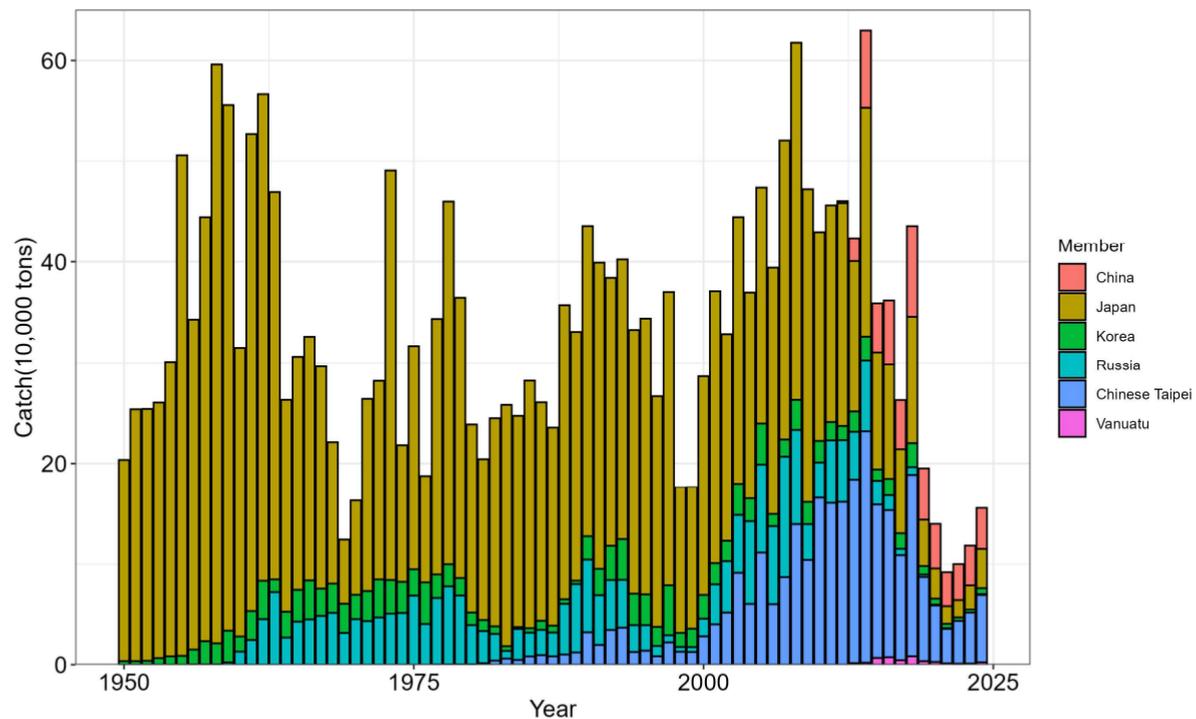NPFC

North Pacific Fisheries Commission

Item 2.3 SSC-PS15 (1-4 Sep@online) and PS16 (11-14 Dec@Nagoya)
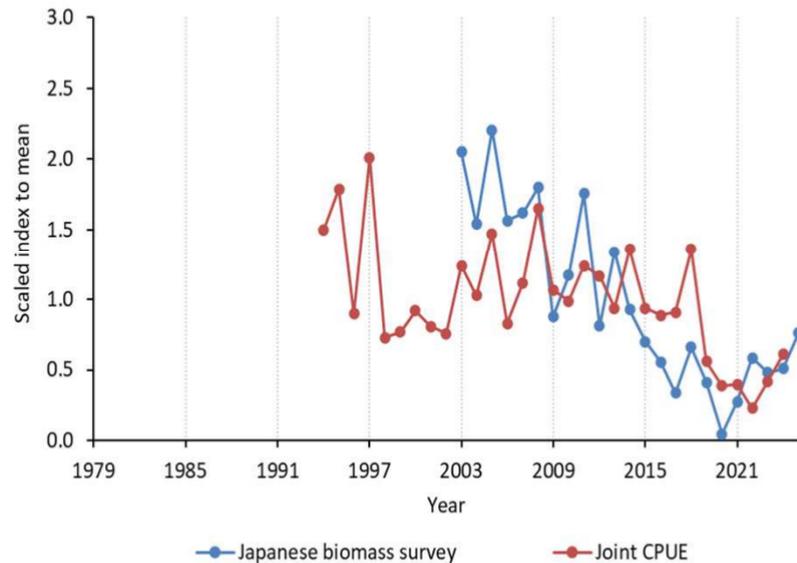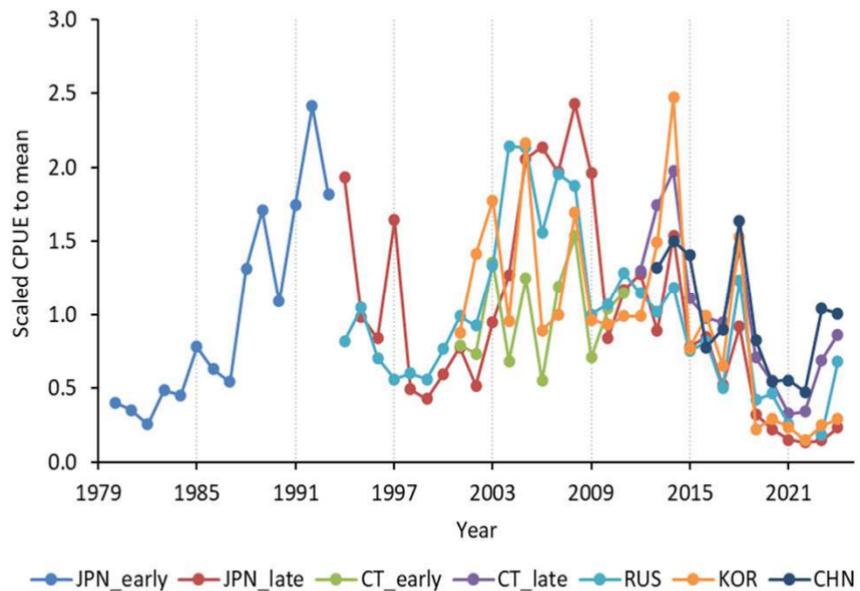with focusing on stock assessment outcomes and recommendations

Chair: Toshihide Kitakado (Tokyo University of Marine Science & Technology)
Vice-chair: Libin Dai (Shanghai Ocean University)

Catch series

Extracted from NPFC-2025-SSC PS16-WP05

# Abundance indices

Specification of BSSPM

|	Base case (B1)	Base case (B2)	Sensitivity case (S1)	Sensitivity case (S2)
Initial year	1980	1980	1980	1980
Biomass survey	$I_{t,bio} = q_{bio} B_t e^{v_{t,bio}}$ $v_{t,bio} \sim N(0, cv_{t,bio}^2 + \sigma^2)$ $q_{bio} \sim U(0,1)$ (2003-2024)	Same as left	Same as left	Same as left
CPUE	CHN(2013-2023) JPN_late(1994-2023) KOR(2001-2023) RUS(1994-2021) CT(2001-2011, 2012-2023) $I_{t,f} = q_f B_t^b e^{v_{t,f}}, \quad v_{t,f} \sim N(0, \sigma_f^2)$ $\sigma_f^2 = c \cdot (ave(cv_{t,bio}^2) + \sigma^2) \quad c=5$ $ave(cv_{t,bio}^2)$ is computed except for 2020 survey	Joint CPUE (1994-2023) $I_{t,joint} = q_{joint} B_t^b e^{v_{t,joint}},$ $v_{t,joint} \sim N(0, cv_{t,joint}^2 + \sigma^2)$	CHN(2013-2023) JPN_early(1980-1993, time-varying q) JPN_late(1994-2023) KOR(2001-2023) RUS(1994-2021) CT(2001-2011, 2012-2023) $I_{t,f} = q_f B_t^b e^{v_{t,f}}, \quad v_{t,f} \sim N(0, \sigma_f^2)$ $\sigma_f^2 = c \cdot (ave(cv_{t,bio}^2) + \sigma^2) \quad c=6$ $ave(cv_{t,bio}^2)$ is computed except for 2020 survey	JPN_early(1980-1993, time-varying q) $I_{t,JE} = q_{t,JE} B_t^b e^{v_{t,JE}}$ $v_{t,JE} \sim N(0, \sigma_{JE}^2)$ $\sigma_{JE}^2 = c \cdot (ave(cv_{t,joint}^2) + \sigma^2)$ Joint CPUE (1994-2023) $I_{t,joint} = q_{joint} B_t^b e^{v_{t,joint}},$ $v_{t,joint} \sim N(0, cv_{t,joint}^2 + \sigma^2)$
Hyper-depletion/ stability	A common parameter for all fisheries with a prior distribution, $b \sim U(0, 1)$	$b \sim U(0, 1)$	A common parameter for all fisheries but JPN_early, with a prior distribution, $b \sim U(0, 1)$ [b for JPN_early is fixed at 1]	$b \sim U(0, 1)$ for joint CPUE. [b for JPN_early is fixed at 1]
Prior for other than q_{bio}	Own preferred options	Own preferred options	Own preferred options	Own preferred options

Time series plots for base cases from 3 members
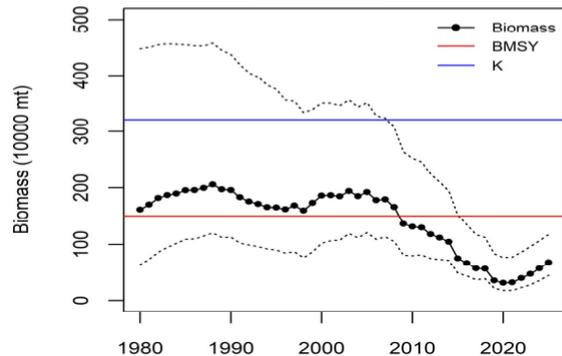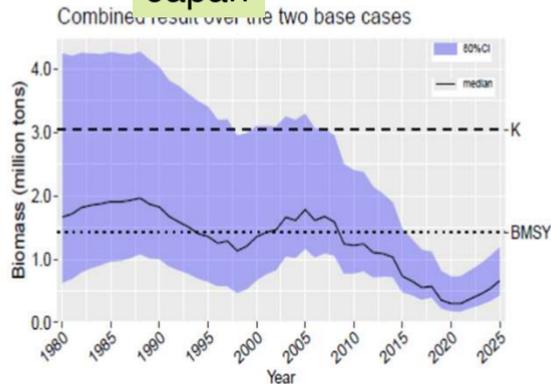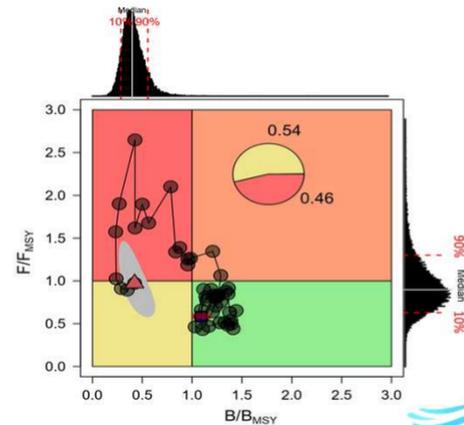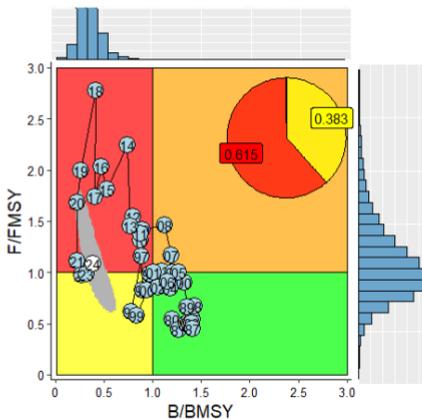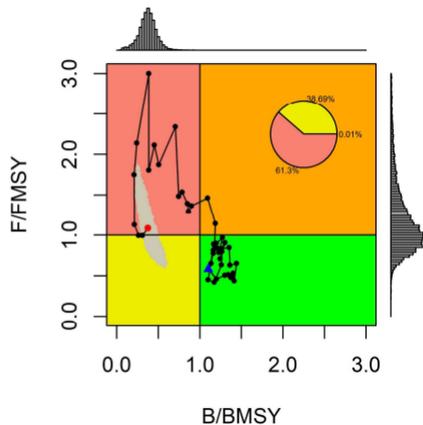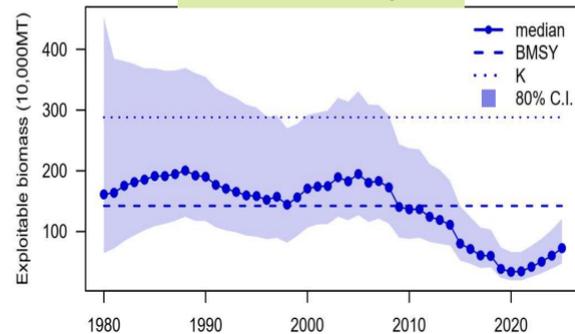
Tables for base cases from 3 members

China

|	Mean	Median
C2024 (10,000 tons)	15.56	15.56
AveC2022-2024	12.47	12.47
AveF2022-2024	0.27	0.26
F2024	0.28	0.27
FMSY	0.27	0.25
MSY (10,000 tons)	39.29	38.73
F2024/FMSY	1.28	1.09
AveF2022-2024/FMSY	1.18	1.02
K (10,000 tons)	439.04	321.2
B2024 (10,000 tons)	66.11	56.71
B2025 (10,000 tons)	76.88	67.86
AveB2023-2025	66.54	57.22
BMSY (10,000 tons)	198.86	150.7
BMSY/K	0.48	0.47
B2024/K	0.18	0.18
B2025/K	0.22	0.21
B2023-2025/K	0.18	0.18
B2024/BMSY	0.37	0.37
B2025/BMSY	0.45	0.44
B2023-2025/BMSY	0.38	0.38

Japan

	Mean	Median
C_2024 (million tons)	0.156	0.156
AveC_2022_2024	0.125	0.125
AveF_2022_2024	0.280	0.276
F_2024	0.298	0.292
FMSY	0.281	0.271
MSY (million tons)	0.383	0.381
F_2024/FMSY	1.153	1.085
AveF_2022_2024/FMSY	1.068	1.015
K (million tons)	3.693	3.042
B_2024 (million tons)	0.632	0.533
B_2025 (million tons)	0.759	0.661
AveB_2023_2025	0.644	0.546
BMSY (million tons)	1.684	1.419
BMSY/K	0.472	0.470
B_2024/K	0.186	0.182
B_2025/K	0.231	0.221
AveB_2023_2025/K	0.191	0.188
B_2024/BMSY	0.377	0.377
B_2025/BMSY	0.486	0.466
AveB_2023_2025/BMSY	0.403	0.394

Chinese Taipei

	Mean	Median
$Catch_{2024}$	15.6	15.6
$F_{2022-2024}$	0.257	0.246
F_{2024}	0.268	0.258
F_{MSY}	0.279	0.268
MSY	38.123	38.250
F_{2024}/F_{MSY}	1.025	0.972
$F_{2022-2024}/F_{MSY}$	0.964	0.927
K	320.662	288.000
B_{2024}	67.464	60.330
B_{2025}	80.476	72.620
$B_{2023-2025}$	68.233	61.303
B_{MSY}	157.136	142.200
B_{MSY}/K	0.538	0.492
B_{2024}/K	0.218	0.211
B_{2025}/K	0.265	0.253
$B_{2023-2025}/K$	0.221	0.215
B_{2024}/B_{MSY}	0.438	0.423
B_{2025}/B_{MSY}	0.532	0.510
$B_{2023-2025}/B_{MSY}$	0.445	0.429

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Retrospective analysis from 3 members
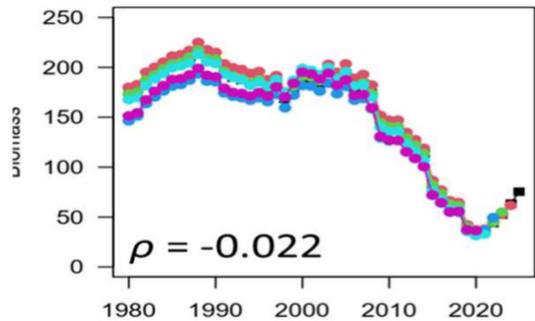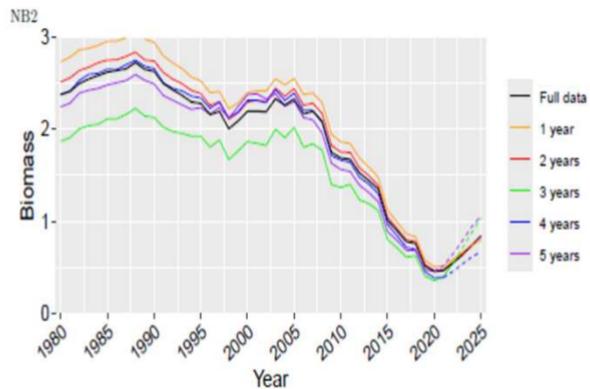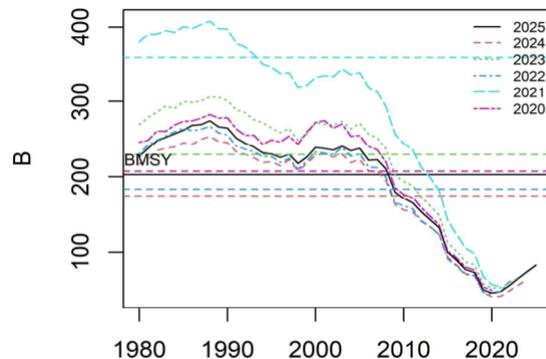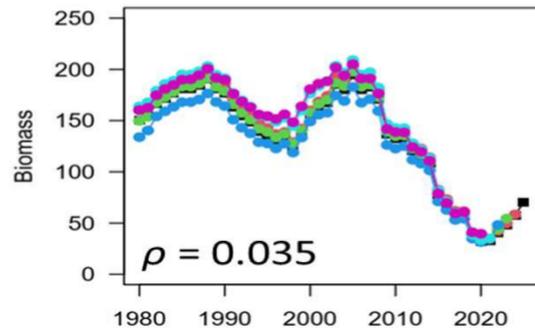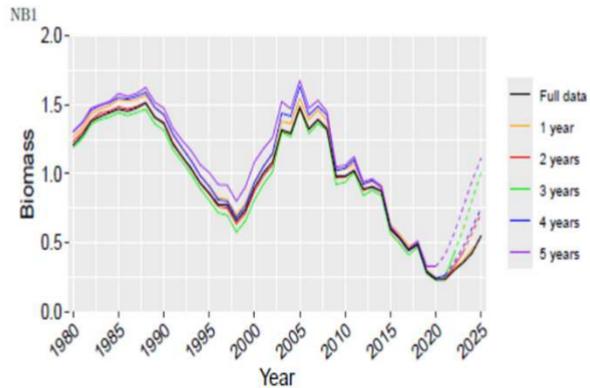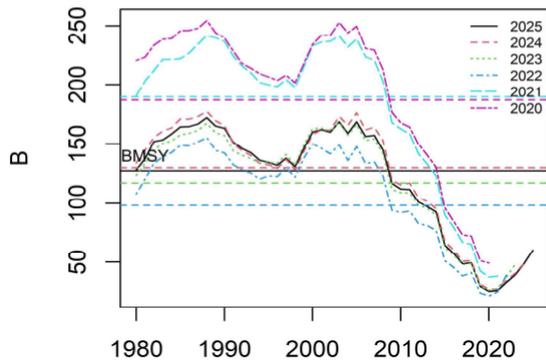
Tables shown by China

Year	CHN B	Bmsy	Fmsy	B/Bmsy	JPN B	Bmsy	Fmsy	B/Bmsy	CT B	Bmsy	Fmsy	B/Bmsy
2021	51.79	119.60	0.37	0.43	47.99	114.41	0.35	0.41	70.35	127.70	0.33	0.55
2022	62.19	118.80	0.36	0.49	56.26	104.43	0.40	0.53	82.03	186.40	0.20	0.44
2023	57.34	136.90	0.30	0.41	52.28	118.58	0.35	0.44	55.32	130.15	0.29	0.42
2024	50.92	113.80	0.35	0.43	52.12	119.00	0.33	0.43	55.15	125.10	0.31	0.44
2025	67.86	150.70	0.25	0.44	66.10	141.90	0.27	0.46	72.62	142.20	0.26	0.51

The B/B_{MSY} ratio likely reflects relative change in B and B_{MSY}, both of which vary greatly across years, rather than providing a reliable indication of stock status......

Year	CHN Bend	Bmsy	Fmsy	B/Bmsy	JPN Bend	Bmsy	Fmsy	B/Bmsy	CT Bend	Bmsy	Fmsy	B/Bmsy
2021												
2022	0.20	-0.01	-0.03	0.14	0.17	-0.09	0.14	0.29	0.17	0.46	-0.39	-0.20
2023	-0.08	0.15	-0.17	-0.16	-0.07	0.14	-0.13	-0.17	-0.33	-0.30	0.45	-0.05
2024	-0.11	-0.17	0.17	0.05	0.00	0.00	-0.06	-0.02	0.00	-0.04	0.07	0.05
2025	0.33	0.32	-0.29	0.02	0.27	0.19	-0.18	0.07	0.32	0.14	-0.16	0.16

change rate=(By-By-1)/By-1
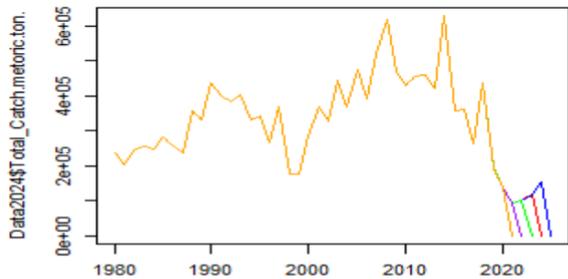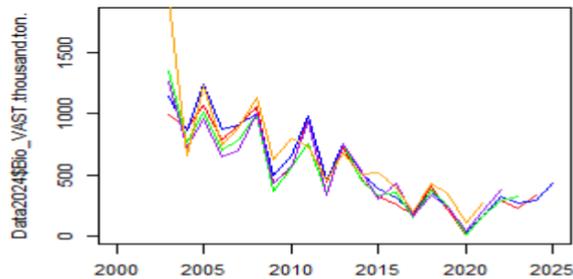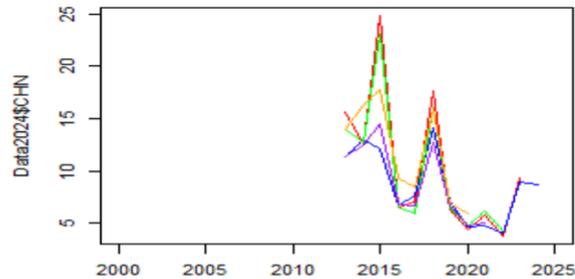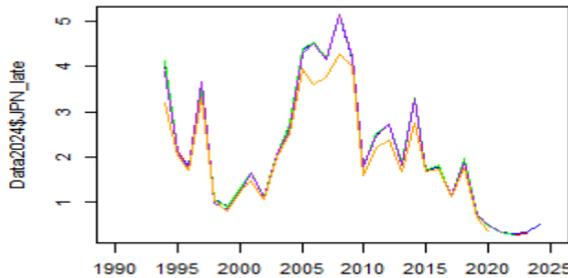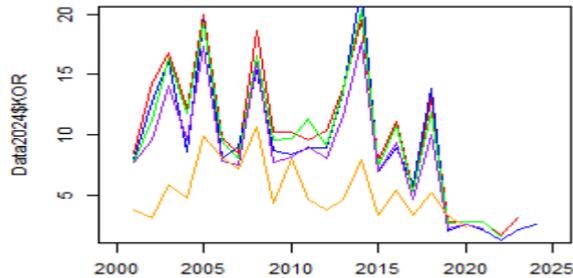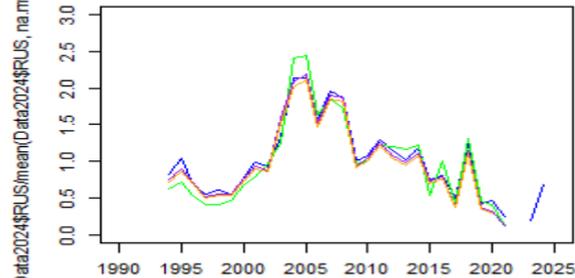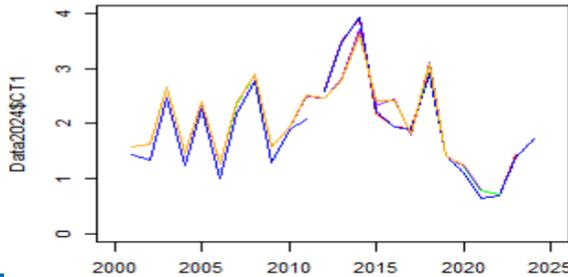
North Pacific Fisheries Commission
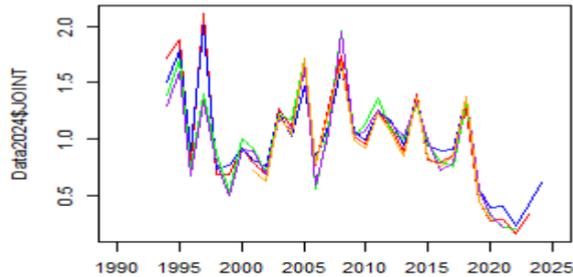
Summary of results of the interim assessment

- The SSC PS reviewed the stock assessments conducted by Members and could not reach consensus on the treatment of the results.

36.   China expressed concerns that the current BSSPM model used for the Pacific saury stock assessment exhibits instability and considerable uncertainty in key parameter estimates and that it does not adequately capture non-stationary population dynamics. An increasing body of scientific evidence indicates that key biological processes of Pacific saury, including growth, survival, and maturation, are closely linked to environmental variability. China is therefore concerned that the assumption of stationary stock productivity is not appropriate for this small pelagic species and is inconsistent with current scientific understanding. In light of these concerns, China considers that the model specification should be improved by incorporating non-stationary formulations for key population parameters, such as the intrinsic growth rate (r) and carrying capacity (K), and that the assumption of hyperstability should be further evaluated.

37.   China also expressed concern regarding the scaling uncertainty in the current BSSPM stock assessments for Pacific saury. The scales of some key assessment outputs such as estimated biomass, biological reference points, and stock status fluctuate across assessment years as newly updated input data are incorporated into the model. Such instability hampers the ability to consistently evaluate management effectiveness and obscures a clear understanding of the true stock status. Until these concerns and limitations are adequately addressed, and to minimize the risk of inappropriate management decisions, China considers that the current assessment results are not sufficiently robust to serve as the basis for developing management advice.

Summary of results of the interim assessment

● The SSC PS reviewed the stock assessments conducted by Members and could not reach consensus on the treatment of the results.

38.   Other Members noted China's reservations and recognized that there continue to be some uncertainties in the stock assessment. However, they considered the stock assessment to be the best scientific information available and believed it would be appropriate to aggregate the results, recognizing the agreement in trends among them. It is also noted that, even though Pacific saury stock has been recovering in recent years, the stock has yet to reach past abundance levels and a precautionary approach as incorporated in the interim harvest control rule (HCR) is warranted given the uncertainty of the stock assessment.

39.   The SSC PS aggregated the results of the stock assessments conducted by Japan and Chinese Taipei (Annex X), while noting that China did not endorse the stock assessment results.

2024 assessment

2025 assessment

1980–2023 time series of median Fratio and Bratio over 6 runs

1980–2024 time series of median Fratio and Bratio over 2*2 runs

2024 assessment

	Median
C_2023 (10000 t)	11.836
AveC_2021_2023	10.352
AveF_2021_2023	0.328
F_2023	0.297
FMSY	0.330
MSY (10000 t)	39.440
F_2023/FMSY	0.920
AveF_2021_2023/FMSY	1.008
K (10000 t)	248.067
B_2023 (10000 t)	39.875
B_2024 (10000 t)	52.763
AveB_2022_2024	41.563
BMSY (10000 t)	120.100
BMSY/K	0.485
B_2023/K	0.161
B_2024/K	0.212
AveB_2022_2024/K	0.169
B_2023/BMSY	0.328
B_2024/BMSY	0.435
AveB_2022_2024/BMSY	0.345

2025 assessment

	Median	Lower10%	Upper10%
C_2024 (10000 t)	15.556	15.556	15.556
AveC_2022_2024	12.463	12.463	12.463
AveF_2022_2024	0.258	0.137	0.414
F_2024	0.272	0.150	0.431
FMSY	0.269	0.130	0.444
MSY (10000 t)	38.165	30.860	45.319
F_2024/FMSY	1.027	0.719	1.526
AveF_2022_2024/FMSY	0.971	0.712	1.371
K (10000 t)	294.397	178.813	593.103
B_2024 (10000 t)	57.200	36.107	103.568
B_2025 (10000 t)	69.460	45.090	119.897
AveB_2023_2025	58.238	37.756	103.933
BMSY (10000 t)	142.100	91.670	266.603
BMSY/K	0.486	0.385	0.617
B_2024/K	0.197	0.127	0.282
B_2025/K	0.238	0.143	0.364
AveB_2023_2025/K	0.202	0.128	0.288
B_2024/BMSY	0.403	0.280	0.562
B_2025/BMSY	0.488	0.314	0.725
AveB_2023_2025/BMSY	0.411	0.285	0.573

Application of adopted HCR

- 8.2 Finalization of input values for the adopted HCR
- 40.   The Chair noted that, although the SSC PS could not reach consensus on the stock assessment results, the SSC PS had been tasked by the Commission to provide relevant information for the conservation and management of Pacific saury, including by applying the adopted interim HCR. The Chair suggested finalizing the input values for the adopted HCR based on the aggregated results of the stock assessments conducted by Japan and Chinese Taipei.

- 41.   To provide the management information requested by the CMM for Pacific saury, with the exception of one Member, <u>the SSC PS agreed that the Chair could apply the adopted interim HCR based on input values from Japan and Chinese Taipei's stock assessments and present the result to SC10 as information, rather than as the consensus advice of the SSC PS.</u>

Recommendations for future work on the interim HCR

42. The SSC PS noted that <u>non-stationary assumptions regarding stock productivity</u> should be examined in future assessments, as several key biological processes of Pacific saury are influenced by environmental change. In addition, <u>the assumption of hyperdepletion in CPUE</u> indices should be explored, given evidence such as substantial seasonal and interannual variability in fleet dynamics, which may indicate that fishing fleets do not consistently or promptly locate the main fish habitat.

2024 assessment

	Median
C_2023 (10000 t)	11.836
AveC_2021_2023	10.352
AveF_2021_2023	0.328
F_2023	0.297
FMSY	0.330
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B_2023 (10000 t)	39.875
B_2024 (10000 t)	52.763
AveB_2022_2024	41.563
BMSY (10000 t)	120.100
BMSY/K	0.485
B_2023/K	0.161
B_2024/K	0.212
AveB_2022_2024/K	0.169
B_2023/BMSY	0.328
B_2024/BMSY	0.435
AveB_2022_2024/BMSY	0.345

Unconstrained CL = 75,741 mt

Results in 2025 assessment

	Median	Lower10%	Upper10%
C_2024 (10000 t)	15.556	15.556	15.556
AveC_2022_2024	12.463	12.463	12.463
AveF_2022_2024	0.258	0.137	0.414
F_2024	0.272	0.150	0.431
FMSY	0.269	0.130	0.444
MSY (10000 t)	38.165	30.860	45.319
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AveB_2023_2025	58.238	37.756	103.933
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B_2024/K	0.197	0.127	0.282
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AveB_2023_2025/K	0.202	0.128	0.288
B_2024/BMSY	0.403	0.280	0.562
B_2025/BMSY	0.488	0.314	0.725
AveB_2023_2025/BMSY	0.411	0.285	0.573

Unconstrained CL = 91,180 mt

Item 12. Development of recommendations to improve conservation and management of Pacific saury stock

12.1 Application of the adopted HCR

The interim HCR for Pacific saury under CMM 2025-08 For Pacific Saury was used to calculate the annual catch level in the 2026 fishing year, while noting the lack of endorsement from China. Based on assessment inputs from Japan and Chinese Taipei, the unconstrained annual catch level for 2026 = $(B_{2025} * F_{MSY} * (B_{2025}/B_{MSY}))$ = 91,180 mt. Based on the adopted HCR, the constrained 2026 catch level would be 0.9 x 202,500 = 182,250 mt.

Chinese Taipei stated that based on thorough comparisons of recent stock assessment results across years and alternative model scenarios, contributing Members' assessments indicate substantial uncertainties in the estimation of key stock status indicators, including biomass, fishing mortality, and reference points F_{MSY} and B_{MSY}. In this regard, the estimated annual catch level derived from the interim HCR is subject to considerable uncertainty and potential error. While the HCR provides a consistent framework for translating stock status into management advice, the resulting calculated annual catch level should be interpreted with caution.

Agenda Item 10. New stock assessment models

44. The Small Working Group on New Stock Assessment Models for Pacific Saury (SWG NSAM) Lead, Dr. Libin Dai

➢ **SWG NSAM01 (May 28, 2025) Kick-off meeting**
  • Introduced the background of the WG and reviewed progress made in 2024.
  • Reviewed the Step16 SS model developed by Dr. Larry Jacobson.
  • Dr. Quang Huynh provided feedback on an earlier model (Step7) and offered suggestions.
➢ **SWG NSAM02 (July 11-13, 2025) Technical meeting**
  • Examined the structure of the Step16 model and its variant (Step17).
  • Introduced and reviewed the seasonal model (Step18).
  • Developed and discussed additional case scenarios (Step19–21)
  • Introduced the Japanese survey.
  • Summarized candidate case scenarios for potential use as base case(s) in future work.
➢ **SWG NSAM03 (Nov. 06, 2025) Technical meeting**
  • Modeling update after SSC PS15
  • Include the latest catch, CPUE (to 2024) and survey index (to 2025)
  • Specify the time-varying growth
  • Set up a catchability prior for survey
  • Update model diagnostic
  • Evaluate the impact of M and h
  • Introduce seasonal variation in maturity ogive

10.2 Works toward finalization of new stock assessment models

45. The invited expert presented an update on the development of the SS3 model for Pacific saury in 2025 (NPFC-2025-SSC PS16-WP07 (Rev. 1)). Improvements have been made to model structure and parameterization and the model fits the historical catch, standardized CPUE, fishery-independent index of abundance, and length composition data provided during SSC PS 15. Diagnostic procedures were also conducted to determine goodness of fit to the data, estimability and stability of parameter estimates using jitter analysis and comparison of MCMC with maximum likelihood estimation, and predictive ability for short-term forecasting with retrospective analysis and hindcast validation of future index predictions in the first projection year. Likelihood profiles inform alternative choices on natural mortality (M) and steepness for sensitivity analysis. A reduction in growth has improved the fit to the length composition and reduced the retrospective pattern compared to previous models. However, predictive performance remains difficult for such a short-lived species. Sensitivity analyses indicate difficulty estimating MSY reference points with the current M value in the base model. Further evaluation is recommended with respect to the choice of M in the base case model, as the current value does not provide practical management advice.

10.3 Recommendations for future work

49. The SSC PS tasked the SWG NSAM and the invited expert to continue

Specification table finalized this time

Feature	Current Approach	Suggested Changes
Fishery catch	- Members' seasonal catch and seasonal length composition - RUS comps not used, assume JPN selectivity	
Fishery CPUE	- Members' annual standardized CPUE assigned to S4 - Separate JPN-early (pre-1994) and JPN-late series	- Assign JPN CPUE to season 4 - Assign CHN, CT, RUS, and KOR CPUE to season 3 - Sensitivity model with joint CPUE
Surveys	- Age-aggregated fishery-independent index of abundance with length composition	
Spatial considerations	- None, single area model	- Potential fleets as area-seasons approach, lower priority
Selectivity	- Asymptotic function estimated for all fleets and surveys	
Model time step	- Seasonal, model start in 1980	
Catchability (q)	- Linear biomass-index relationship - Catchability prior for biomass scale - Hyper-stability parameter estimated for CPUE - Q walk for JPN-early CPUE	- Q change in CT series in 2011

Specification table finalized this time

Feature	Current Approach	Suggested Changes
Variance weighting	- CPUE downweighted (lambda = 0.2) - McAllister-Ianelli method for length composition	
Natural mortality (M)	- M = 2.18, sensitivity model with M = 1 (both age-independent)	- Sensitivity models with M = 1, 1.5, or 2 - Age-varying M - Model post-spawning mortality at end of 2 year lifespan
Steepness (h)	- Fixed at 0.82	- Sensitivity models with h = 0.6, 0.7, 0.8, 0.95 - Estimate with prior from Hsu et al. (2024)
Recruitment	- Beginning of season 1, 2, and 4	
Growth	- Time-varying asymptotic length from survey length-age	
Growth variability	- Estimated to fit length composition	
Maturity	- Constant ogive (logistic inflection at 25 cm)	- Seasonal maturity ogive
Fecundity	- Proportional to weight	- Update from batch fecundity and spawning frequency data
Environment	- No environmental information in model	- Explore relationships between recruitment, growth with environmental indices outside model

Objectives stipulated in ToR of SWG MSE PS

Short-Term Objectives: within one to two years:

a) develop **draft interim management objectives** and a **draft interim harvest control rule (HCR)** that meets such objectives to report to the Commission (preferably before the 8th Commission annual meeting); and

b) **evaluate the robustness of the draft interim harvest control rule** with consideration of possible uncertainties including effects of climate changes.

Mid-Term Objectives: within three to five years:

a) develop **draft mid- to long-term management objectives** by setting the **target and limit reference points** for the population status as well as by defining "overfishing" and "overfished" for the sustainable use of the Pacific saury stock;

b) assess the feasibility of establishing a **management procedure through an MSE**

Item 11. MSE

51.   The SSC PS noted that work is ongoing to develop an age-structured model and that progress on this work will support the conditioning of OMs and development of a full MP.

52.   The SSC PS noted that the MP could be model-based, empirical-based, or a combination of the two, and that options remain open.

53.   In terms of the timeline, the SSC PS noted that it would be difficult to complete the ongoing simulation work within the coming year.

54.   The SSC PS suggested that further discussions on technical and other matters related to the development of a full MP could be held at SWG MSE PS07. The SSC PS noted the need for greater dialogue among scientists, managers, and stakeholders at the SWG MSE PS, and requested Members to encourage greater participation by managers and stakeholders at the SWG MSE PS meetings.

55. The Ocean Foundation and Pew expressed their support for progressing discussion on the MSE process and the development of a full MP.

56. Japan acknowledged that the MSE process is designed to account for uncertainty and that uncertainty should not be a reason for delaying further action. However, Japan also pointed out that the MSE and MP process would not work well with a very unreliable stock assessment model and without Members' trust in the model. Japan emphasized the importance of the work to develop an age-structured model.

57. The invited expert suggested that if there are major uncertainties in the stock assessment, it would not make sense to use the stock assessment in the MP. Alternative, simpler MPs could be evaluated in the MSE.

58. The SSC PS recommended that the SWG MSE PS invite Dr. Quang Huynh as an invited expert to SWG MSE PS07.

Item 12. Development of recommendations to improve conservation and management of Pacific saury stock

- As a reference, the unconstrained annual catch level calculated from the interim HCR for 2026 increased by about 20% from 2025 (from 75,741 MT to 91,180 MT).
- The Chair provided the comparison of 1) theoretical unconstrained annual catch level calculated based on HCR under CMM 2024-08 using 2025 assessment results, 2) unconstrained catch level for 2024, 2025 and 2026 computed in 2023, 2024 and 2025 assessments, respectively, 3) actual catch, and 4) TAC actually applied. Theoretical unconstrained catch level in 1) is calculated as if the current HCR was applicable historically and assumes equilibrium reference points estimated in the latest stock assessment from 2025 (NPFC-2025-SSC PS16-IP09).
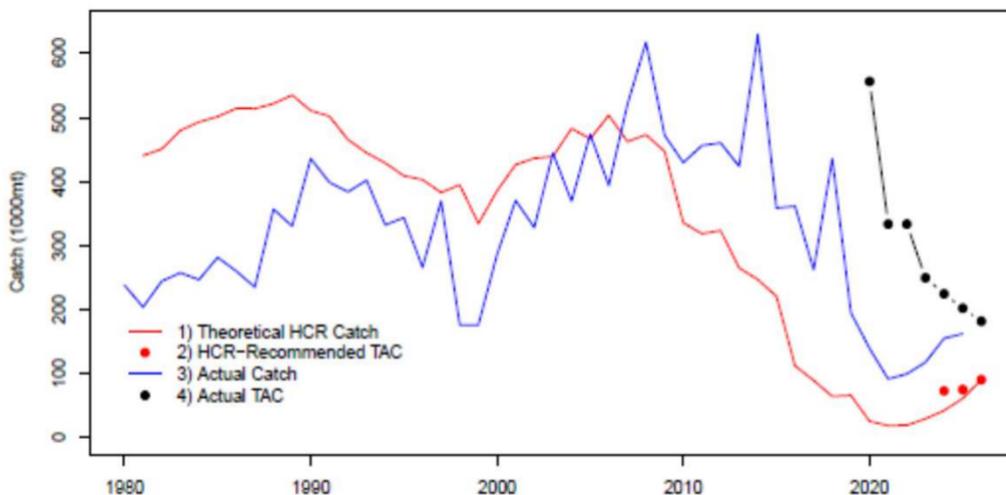
Priority issues for next meetings

The SSC PS recommended holding a data preparatory meeting and a stock assessment meeting in the 2026 operational year and requested the guidance of the SC and Commission for determining the date, format, and location of the meetings. In addition, the SSC PS may hold regular virtual intersessional meetings. The SWG NSAM will also meet intersessionally.

(a) Review **standardized CPUE** up to 2025 or 2026.

(b) Review the **Japanese fishery-independent survey results** up to 2026.

(c) Update **BSSPM** analyses.

(d) Review progress on development and evaluation of **management procedure** as a medium-term task.

(e) Review progress made by the SWG NSAM on the development of the **SS3 model**.

(f) Review Pacific saury **bycatch information** from Members.

Recommendations to the SC

The SSC PS recommended that the SC to

(a)   Consider the stock assessment report, while noting that one Member did not endorse the stock assessment results (Annex X).

(b)   Endorse the SSC PS Work Plan (NPFC-2025-SSC PS16-WP01 (Rev. 1)).

(c)   Allocate funds for an invited expert to support the work of the SSC PS and SWG NSAM by conducting the tasks described in Annex X.

(d)   Adopt the updated species summary of Pacific saury (Annex X).

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- All the participants for preparation of papers/presentations and dedicated discussion

- Quang Huynh (invited expert)

- Libin Dai (vice-chair)

- Alex Meyer (rapporteur)

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