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15-16, 18-19 December 2023
Nanaimo, British Columbia, Canada
Agenda Item 6.4

NPFC-2023-SC08-IP06

Domestic stock assessment of Japanese flying squid in Japan

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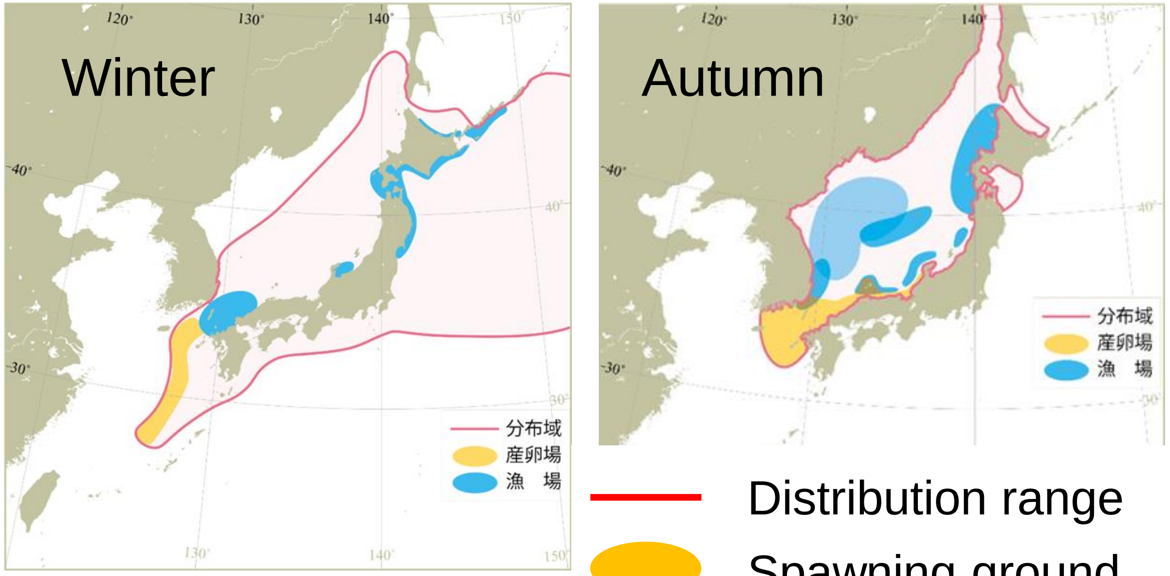
Population structure

Distribution and spawning ground by each stock

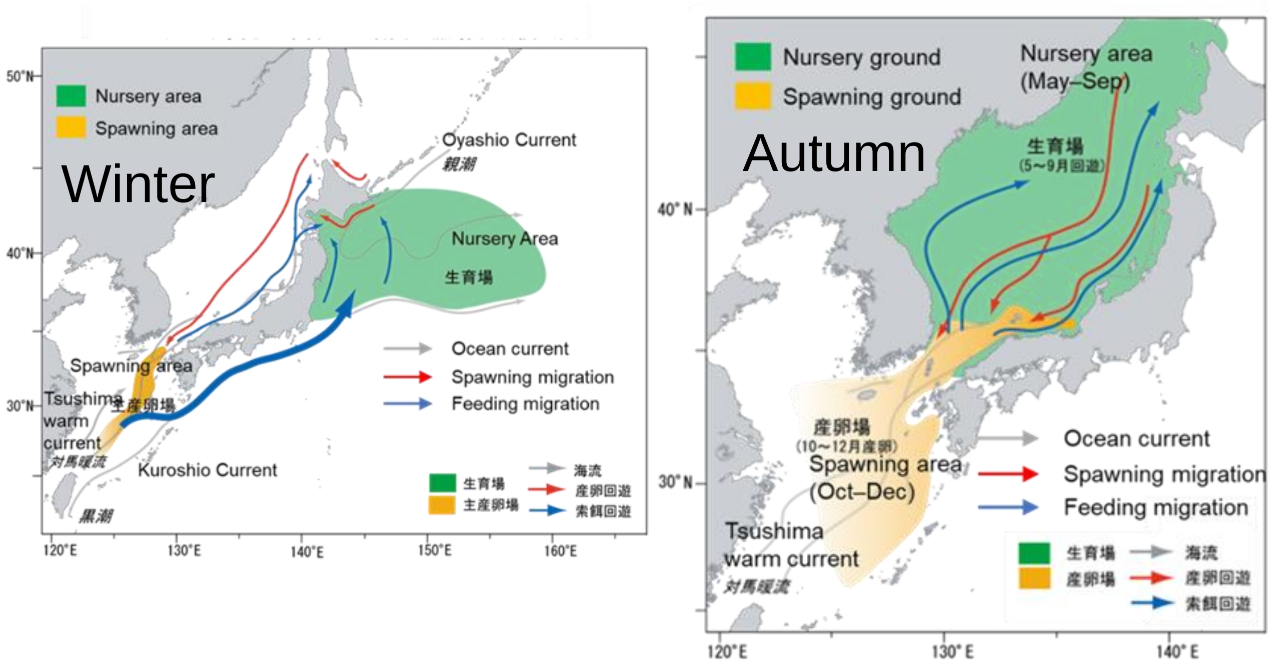


Distribution range

Spawning ground

Fishing ground

Seasonal migration route by each stock

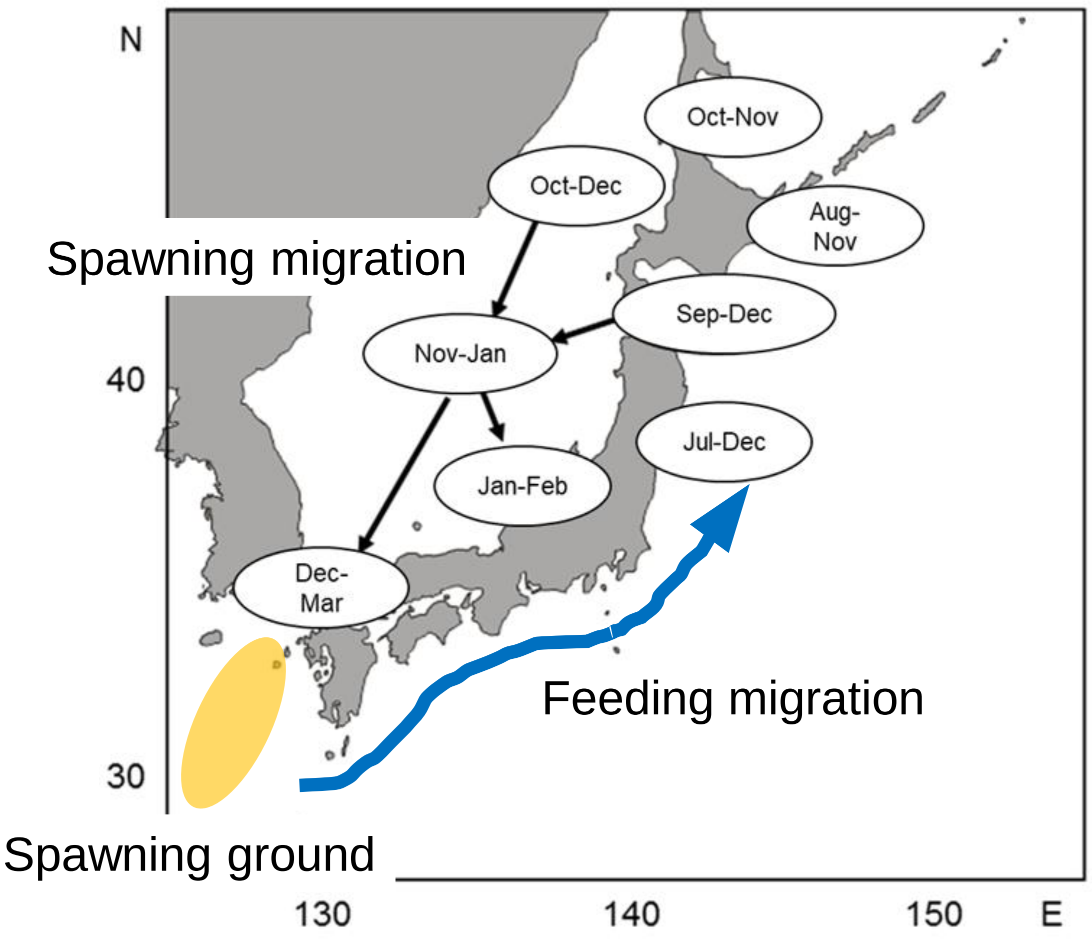


The winter and the autumn spawning stocks are dominant

The stock assessment has been conducted to each stock

JFS caught in the NPFC Convention Area is the winter spawning stock

Migration and Seasonal change of fishing grounds



Winter to Spring
Paralarvae are transported to the Pacific Ocean by the Kuroshio Current

Summer to Autumn
Migrating northward to feeding grounds

Late Autumn to Winter
Migrating southward to spawning grounds through Sea of Japan

・Fished by jigging, set net, bottom trawl, purse seine

・Catch by Japan and Korea in the Sea of Japan from late autumn to spring was considered as the winter spawning stock

Biological information

Squid sampling

・Squid samples were collected by local fisheries research bodies and local fisheries associations at major ports on the Pacific side

・Samples were measured in the laboratory

Squid measurement

・Mantle length, body wight, reproductive organ (3000-15000 individuals/year)

・Maturity classification

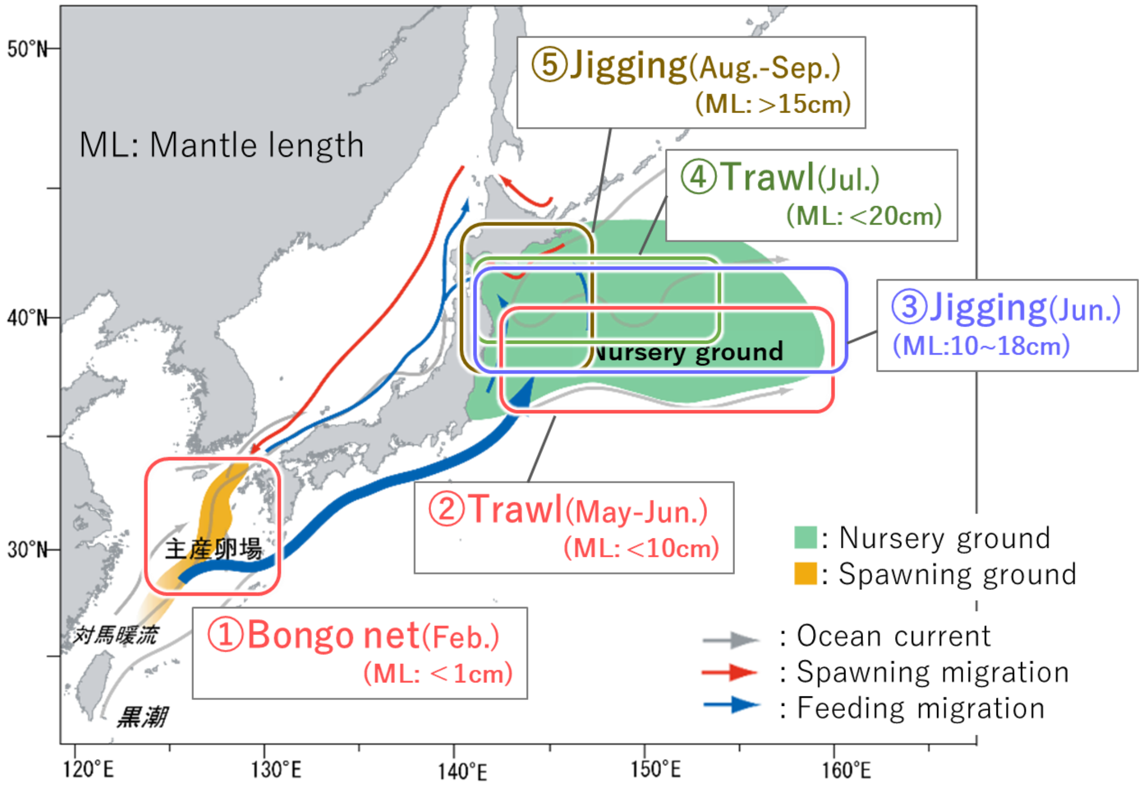
・Age determination (500-1200 individuals/year)

Survey

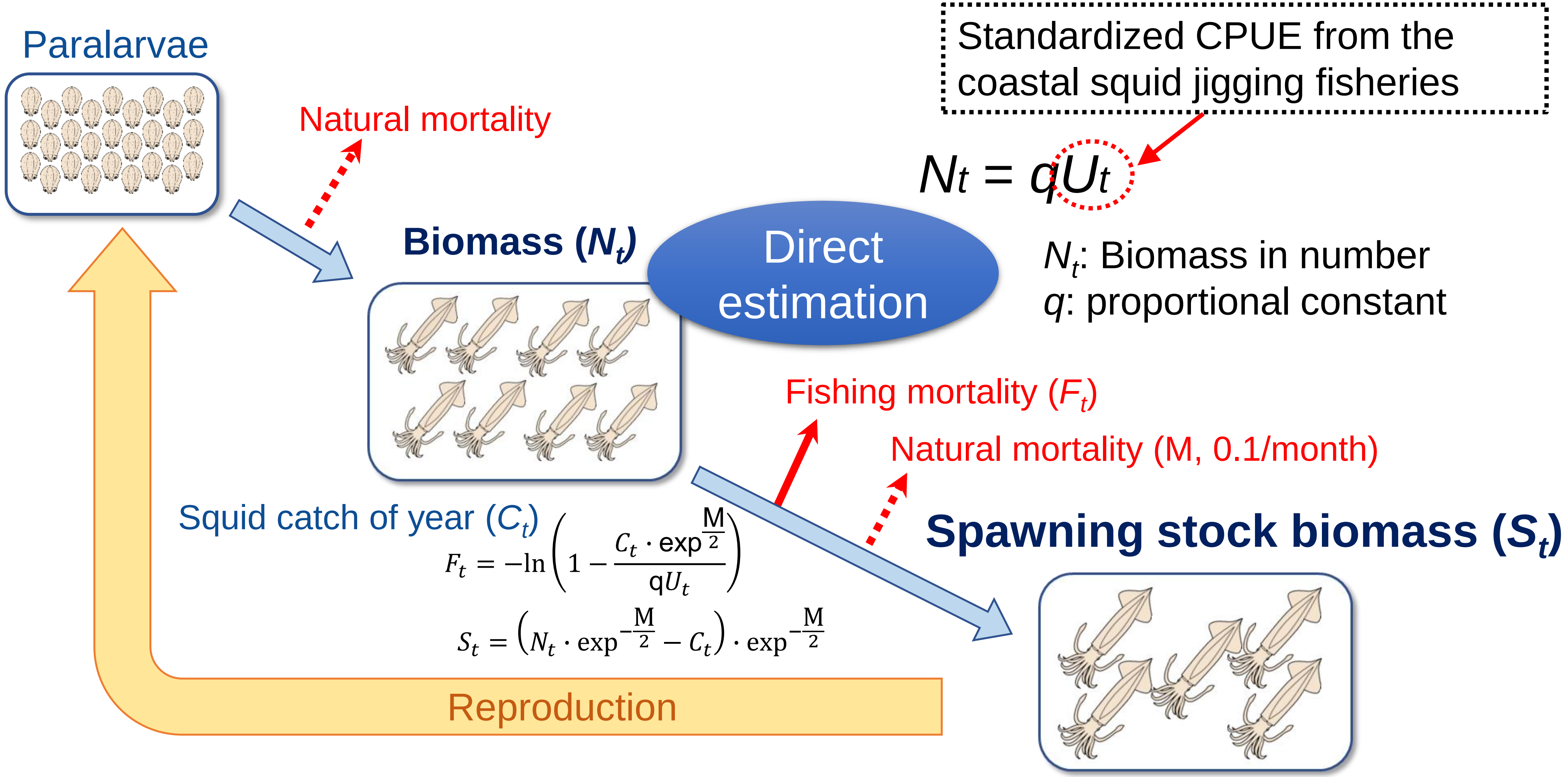
・Winter survey for paralarvae by Bongo net

・Recruitment survey by midwater trawl and jigging

Japanese survey of the winter spawning stock JFS



Biomass estimation method



Biomass in number (N_t) was estimated from the abundance index (U_t) multiplied by q (proportional constant)

Input data

Duration of the stock assessment

・1979 to 2022 (Fishing year: April-March)

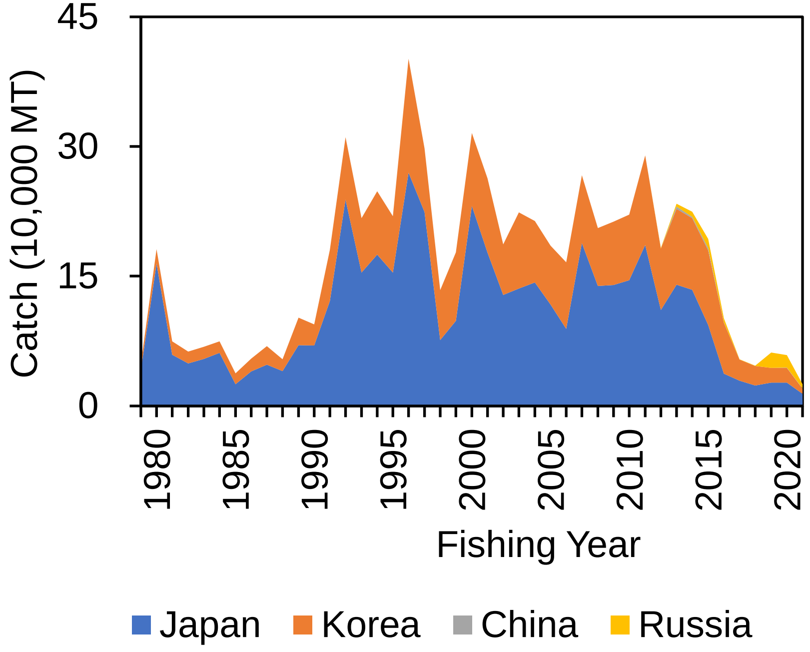
Catch data used for the estimation

・Catch by China and Russia are taken from the NPFC statistics
・Catch by Japan and Korea are taken from the official statistics
・CPUE from coastal squid jigging fisheries as abundance index

Estimation method:

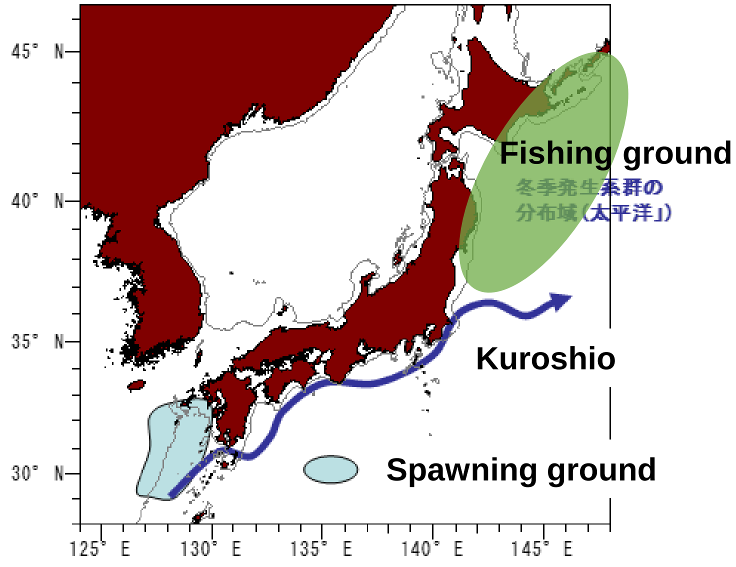
・Standardization of abundance index (Okamoto et al. 2016)
・Estimation of *q*
・Natural mortality (M)：0.1/month and 0.6 as 6 months of fishing season (July to December)
・Fishing mortality (F) and spawning stock biomass (SSB) estimated through Pope's equation
・The Hockey stick model, Ricker model and Beverton-Holt model were compared as the stock-recruitment relationship

Time series of catch of the winter spawning stock



Standardization of the abundance index (Okamoto et al. 2016)

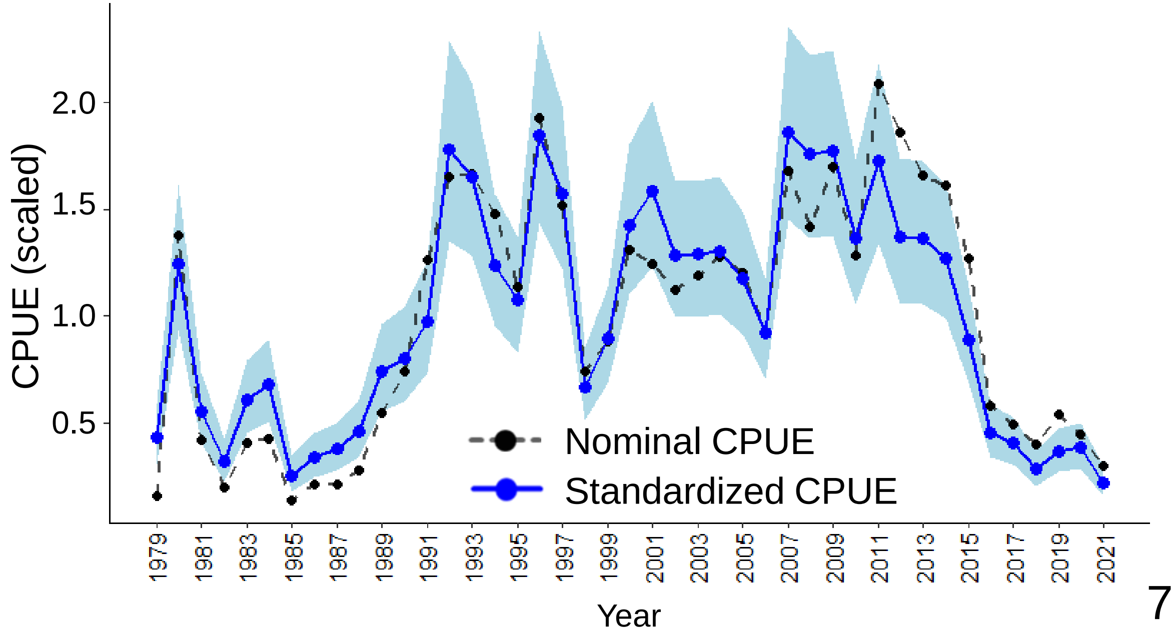
Data set: Monthly catch and number of boats collected from sales slips data
Fishing season: July to December
Fishing method: Jigging (Coastal squid jigging fisheries account for 31~98% of JFS catch by Japan in the Pacific)
Fishing ground: Coastal waters off the northeastern part of Japan on the Pacific side



Statistical model: GLMM
Explanatory variables: Year, Month, Port and those interaction terms
Model selection: BIC was used to select the model

$$\log(CPUE + \delta) = Intercept + Year + Month$$
$$+Port + Year * Port + Month * Port$$

δ is constant.
All explanatory variables were categorical
Interactions with *Port* worked as mixed effect



Calculation of *q*

Assumption

□Mean exploitation rate (C_t / N_t) for 1979-2001 = 0.3

Rationale

The exploitation rates of the autumn spawning stock in the Sea of Japan were estimated to be ranged between 0.2 to 0.4 (JSNFRI 1997; 1998)
Kidokoro et al. (2006) estimated this rate to be approx. 0.3 for 1979-2001
The exploitation rates for the winter spawning stock were estimated to be at the same level (0.3) for 1979-2001 (Mori 2006, Nishijima et al. 2021, Moriyama and Okamoto 2023)

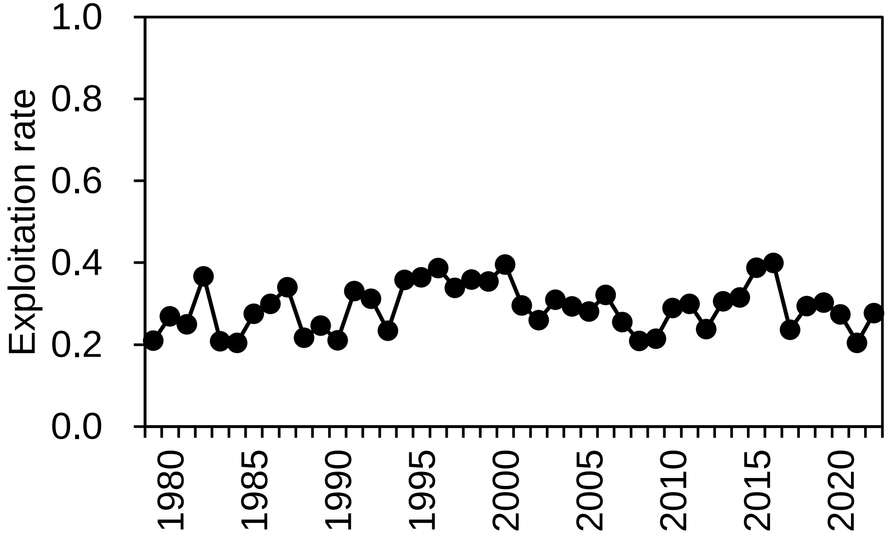
Calculation

$N_t = qU_t$
Mean C_t / N_t for 1979-2001 is 0.3.
q was calculated with (C / U) / 0.3

- C is catch
- U is standardized CPUE
- C / U corresponds to a mean value for 1979-2001

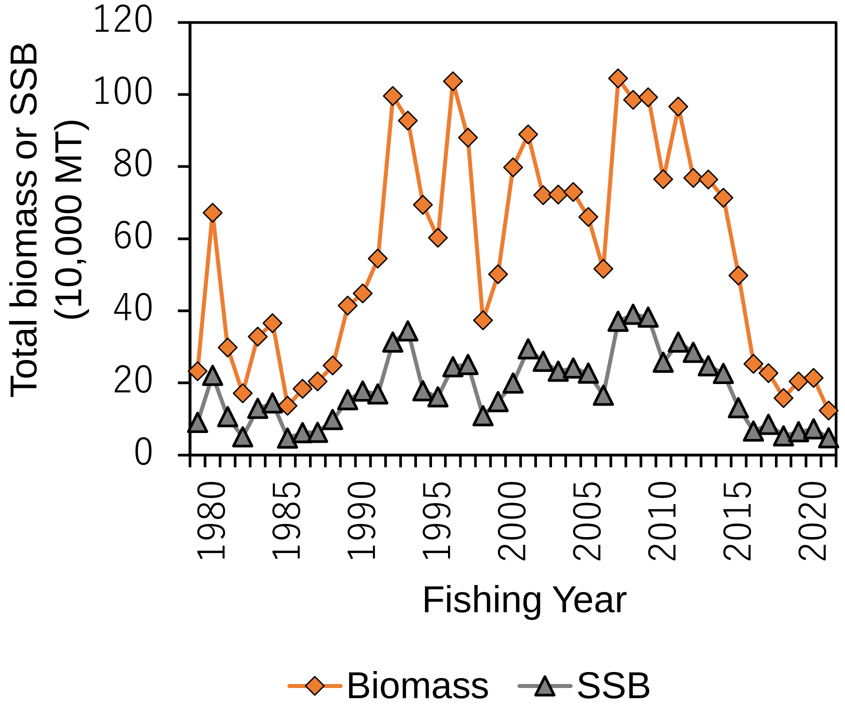
□q = 18.0

Time series of exploitation rate



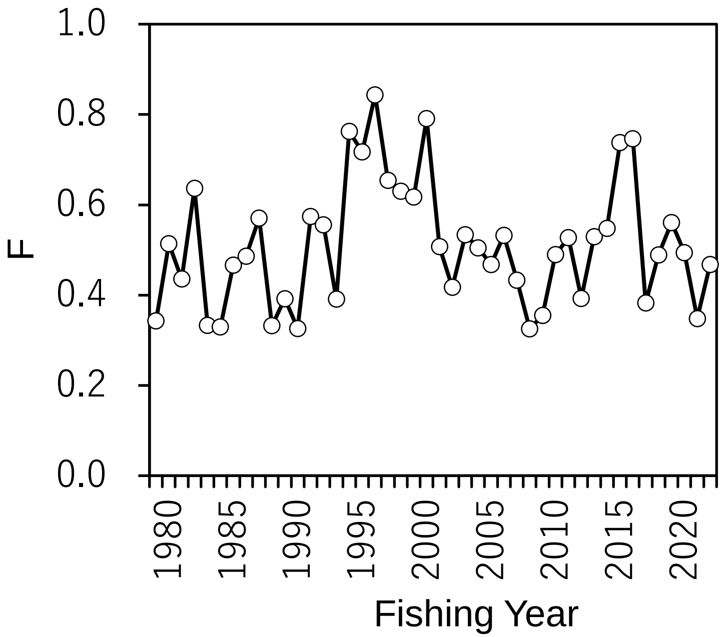
Results

Time series of biomass, SSB



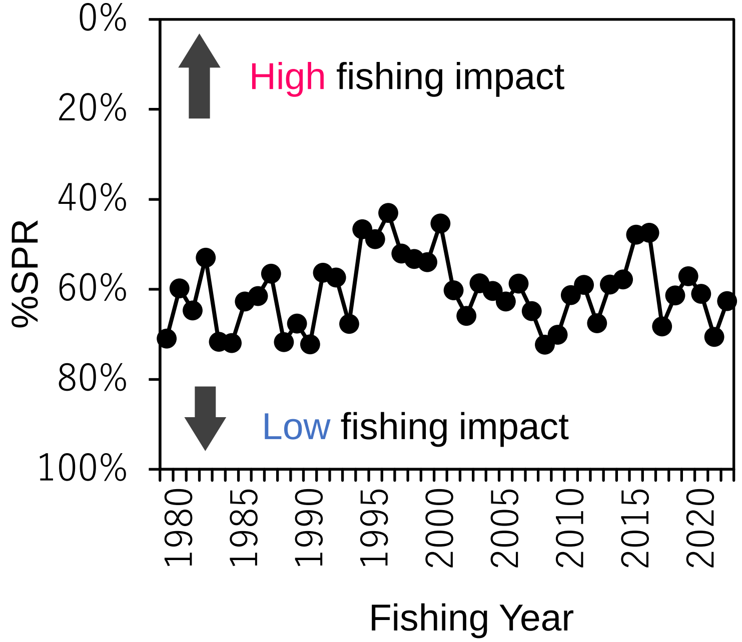
Decreased largely from 2015 to 2016 and has remained low level since then

Time series of F



Fluctuating around 0.5 in recent years

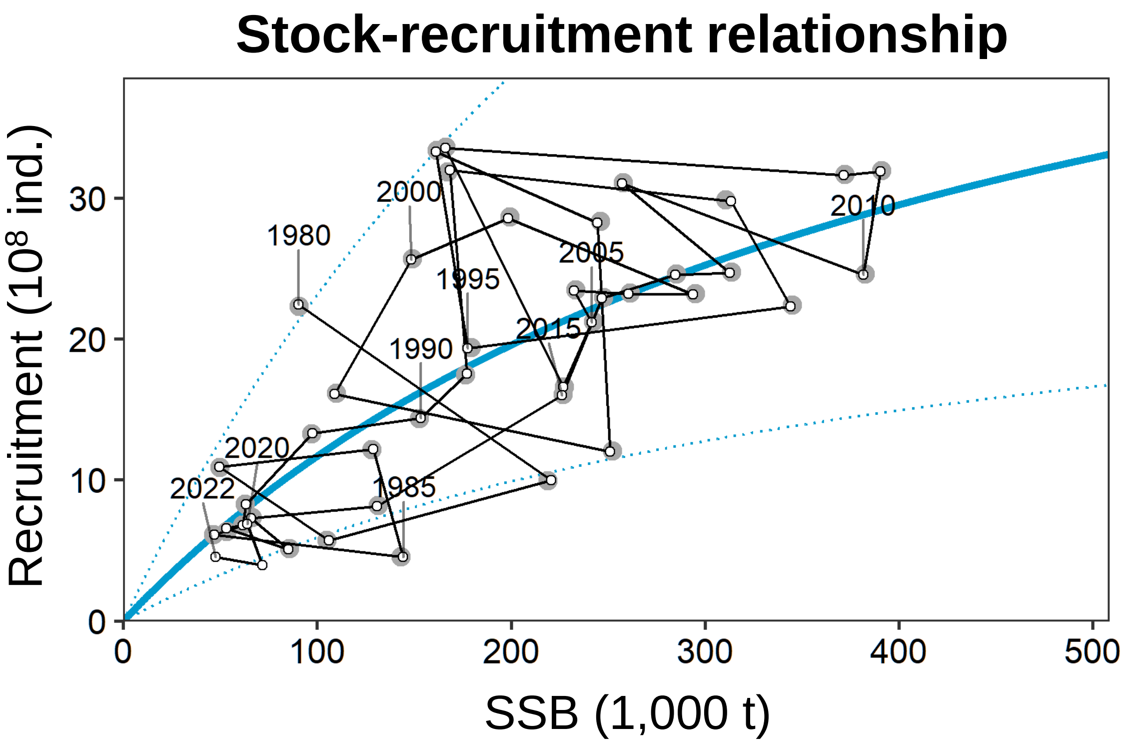
Spawning stock biomass per recruitment (%SPR)

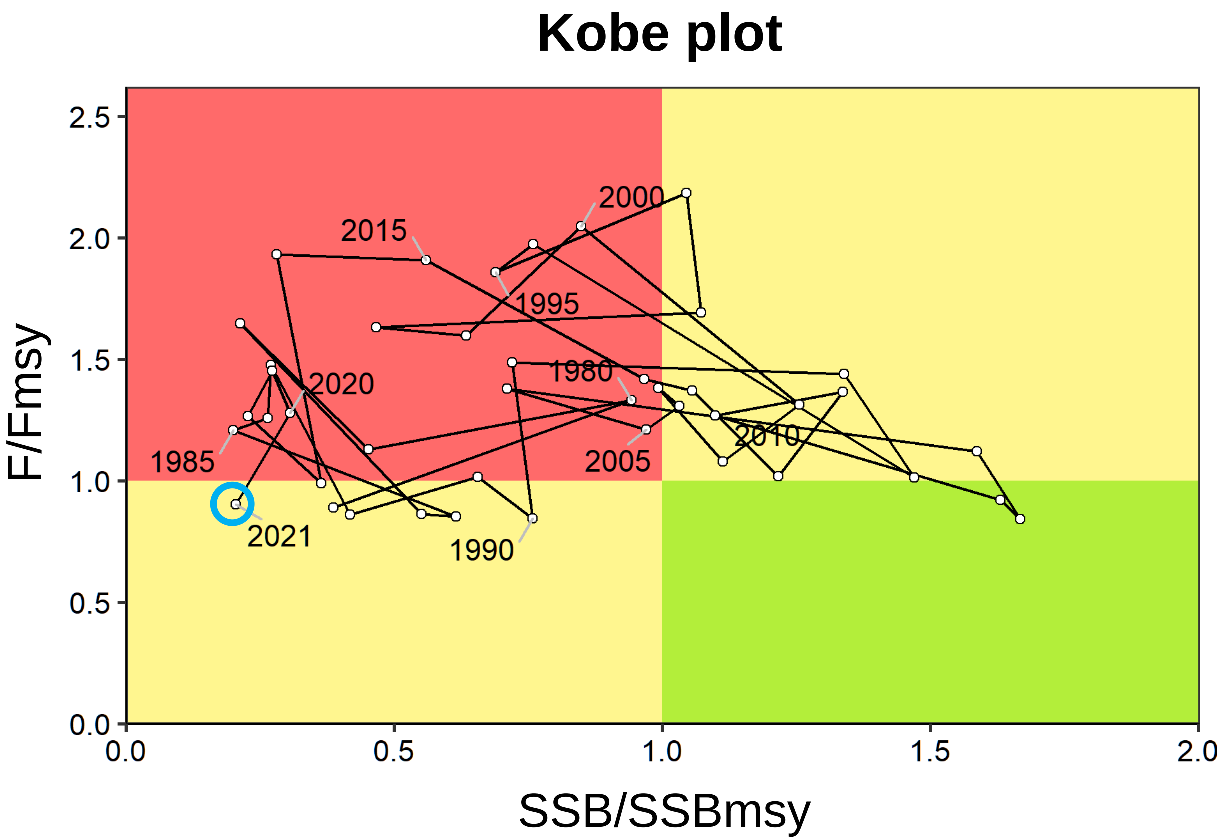


Fluctuating around 60% in recent years

https://abchan.fra.go.jp/wpt/wp-content/uploads/2023/07/details_2022_18.pdf

Stock status





The Beverton-Holt stock-recruitment model was applied

SSB is lower than SSBmsy, and F is lower than Fmsy in 2021

MSY reference points were estimated by stochastic simulation with a random variability of recruitment based on the stock-recruitment relationship

(see, Ichinokawa et al. 2017, ICES JMS, for details)

Summary

- ✓ The estimated total biomass of the winter spawning stock decreased largely from 2015 to 2016 and has remained low level since then
- ✓ The MSY-based reference points were estimated from the stochastic simulation with the Beverton-Holt stock-recruitment relationship
- ✓ In 2022, the estimated total biomass was 141,000 MT and SSB was 49,000 MT
- ✓ SSB is lower than SSBmsy, and F is lower than Fmsy in 2021

Future issues

- ✓ In the current stock assessment method, there are uncertainties such as using fixed *q* value
- ✓ SAMUIKA (State-space Assessment Model Used for IKA, Nishijima et al. 2021) is the top-prioritized stock assessment model applied for the future domestic JFS stock assessment in Japan