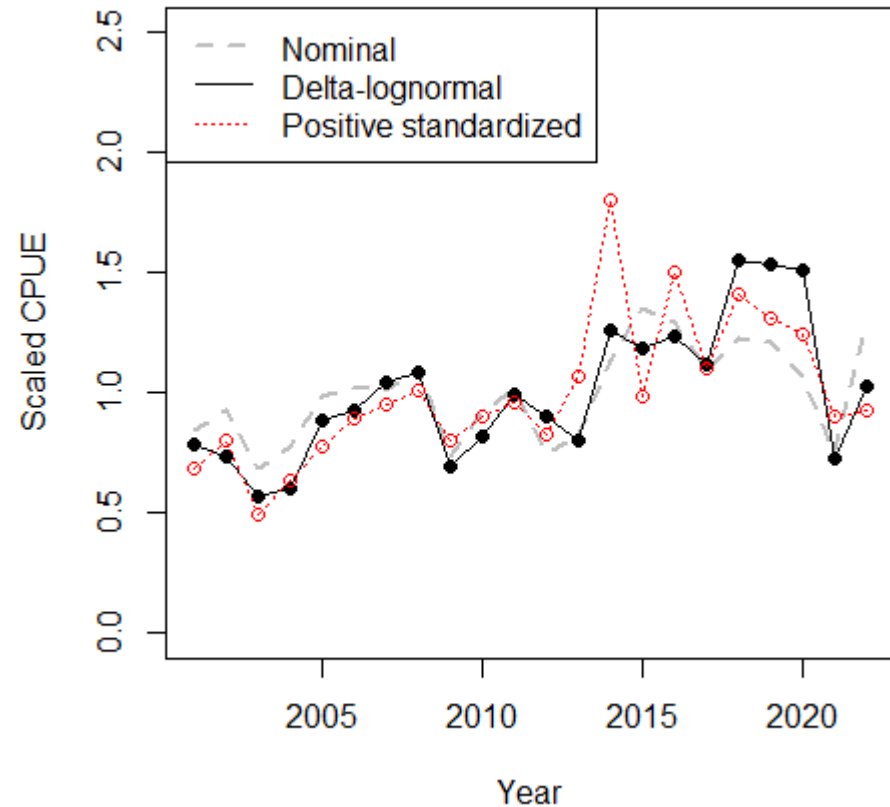
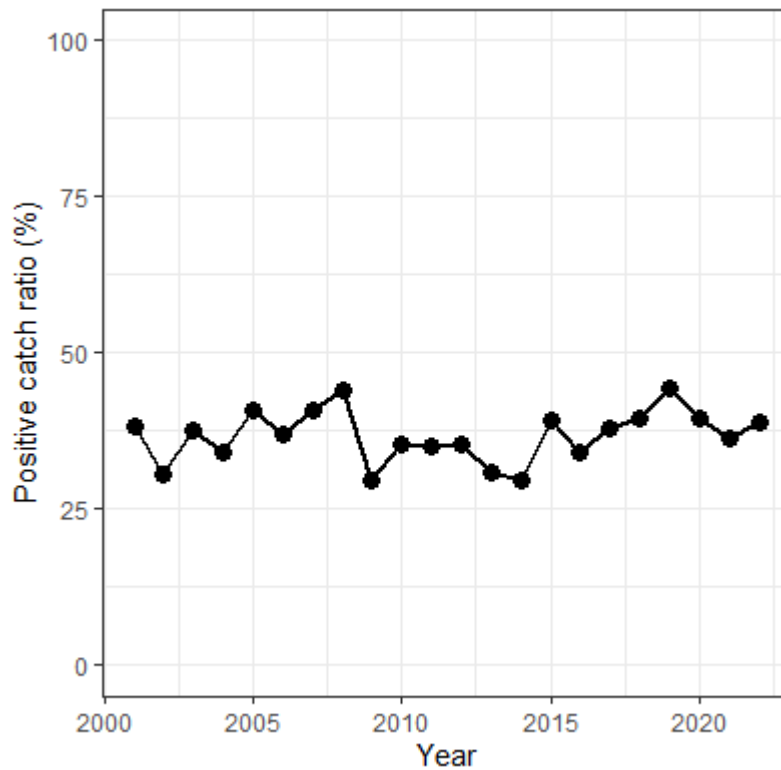
Fishing area and fraction of anchovy in Nagasaki Pref.



- Fishing ground for anchovy is coastal area around Nagasaki Prefecture. In particular, catch amount of anchovy in Ken-hoku and Ken-nan areas were higher than that in the other areas.
- The catch amount in Nagasaki Prefecture is the highest, and the fraction of the catch in Nagasaki Prefecture is almost 50%.

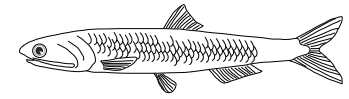


Positive catch ratio, CPUE standardization



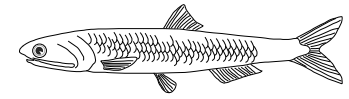
- The positive catch ratio was almost 40%, and stable.
- In this year, we calculated the CPUE using delta-lognormal standardization method. The results between both models were almost same.

Data



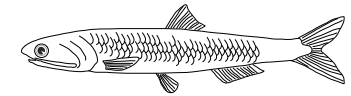
- Indices, CPUE -

- Where did the vessels that left the fishery go? Did they switch to a different fishery or region?
 - > Operation area limited to coastal area, because fishery boats are small.
- Is it assumed that all these vessels are targeting anchovy?
 - > Most of vessels are targeting anchovy.
- What proportion of the purse seine data were 0 for anchovy?
 - > The fraction of positive catch was almost 37%, and the annual value was almost stable.
- Were the purse seines that caught 0 anchovy targeting a different species?
 - > Jack mackerel, chub mackerel and sardine are targeting.
- Was the delta model used for anything? I've seen delta models used to standardize trawl survey data, but I'm curious if fishermen will set purse seine nets if they don't see anchovy schools.
 - > No.
- Was a Bayesian model used? I ask because BIC was used for model selection. Please provide some clarification on this point. If the model is Bayesian details such as the definition of the prior distributions and likelihoods explored will be relevant.
 - > No. However, the results were same when AIC value was used.



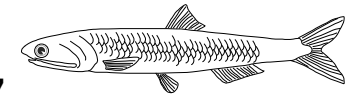
Model and Diagnostics

- Given the relatively high uncertainty of the catch-at-age data, a VPA model is likely not appropriate. Why was a VPA model used for this assessment? (Steven)
 - > (Confirm) Please let me know the alternative assessment if you have. We will challenge it if we can.
- Given the data problems, it is difficult to discuss model diagnostics [just a comment]. (Steven)
 - > Agree. The data, including catch and CAA have a large uncertainties. We have evaluated the data and model as well as possible, and the model and data will be developed in the future.
- Have there been research into using alternative modeling approaches for this stock? (Steven)
 - > (Confirm) What is alternative modeling approaches?

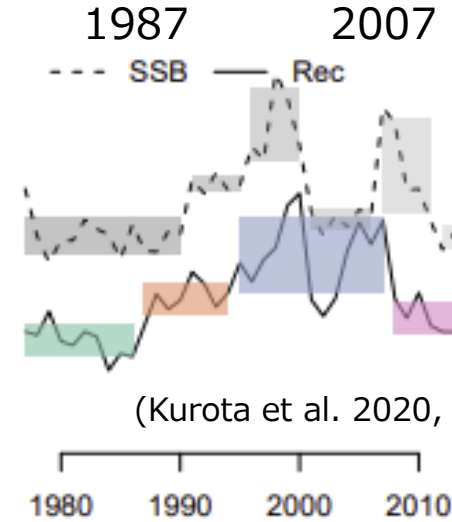
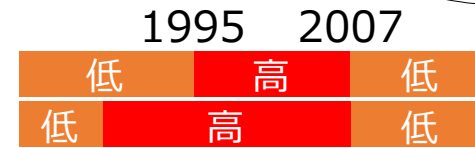
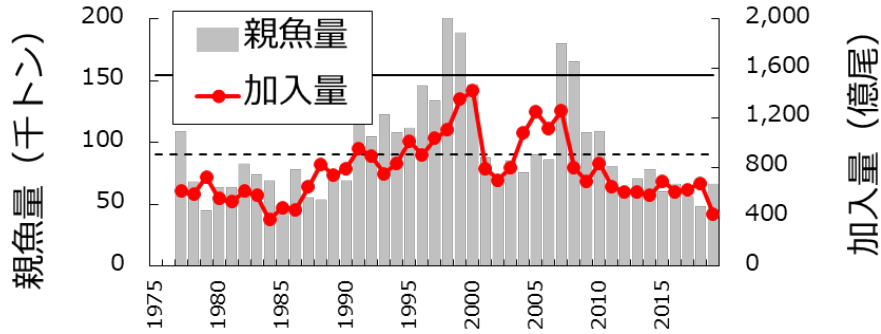


Stock-Recruitment

- It is common for anchovy stocks to exhibit “high” and “low” regimes. Was there evidence for this in this stock? (Steven)
> Next slide shows the results.
- Is there any research into why the SRR is so different between this stock and other anchovy stocks? (Steven)
> There are no research about SSR of anchovy, our results are first step for stock assessment and management.

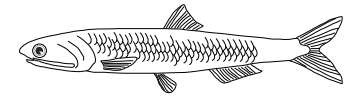


Stock-Recruitment



(Kurota et al. 2020, Fig.S1改変)

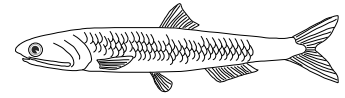
	SBtarget (thousand tons)	SBlimit (thousand tons)	SBban (thousand tons)	Umsy	MSY (thousand tons)	SBtarget/ SB0	Fref /Fcur	Catch2022 ($\beta=0.8$) (thousand tons)
No Split	83.9	31.7	4.3	0.33	51.4	0.45	0.47	33.9
Split	72.8	32.6	5.0	0.32	43.5	0.46	0.44	25.8



Projection

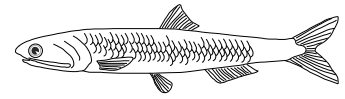
- Based on the document “Guidelines for HCRs and ABC calculations”, these calculations are supposed to be risk-based and incorporate the uncertainties in the assessment. However, the only uncertainty included in the projections appeared to be the uncertainty in future recruitment deviates. There did 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? (Steven)
> Yes. Only uncertainty in future recruitment deviates is incorporated into the model. In the future, other uncertainties will be incorporated.

Others



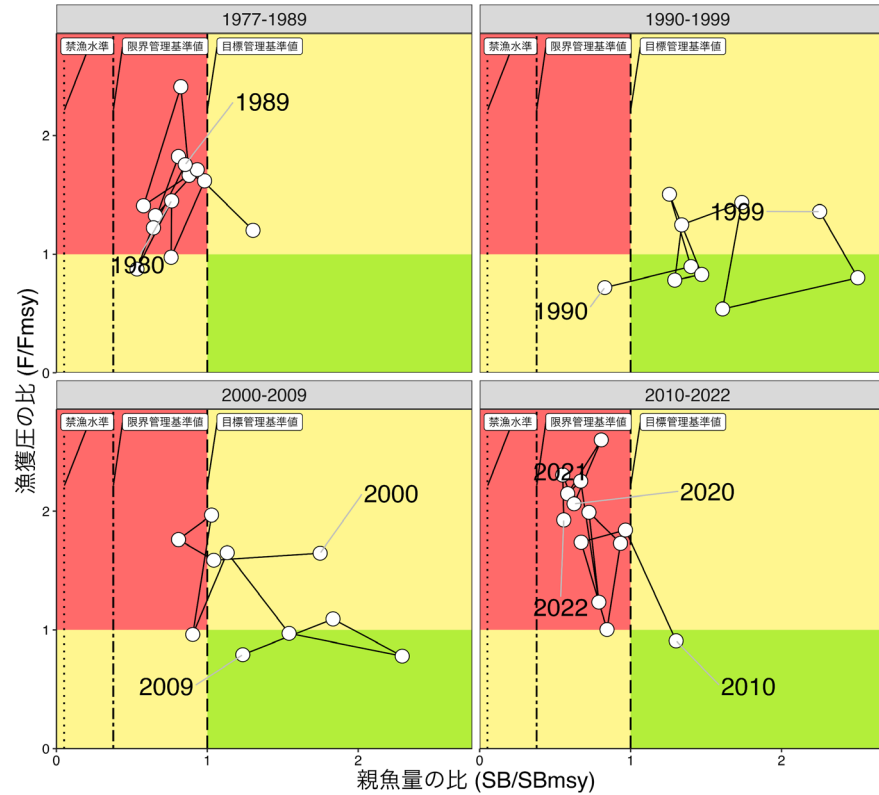
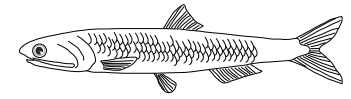
- What are the potential improvements for this assessment? (Steven)
 - > Detecting the stock structure and incorporating the foreign countries fisheries data are necessary. Biology and CAA evaluations are need. Fisheries non-dependent surveys in offshore area are also need.
- Given the problems with the data, it may be useful to consider alternative approaches to managing this stock, like empirical-based (i.e., non model based) approaches. Has there been any research into this? We can discuss more during the meeting. (Steven)
 - > Thank you.

Others



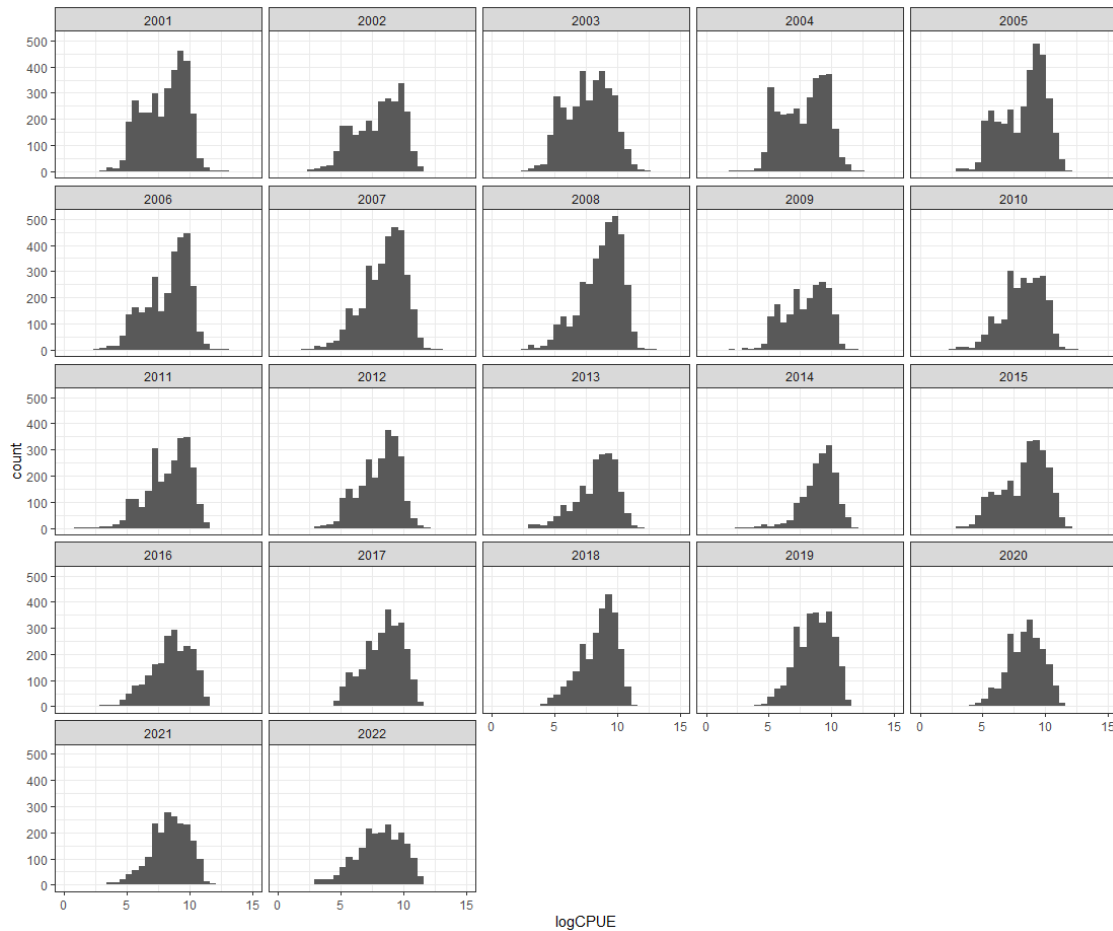
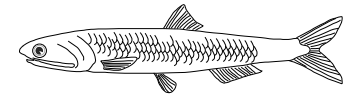
- Fig. 3-1: Please indicate in the caption that these catch values are only those from Japan. Is it possible to add plots for landings from Korea and China? (Peter)
 - > Yes. This annual catch amount indicates only from Japanese fisheries. Catch amounts in China and Korea indicated in Table 3-1, please check it.
- Supplementary Fig. 3-1: Can this plot perhaps be broken out into decades (1990s, 2000s, 2010s)? I am finding it hard to track the trajectory in the Kobe plots.
 - > We can do this suggestion.
- Appendix 8: Is it possible to include a plot of the purse seine observations used in the CPUE standardization? I think the decision to wrap an anchovy school will be based on the presence of a school, I would think that the data would be skewed one direction rather than normally distributed.
 - > Next slide shows the histograms of $\log(\text{CPUE})$.

Others



- This stock could be overfished and overfishing during 1980th and 2010th.

Others



- Annual histogram of $\log(\text{CPUE})$ of medium-small powered purse seine in Nagasaki Prefecture during 2001 and 2022.