North Pacific Fisheries Commission

Preliminary chub mackerel stock assessment using KAFKA model

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Purpose

To obtain parameter estimates and make stock assessment using KAFKA model and data provided by Russia, Japan and China.

To get estimates of the KAFKA model parameters;

Perform Chub Mackerel stock assessment based on data that have provided by Russia, Japan and China.

Methods

KAFKA model was used (Mikheev, 2016; Metodicheskiye rekomendatsii ..., 2018). The following steps were made:

1. The analysis of information provided by WG members was carried out, and initial datasets were formed according to the requirements of the KAFKA model.

2. By using the KAFKA model, estimates of a number of biological and fishery data were obtained, retrospective and predicted dynamics of the commercial stock were modeled, and the statistical characteristics of the stock assessment were calculated.

Data analysis

The WG members provided data for models-candidates according to general structure and requirements developed during the second meeting of the TWG CMSA03 which was held from November 11 to November 27, 2020 (NPFC, 2020). The metadata are described in Table 1.

Table 1. Data description

Label	Fleet	Description	Unit
catch-at-age	1	Age-specific catch numbers for all fisheries in Japan	millions

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weight-at-age	1	Age-specific weights numbers for all fisheries in Japan	grams
abundance_index	2	Standardized catch rates in summer trawl survey for tuning the numbers of recruits (scaled by their means)	dimless
abundance_index	3	Standardized catch rates in autumn trawl survey for tuning the numbers of recruits (scaled by their means)	dimless
abundance_index	4	Standardized CPUEs in dip-net fishery for tuning spawning stock biomass (scaled by their means)	dimless
abundance_index	5	Absolute number of eggs for tuning spawning stock biomass (scaled by their means)	dimless
catch-at-age	6	Age-specific catch numbers for all fisheries in China	millions
weight-at-age	6	Age-specific catch numbers for fisheries in China	grams
abundance_index	7	CPUEs for fisheries in China	tonns/day/vessel
catch-at-age	8	Age-specific catch numbers for all fisheries in Russia	millions
weight-at-age	8	Age-specific weights numbers for fisheries in Russia	grams
abundance_index	9	CPUEs for fisheries in Russia	tonns/day/vessel
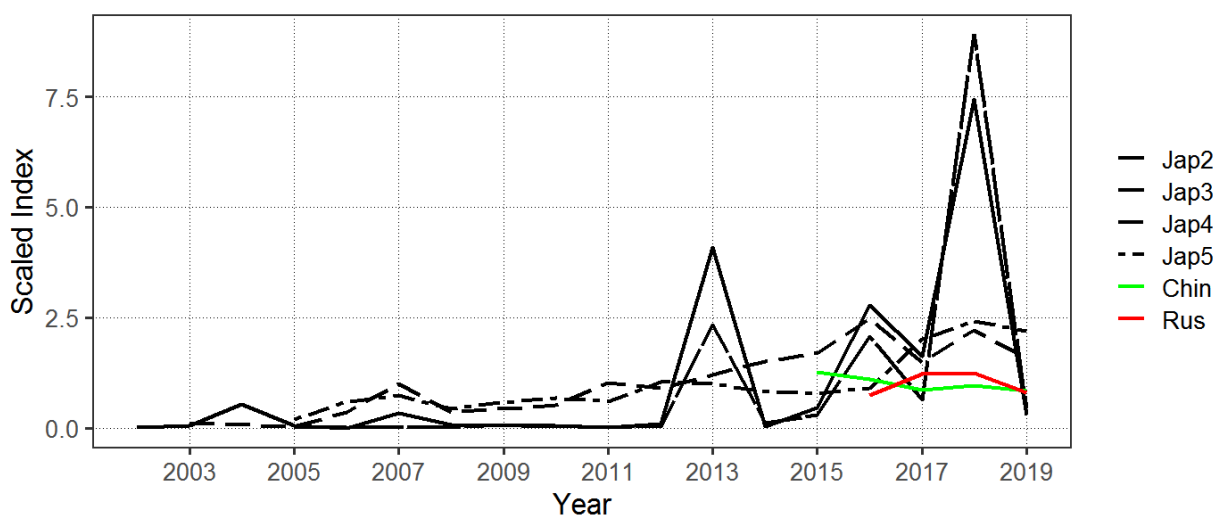
Figure 1. Scaled stock indices dynamics by fleet in 2003-2019
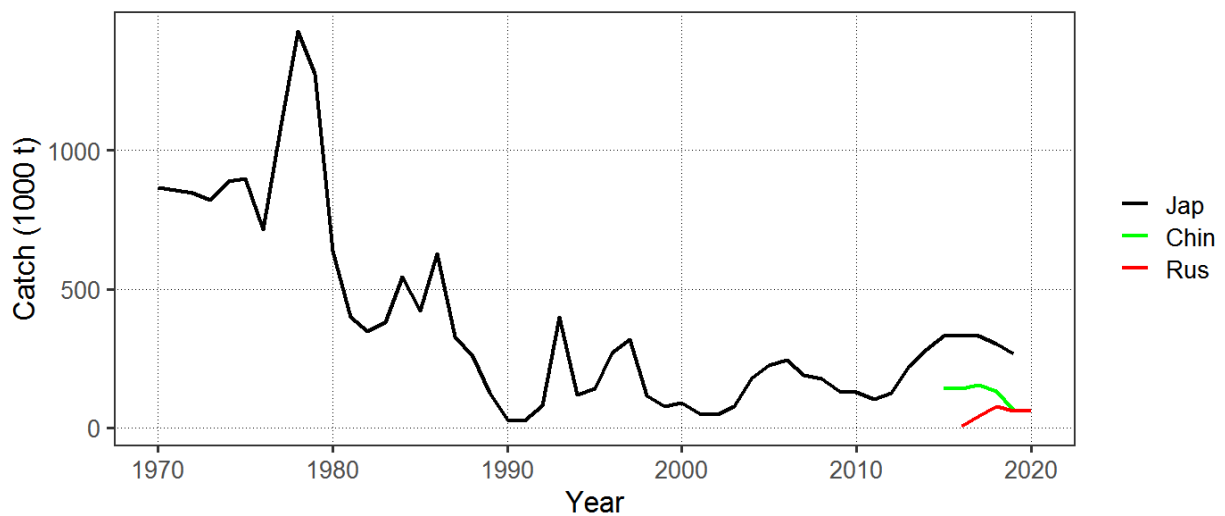
Figure 2. Chub Mackerel catches of Japan, China and Russia in 1970-2019

Since KAFKA handles biomass indices only, the first two indices were not taken into account. Indices provided by Russia and China were not used due to short series. Thus, model fitted by indices of SSB (Fleets 4 and 5).

KAFKA model stock assessment results

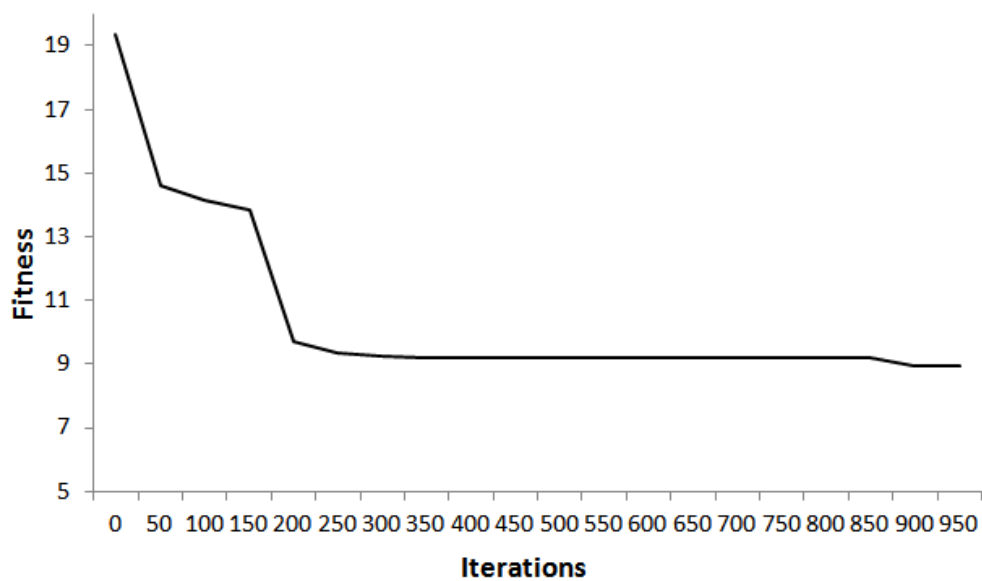Good convergence of the genetic algorithm was obtained (Fig. 3).

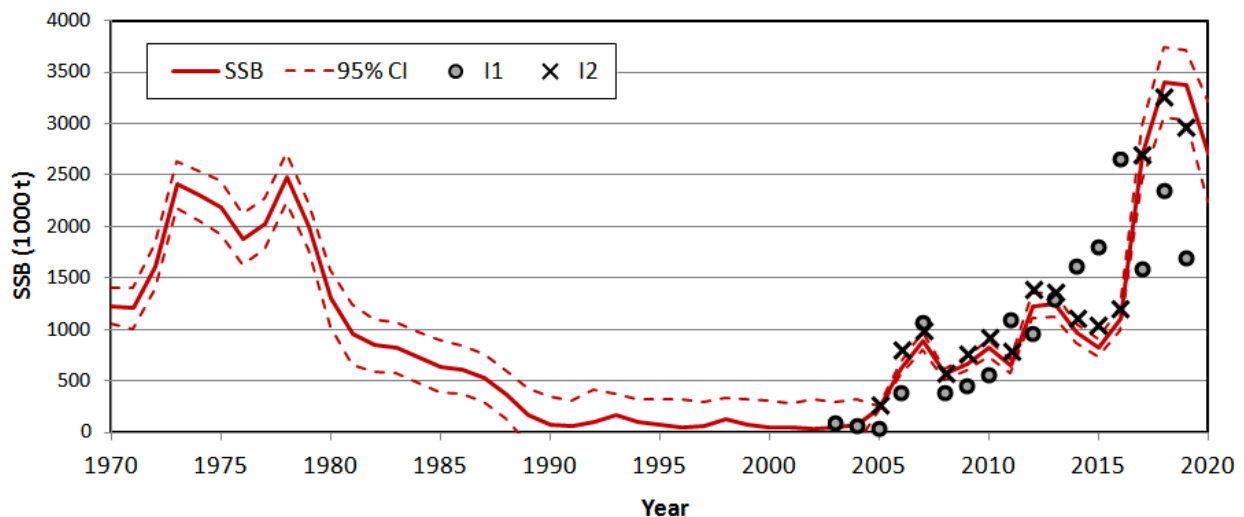Figure 3. The convergence curve of fitness value

Figure 4. Chub mackerel stock dynamics in 1970-2019 based on simulation results. SSB – spawning stock biomass, 95% CI – 95% confidence intervals, I1 – sdandardazed CPUEs in dip-net fishery sclaled by catchability rate, I2 – absolute numbers of eggs sclaled by catchability rate.

Preliminary chub mackerel SSB estimation for 2019 is 3,035,000 t and for 2020 – 2,246,000 t.

References

Metodicheskiye rekomendatsii po otsenke prioritetnykh vidov biologicheskikh resursov: monografiya / V.K. Babayan et al. M.: Izd-vo VNIRO, 2018. 312 p. (In Russian)

Mikheyev A. A. Primeneniye filtra Kalmana v kogortnoy modeli dlya korrektirovki otsenok zapasa pri nalichii neuchtennogo vylova / Fishery Issues, 2016. Volume 17, No. 1, P. 568-589. (In Russian)

Nishijima Sh., Hashimoto M., Yukami R., Ichinokawa M., Okamura H., Kamimura Y., Furuichi Sh., Watanabe Ch. Standardizing abundance indices for recruitment and spawning stock biomass of the chub mackerel in the Northwest Pacific / NPFC-2017-TWG CMSA01-WP05, 2017.

NPFC. 2nd Meeting of the Technical Working Group on Chub Mackerel Stock Assessment: Report / NPFC-2019-TWG CMSA02-Final Report, 2019.

NPFC. Annotated Indicative Schedule / NPFC-2020-TWG CMSA03-MIP03, 2020.