2026 North Pacific albacore stock assessment

International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC)

Albacore Working Group

Peter Kuriyama

SC22 Agenda Item A4.4.2

14 August, 2026

Acknowledgements

- Conducted by the ISC ALBWG
- 3-year cycle (Last benchmark assessment in 2023)
- Several hybrid workshops were held in 2025/2026 to collaboratively conduct the updated assessment
- Updated 2026 benchmark assessment was reviewed by ISC Plenary in June 2026

WG Members:

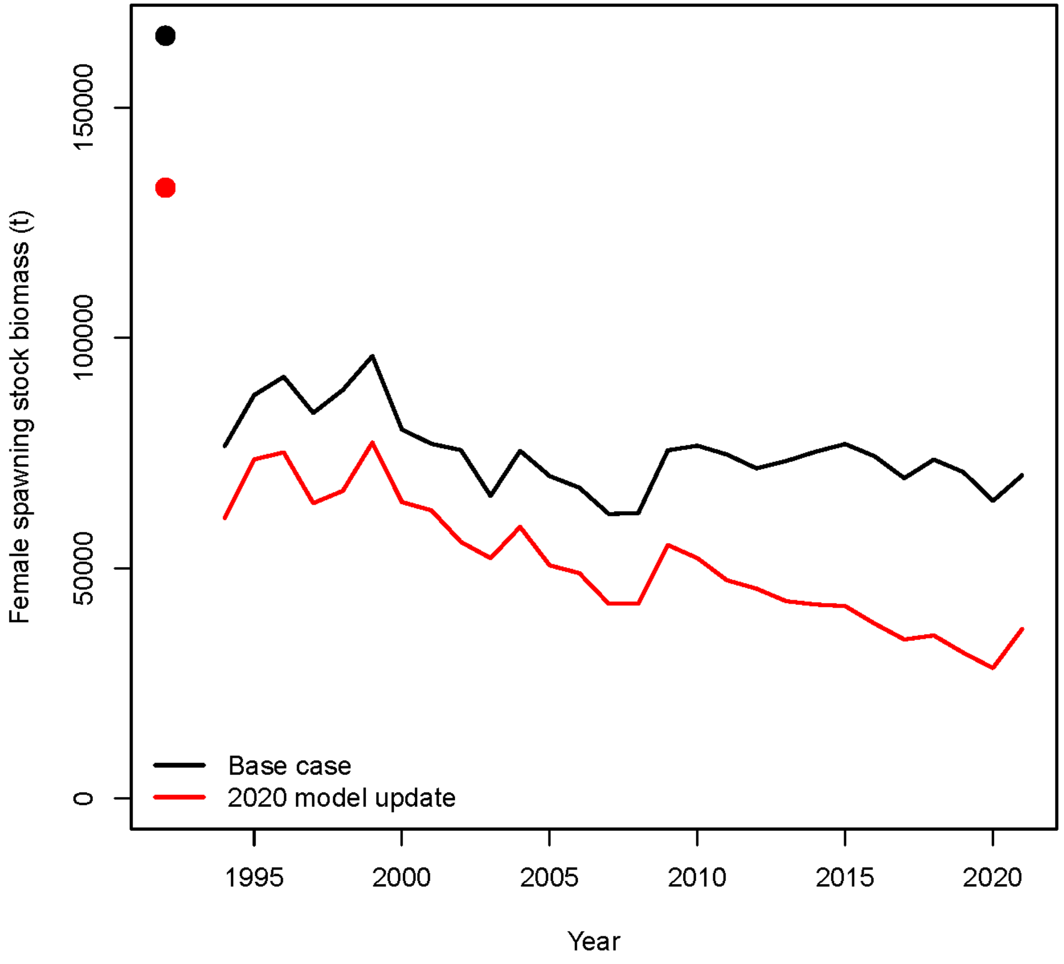
- S. Hawkshaw (Canada+WG chair); N. Matsubara (Japan+WG vice chair); Y.-J. Chang (Chinese Taipei); H. Ijima + Y. Aoki (Japan); S. Teo + P. Kuriyama (USA); H. Xu (IATTC)

Outline

1. 2023 benchmark assessment
2. Assessment modeling
   2.1 Conceptual modeling
   2.2 Input data
   2.3 Biology
   2.4 Selectivity
   2.5 Model configuration
3. Model diagnostics
4. Assessment results
5. Sensitivity analysis
   5.1 Research recommendations
6. Future projection
7. Stock Status and Conservation Information

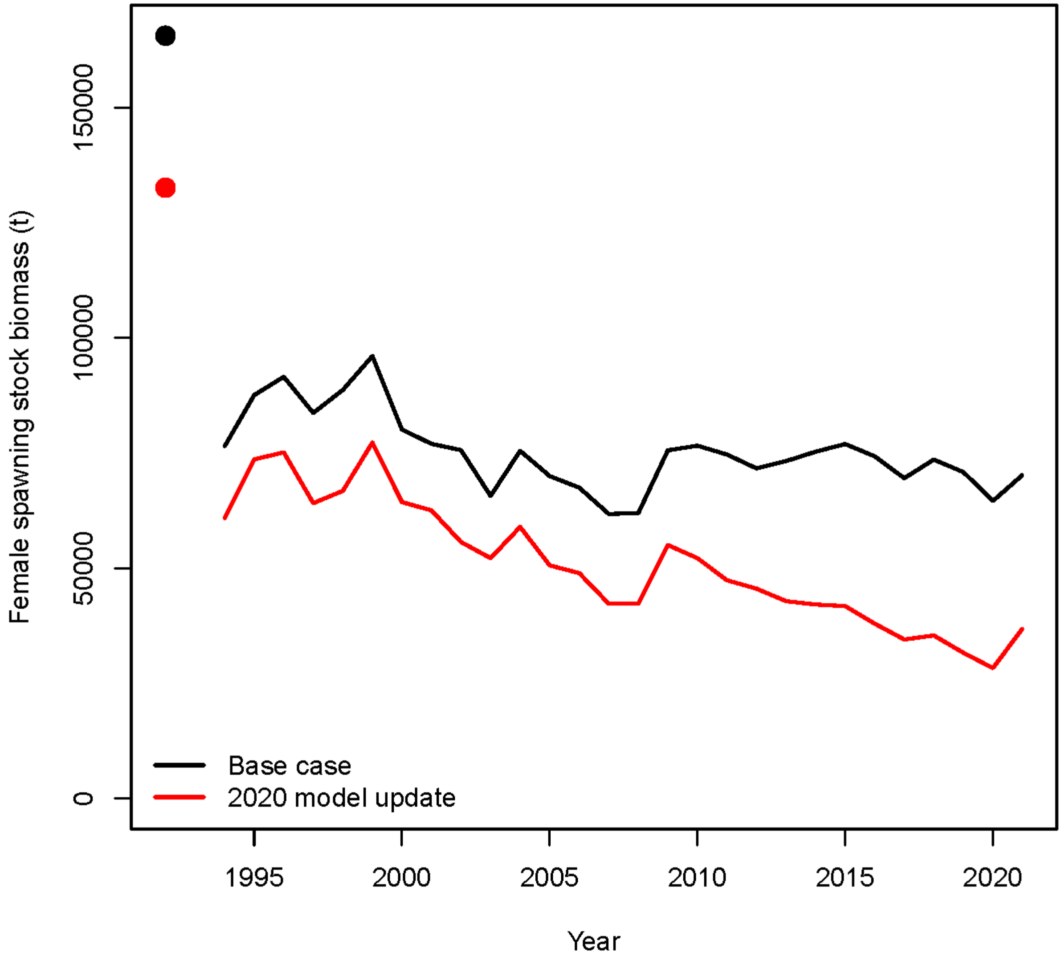
1. 2023 benchmark assessment

- 2023 Stock status:
  - Stock likely not overfished relative to threshold (30%$SSB_{current,F=0}$) and limit (14%$SSB_{current,F=0}$) reference points
  - Stock likely not experiencing overfishing relative to target reference point ($F45_{\%SPR}$)
- 2023 Future projections:
  - Management objectives will likely be met under both fishing intensity scenarios evaluated

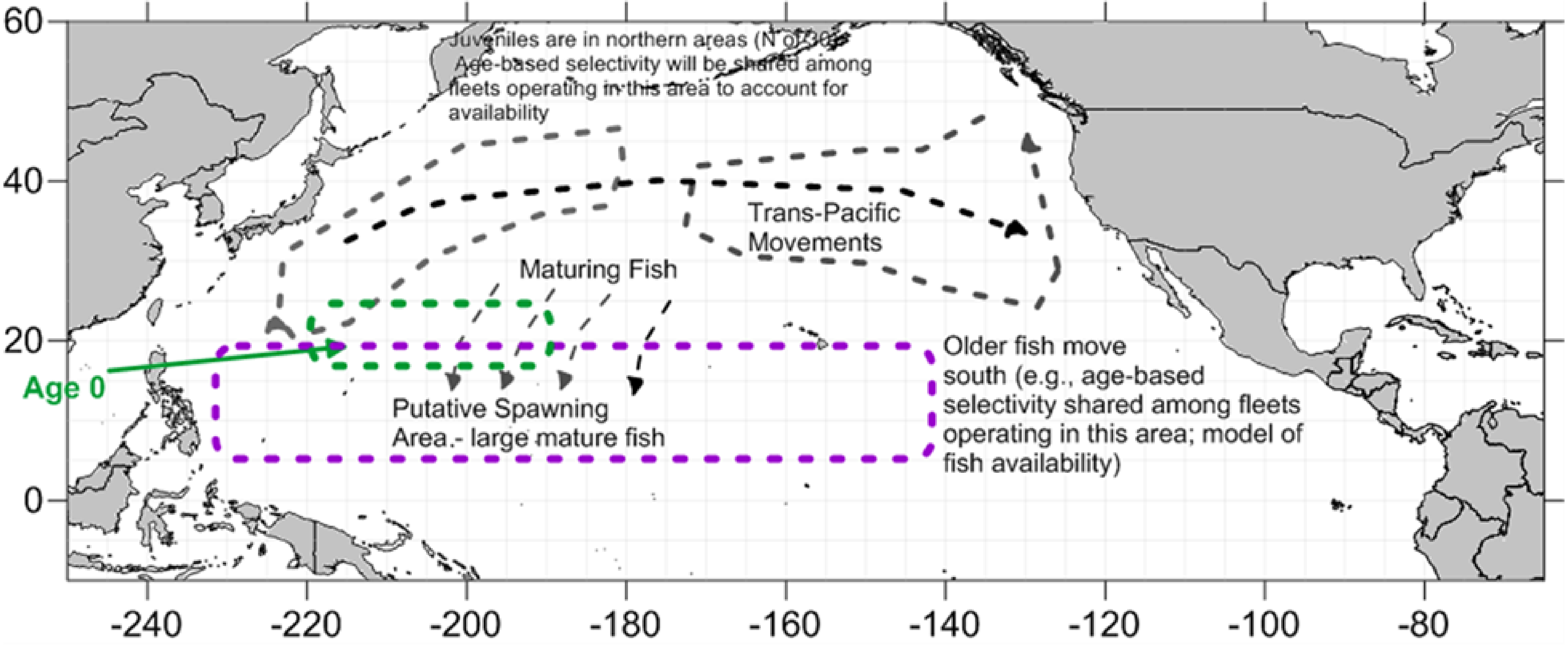


1. 2023 benchmark assessment

- Model time period: 1994-2021
- Index of abundance 1996-2021
  - Japan longline (JPLL), Area 2, Quarter 2 (April-June)
- Fleet structure
  - Juvenile and adult fleet for JPLL, Areas 1+3, Quarter 1 (January-March)
    - Catch and size composition data
  - No other stage-specific fleets
- Time-varying, age-based selectivity
  - For fleets with high year-to-year variability in size composition data
  - Generally two time blocks (e.g. 1994-2005; 2006-2021)
- Stock Synthesis 3

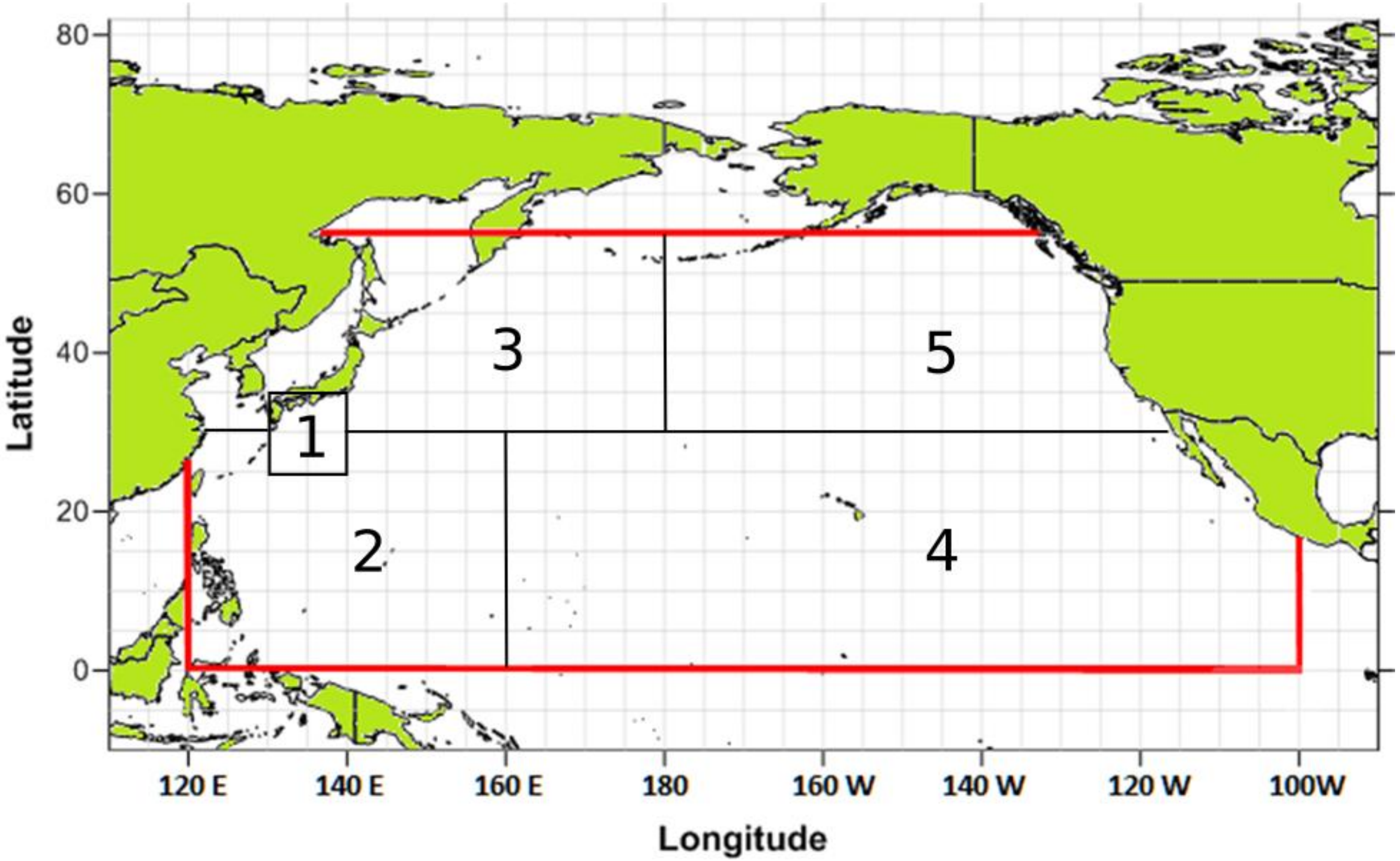


2.1 Conceptual model



2.1 Conceptual model – data areas

- Fleets as areas approach

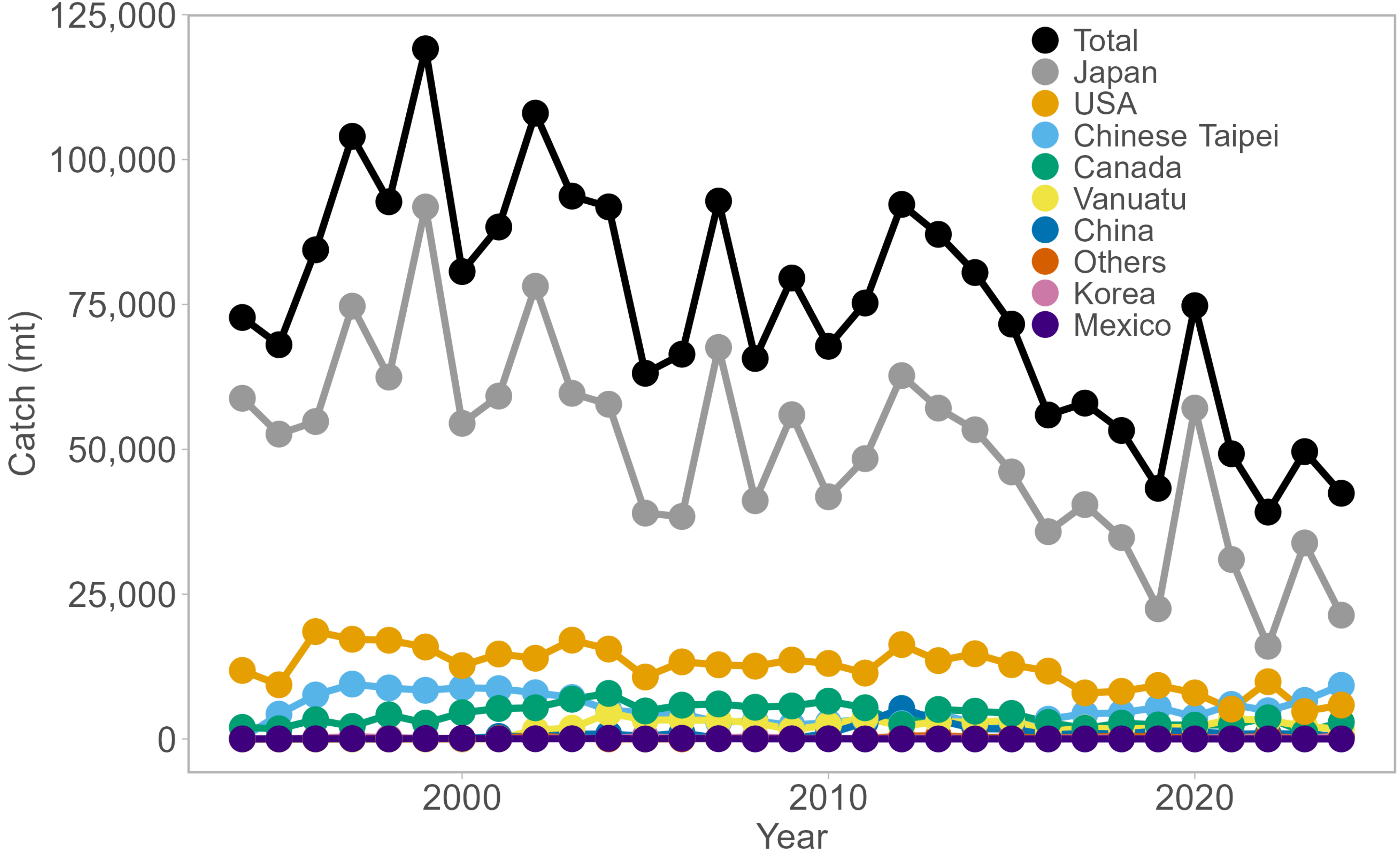


2.2 Input data

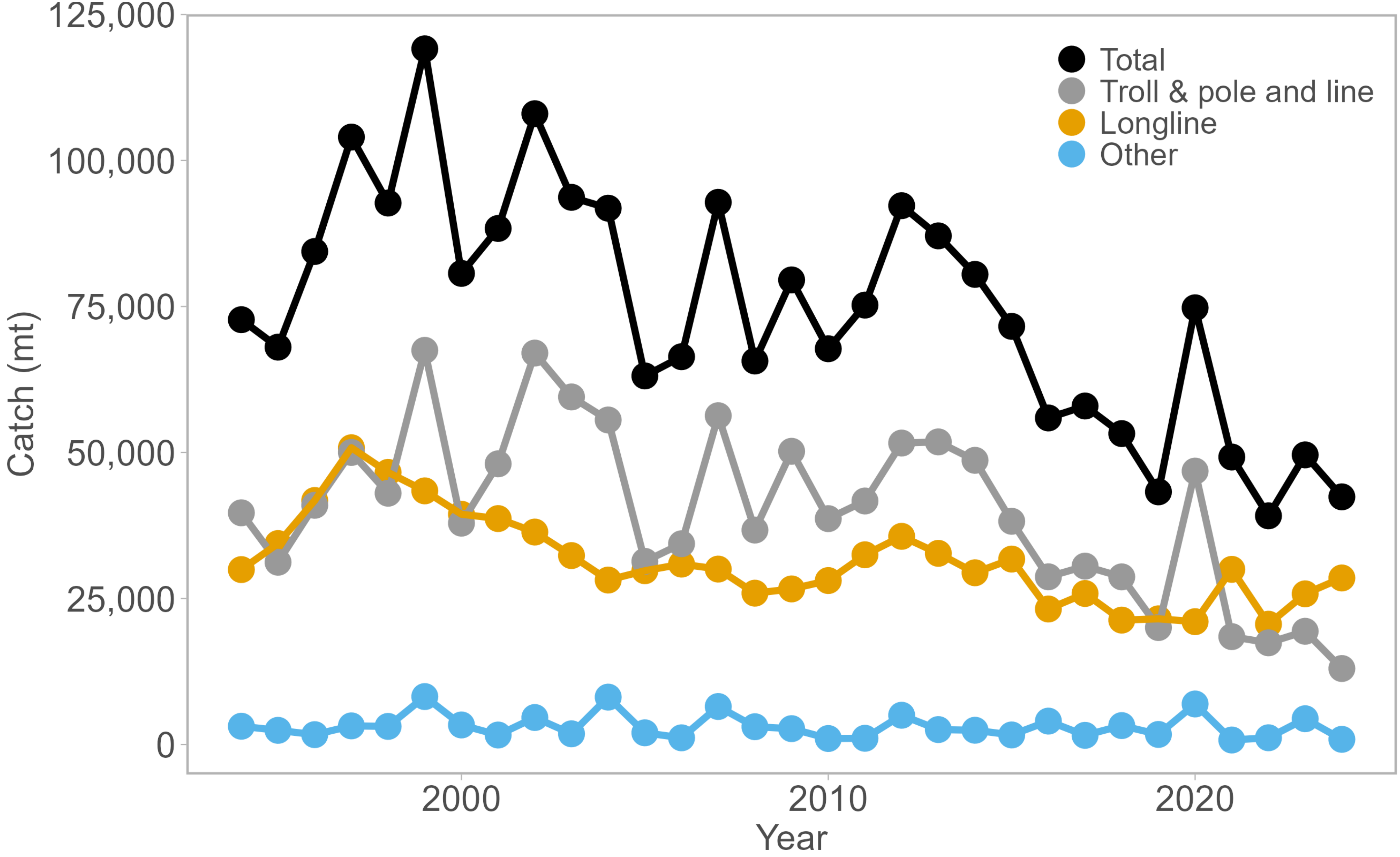
- Updated to cover model time period 1994-2024
  - Capture current stock status
  - Multiple cohorts

- Catch
  - Records prior to 1994 are unreliable
- Index of abundance
- Size composition data

Updated catch data

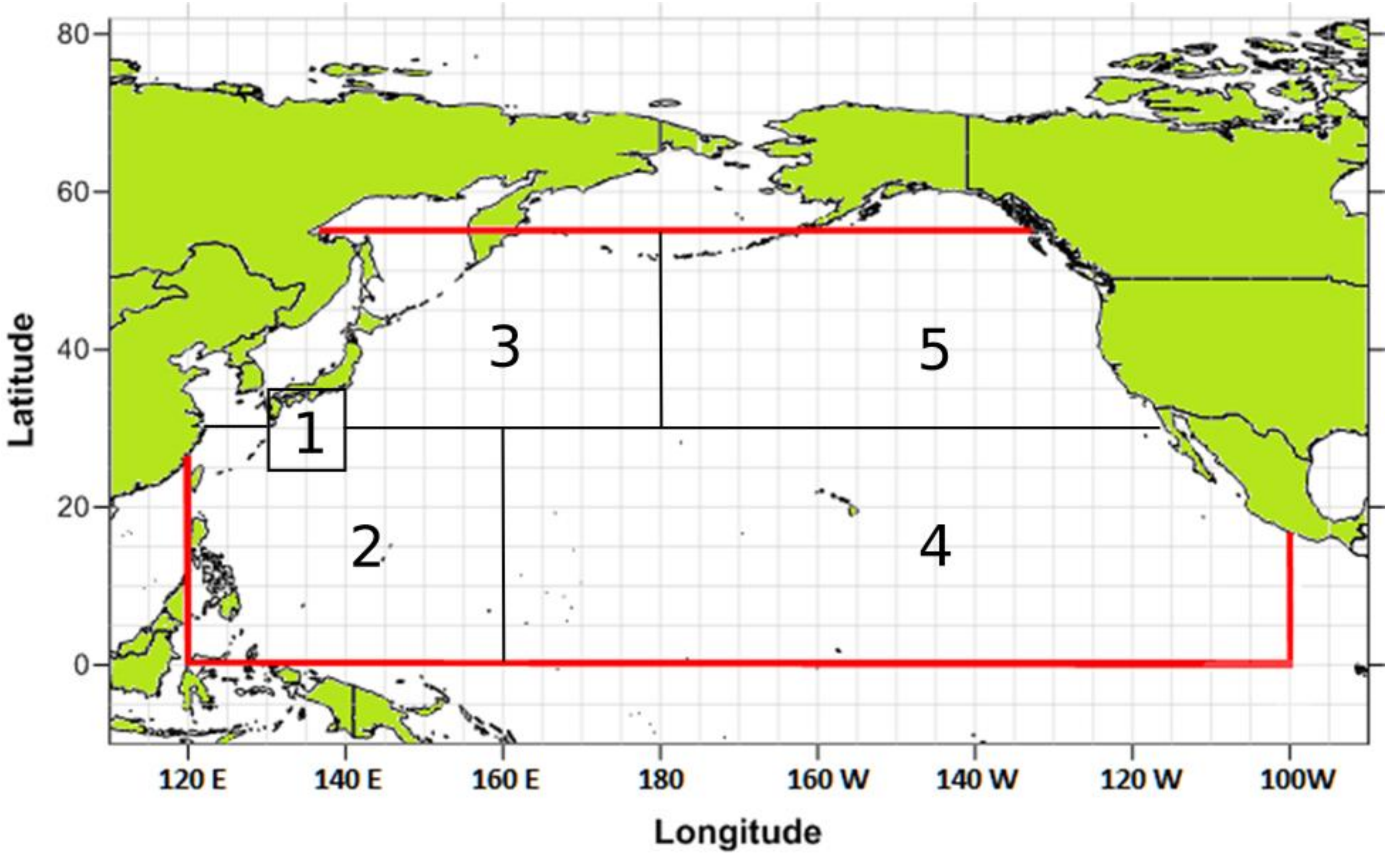


Updated catch data – by gear type

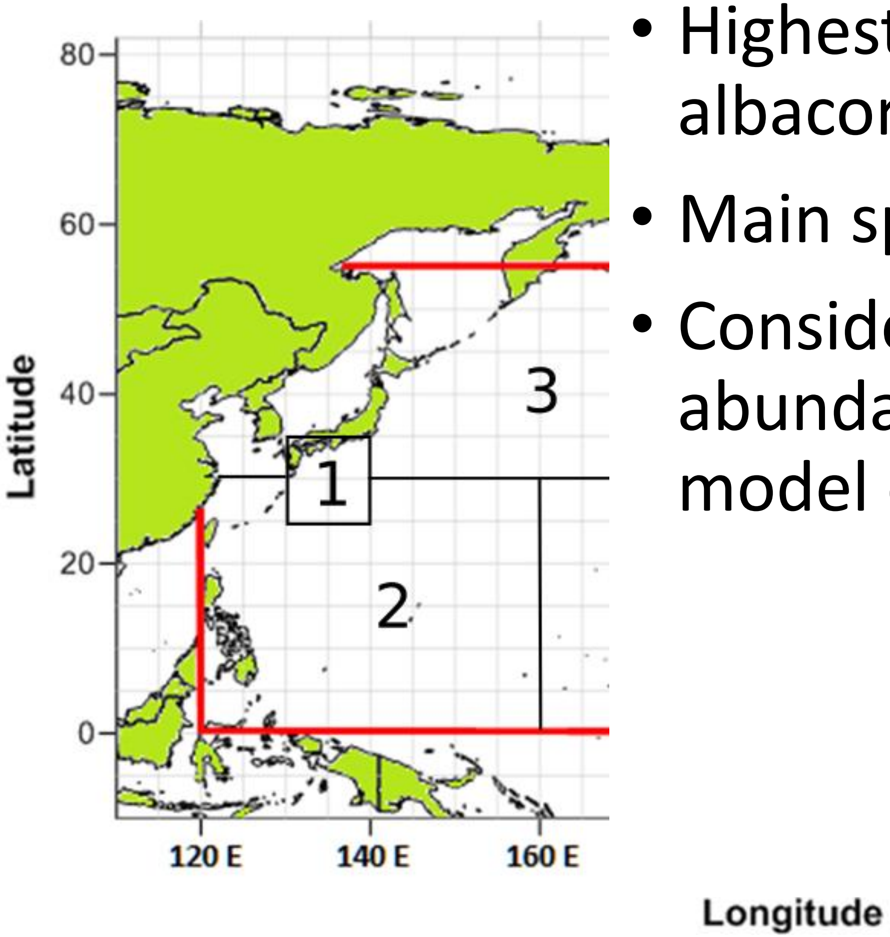


Highest average catch amounts by fleet

- EPO surface
  - ~3,800 t per year
- JP pole and line (JPPL), Area 3+5, Quarter 2
  - ~3,700 t per year
- JPPL, A35, Q3
  - ~1,900 t per year
- Chinese Taipei LL, A35
  - ~900 t per year
- Smaller fish in north, larger in south



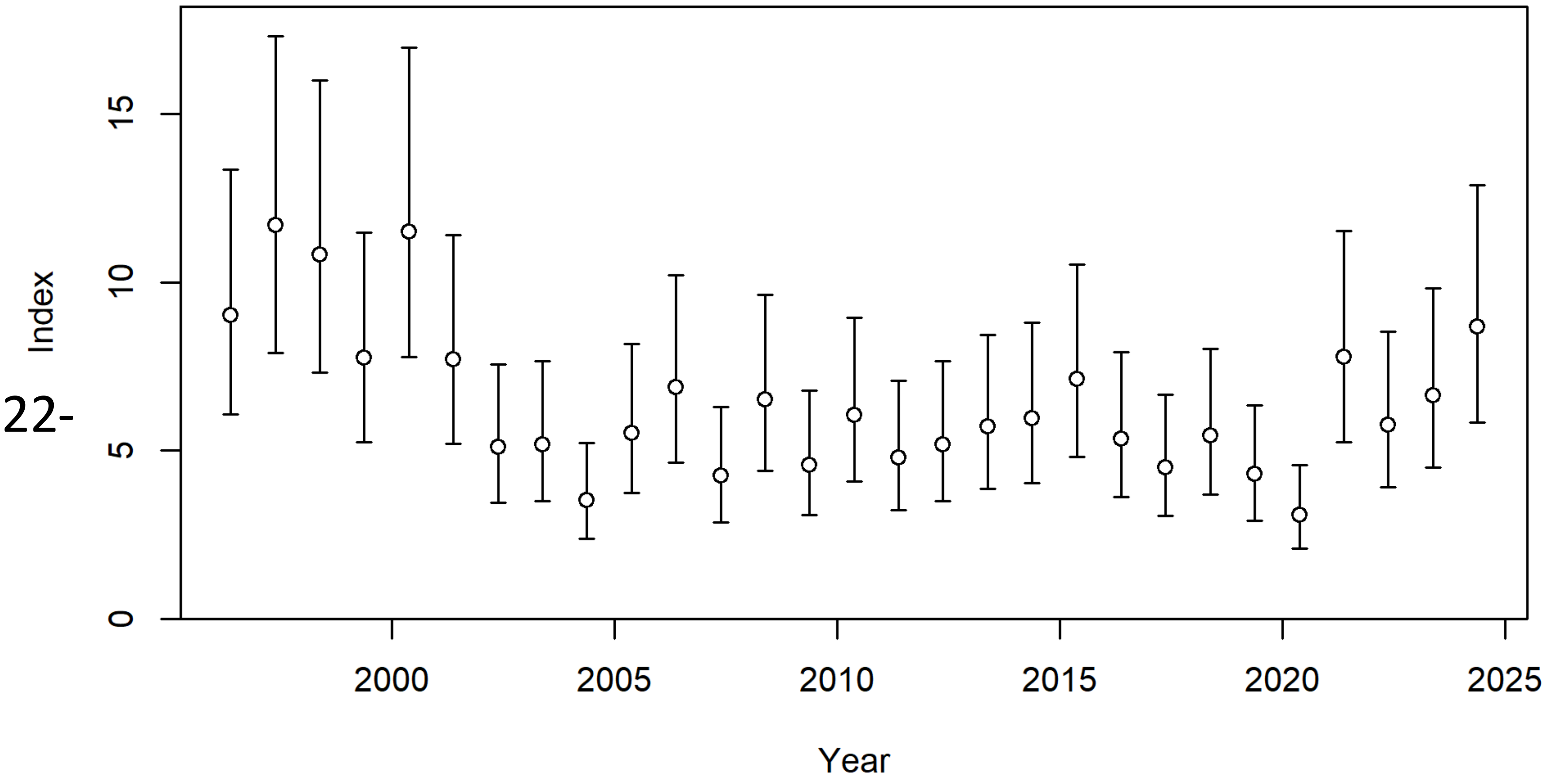
Index of abundance (Japan longline, April – June, Area 2)



- Highest proportion of adult female albacore in April-June (Q2) in Area 2
- Main spawning area and season
- Considered other indices of abundance but this one had the best model diagnostics

Index of abundance (Japan longline, April-June, Area 2)

- Spatiotemporal GLMM estimated with INLA
- Uncertainty shown in vertical lines (95%CI)
- Slight change in index values with new data (2022-2024) compared to 2023 assessment
- Starts in 1996

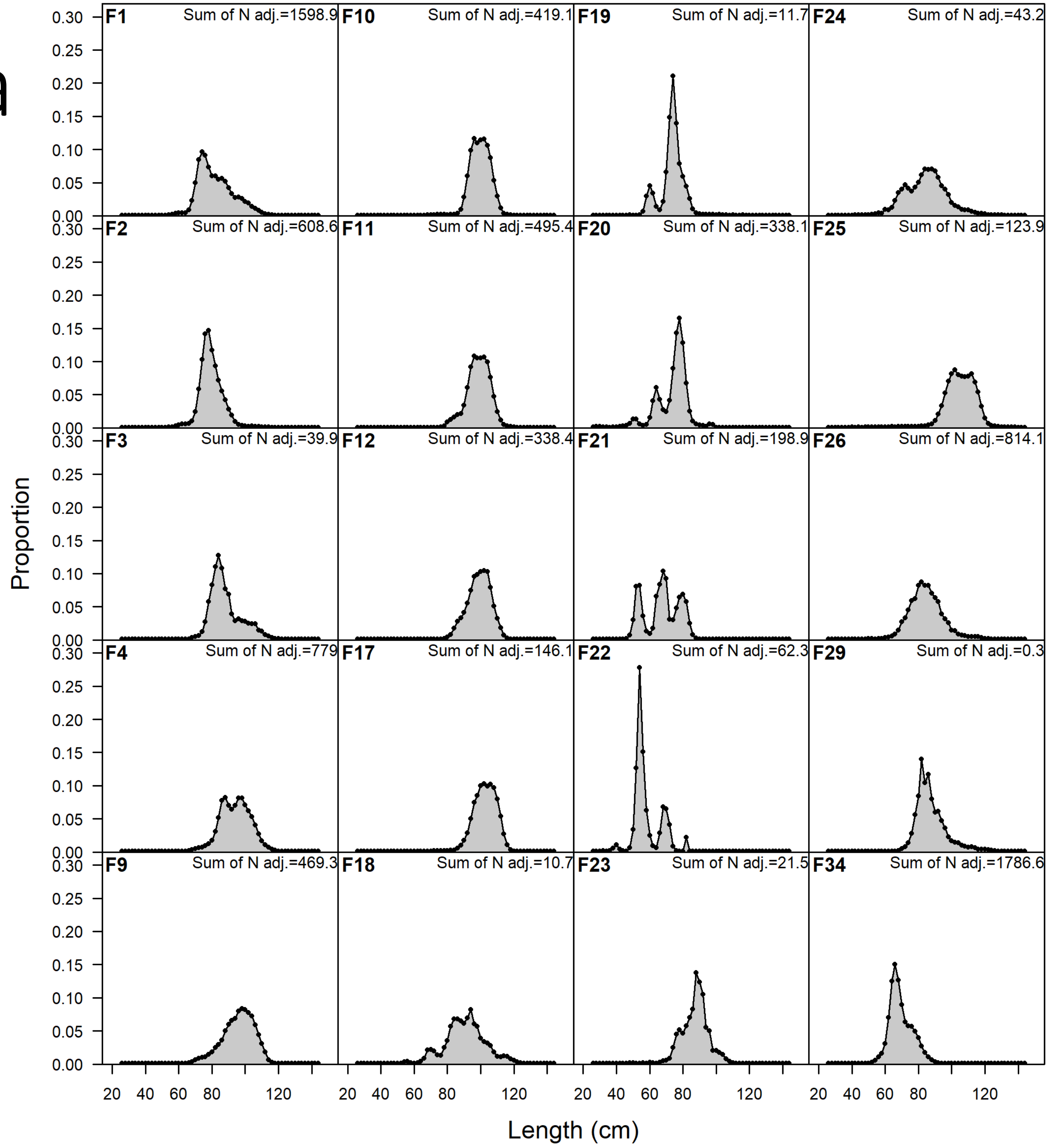


Other indices considered

- Japan longline, All ISC Areas, April-June (referred to as fleet S36 in assessment document)
  - Spatiotemporal GLMM
  - Adults 85-105cm
- Eastern Pacific Ocean surface index, Areas 3 and 5, July-September (F34)
  - Juvenile index
- Longline from Chinese Taipei fleet index, Areas 3 and 5, July-September (S37)
  - Juvenile index

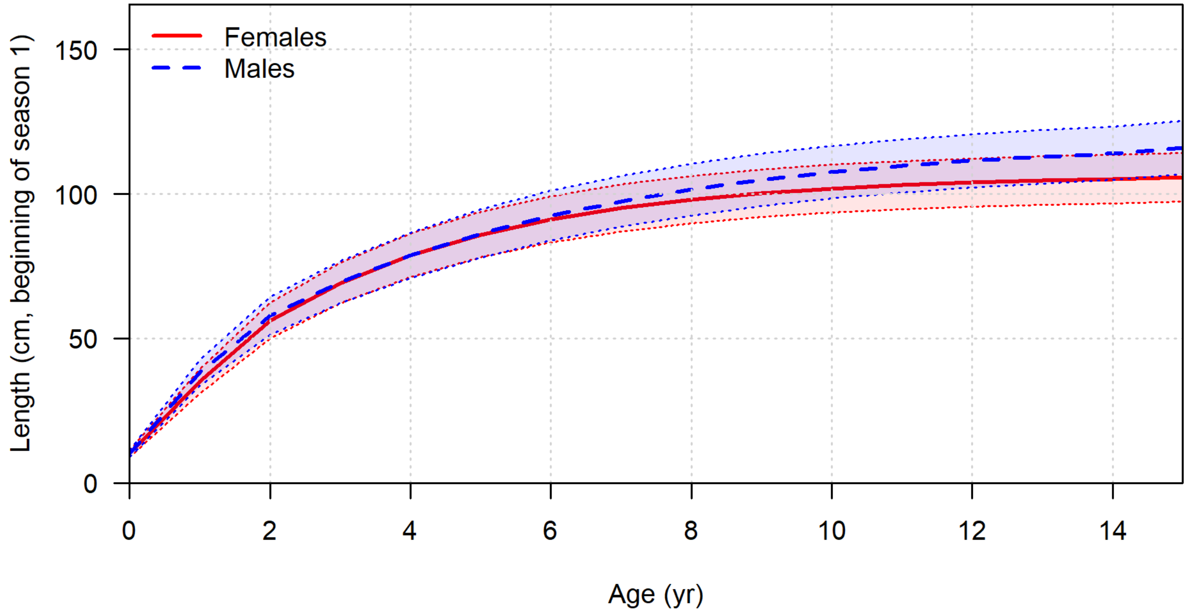
Length composition data

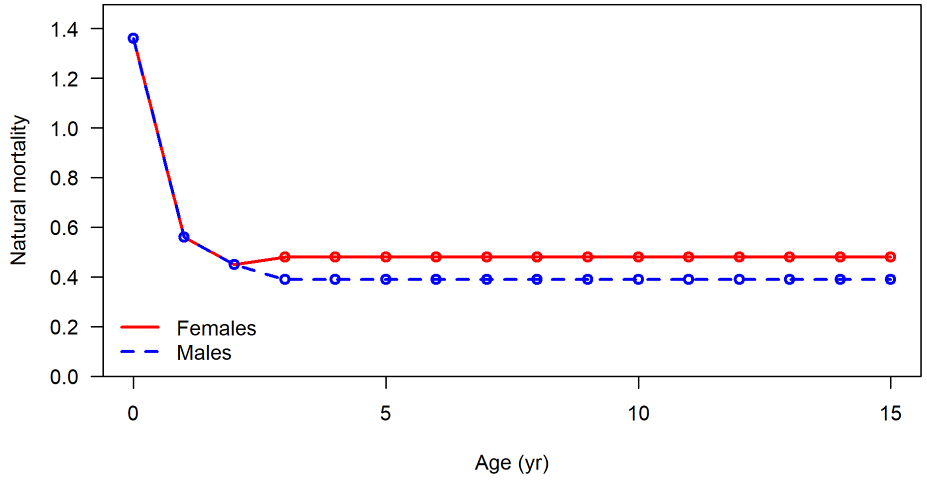
- Aggregated across years
- Arranged by fleet
- Pole and line fleets have multiple modes

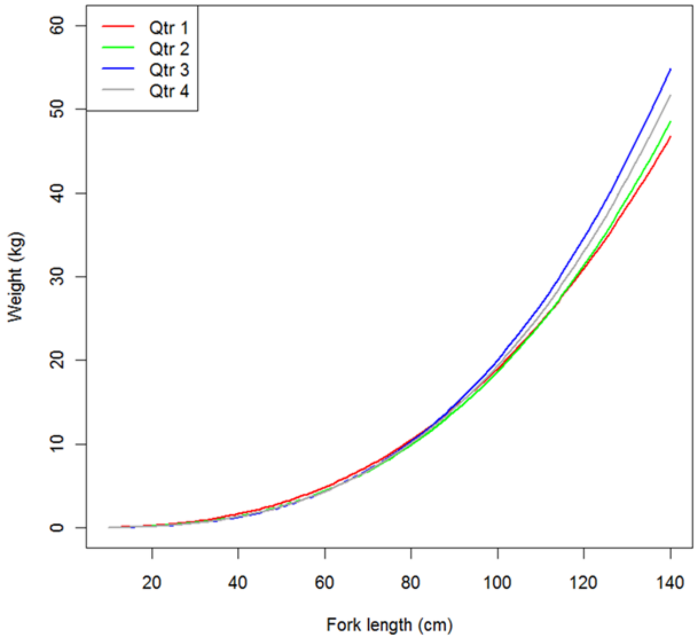


2.3 Biology

- Maximum age of 15
- von Bertalanffy, sex-specific growth
  - Fixed, estimated in Xu *et al.* (2014)
  - CV young = 0.06; CV old = 0.04
- Season-specific length-weight relationships
  - Watanabe *et al.* (2006)
- Natural mortality (*M*)
  - Sex-specific after age 3
  - Female *M* = 0.49 y^{-1}
  - Male *M* = 0.38 y^{-1}
- Maturity
  - 50% maturity at age 5

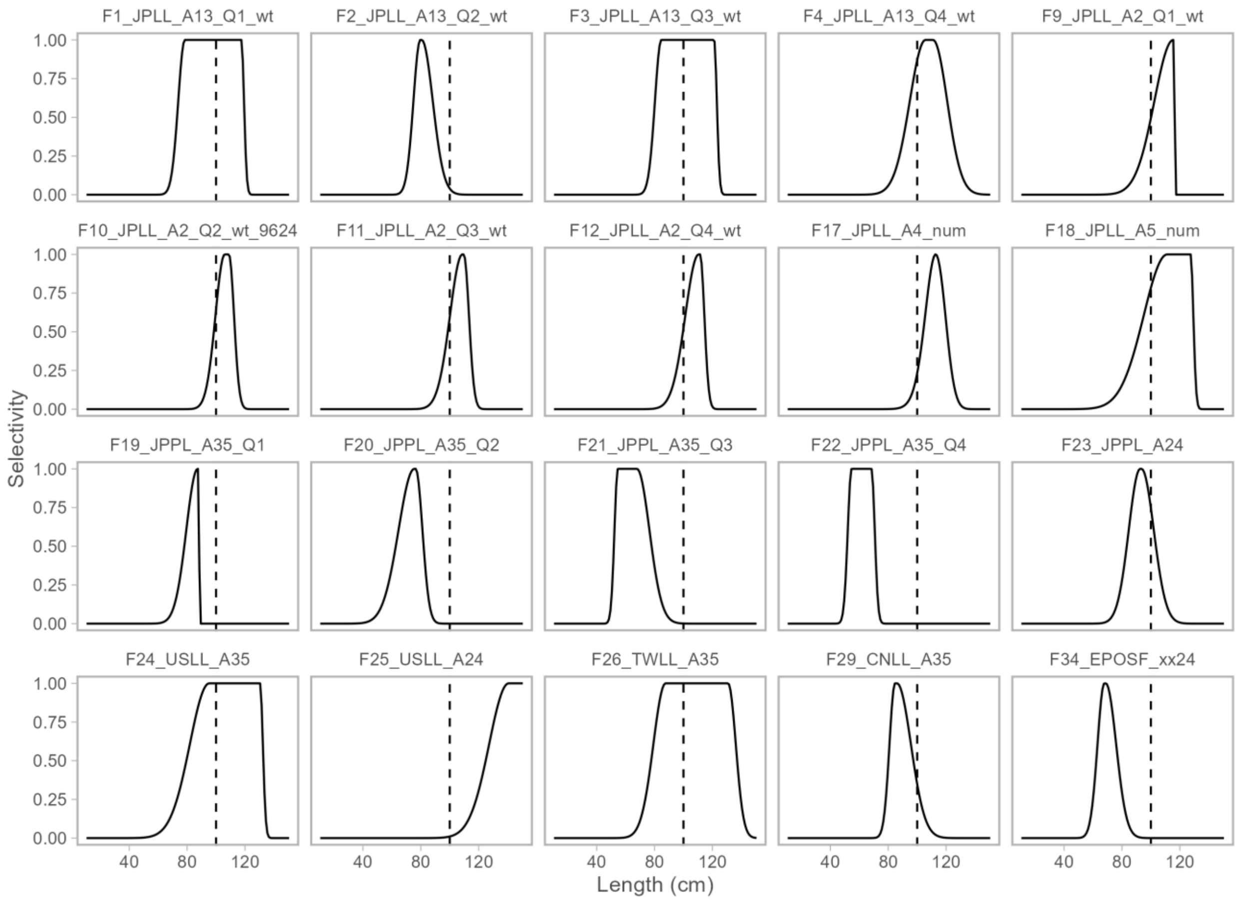






2.4 Selectivity

- Length-based selectivity
  - Spline for one fleet
  - Dome shaped for most fleets
- Age-based selectivity (6 fleets)
  - Estimated in addition to length
  - High year-to-year variability in size comps.
    - Japan longline Areas 1+3; Japan pole and line; EPO surface
  - Time-varying for four fleets
    - JPLL A13 Q1; JPPL A35 Q2; JPPL A35 Q3; EPO Surface
    - Estimated with two-dimensional autoregressive option (Xu et al. 2019)



A new semi-parametric method for autocorrelated age- and time-varying selectivity in age-structured assessment models

Haikun Xu, James T. Thorson, Richard D. Methot, and Ian G. Taylor

CJFAS 2019

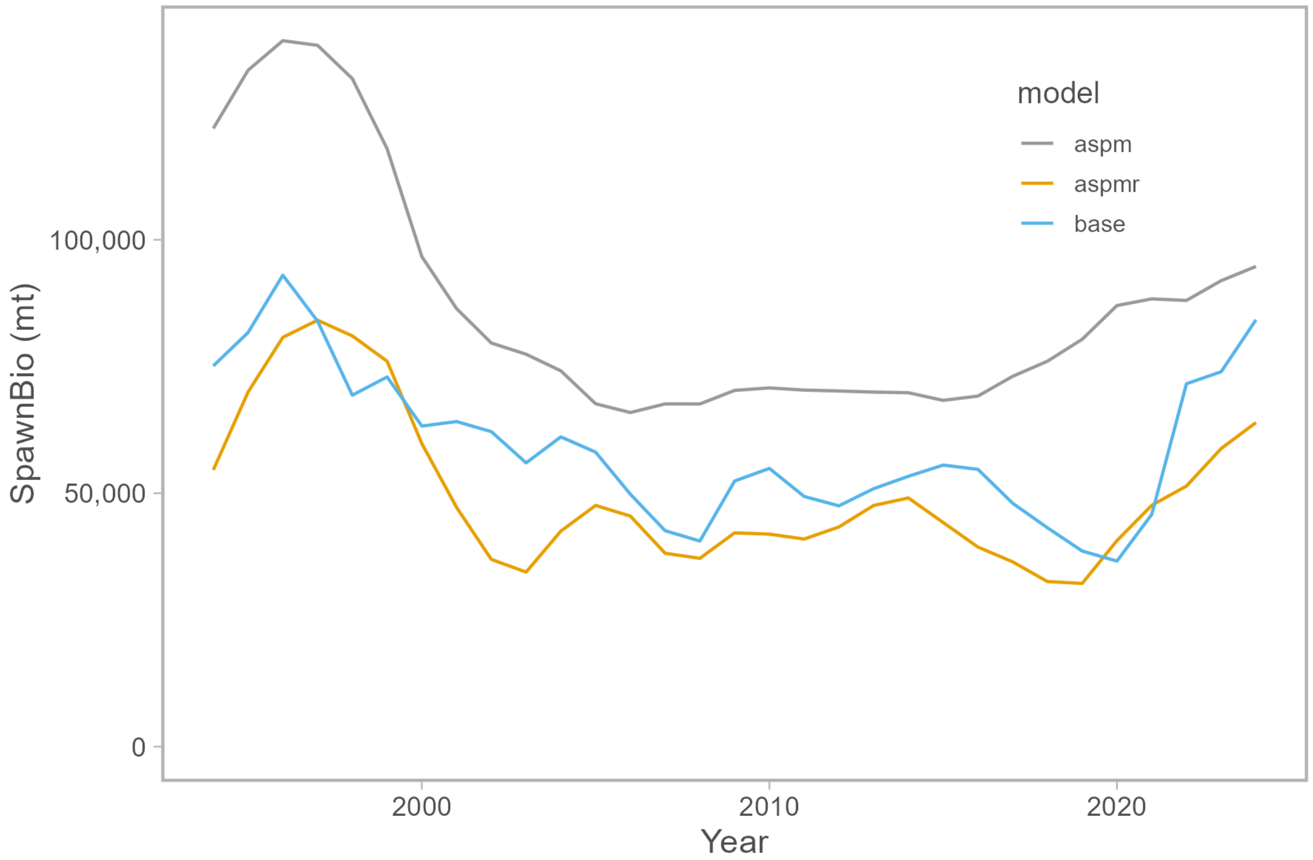
2.5 Model configuration

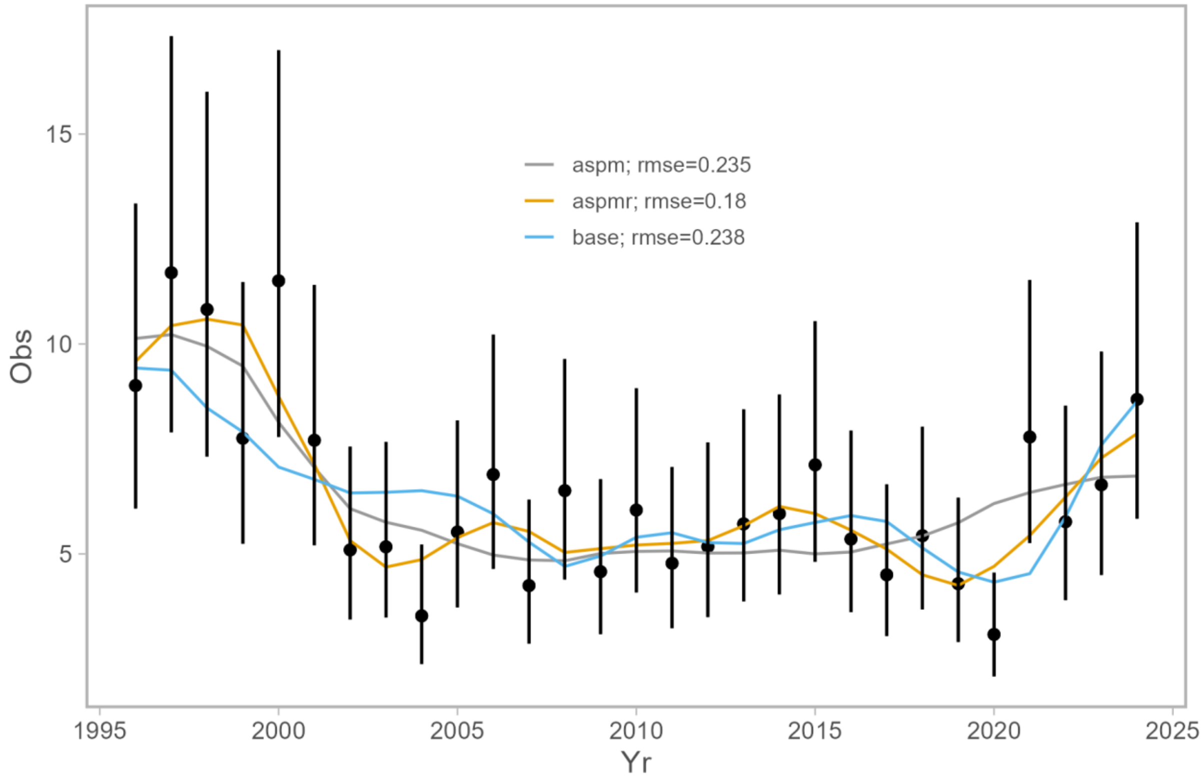
- Stock Synthesis v3.30.24
  - Identical estimates with previous version
- Time period: 1994-2024
  - Start year has been consistent through recent benchmarks
- Stock-recruit relationship
  - Beverton-holt
    - Steepness = 0.9; σ_R=0.48
  - Recruitment deviations estimated for 1994-2024
- Equilibrium conditions
  - Initial fishing mortality estimated
  - Stock recruitment regime
- Catchability coefficients analytically estimated

3. Model diagnostics

- Jittering of starting values
  - 50 jitters, better solution not found
- Age-structured production model (ASPM)
  - Evaluates the consistency between catch and index observations under specified productivity assumption
  - Model fitted to catch and indices of abundance only
  - Model estimated recruitment deviations (ASPM-R) or not (ASPM)
- Hindcasting from Kell *et al.* (2021)
  - Sequentially peel index values from 1 to 5 years (horizon)
    - Model ends 2024, index ends in 2023, 2022, 2021, 2020, 2019
  - Retrospective of 0 to 5 years as well
  - Predictions compared to naïve prediction (one-year lagged observation)
    - 2022 index observation used as prediction for 2023
- Likelihood profiles

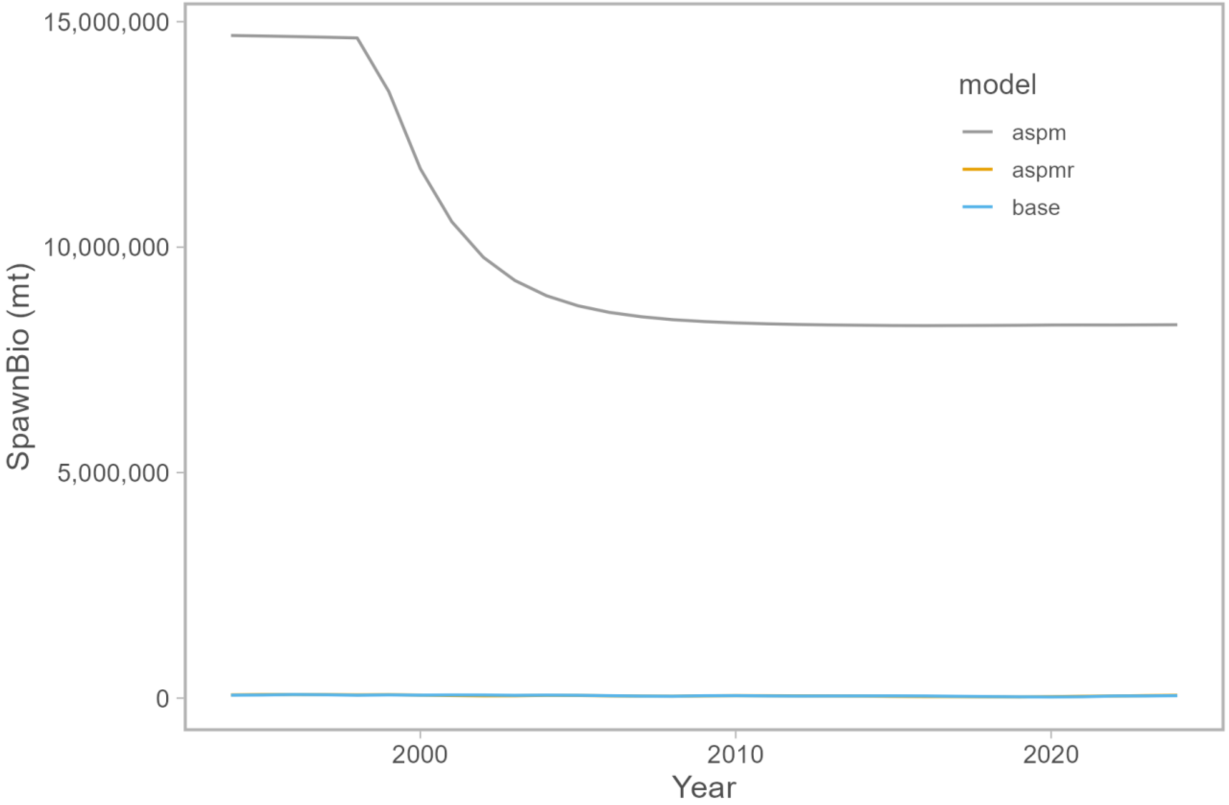
F10 index ASPM

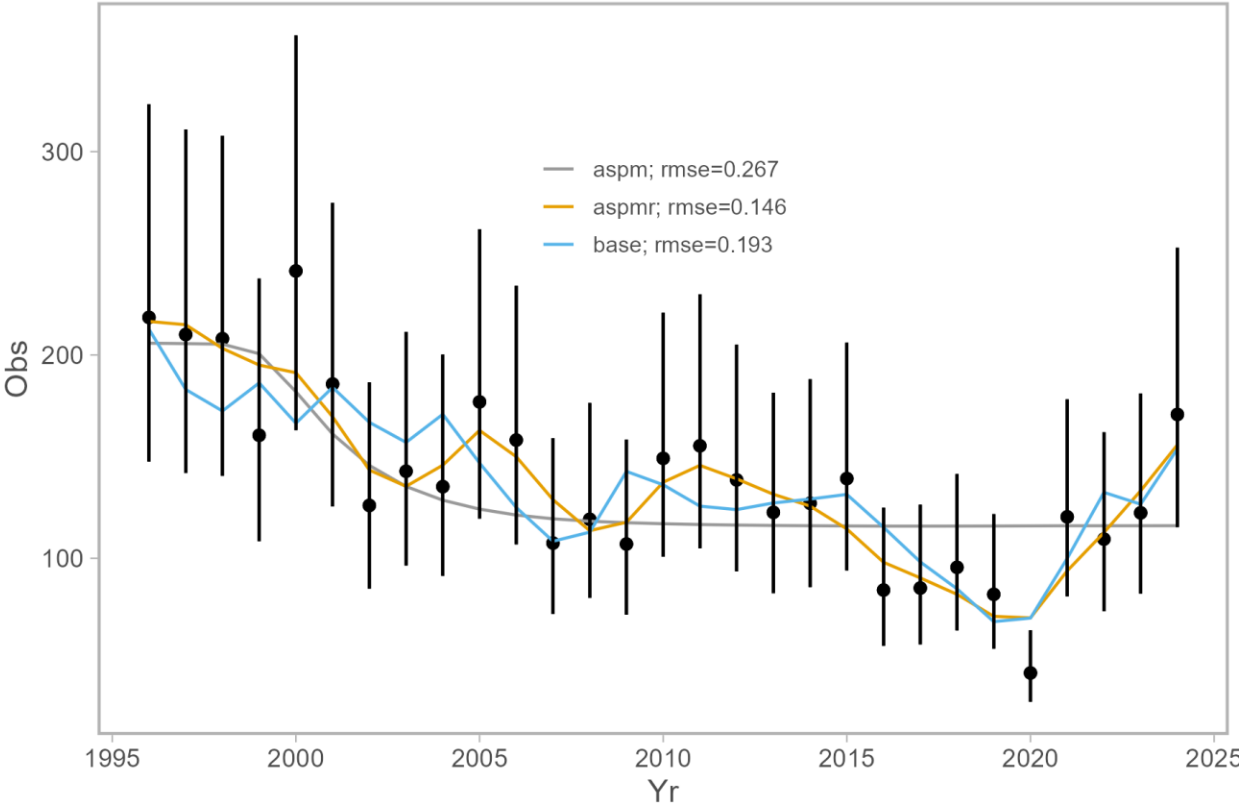




- F10 index is consistent with catch data and contains information on unfished recruitment (R_0); evidence of production function
- Fits to index all have similar root mean squared error values
- ASPM-R estimated recruitment deviations

S36 index ASPM





- S36 index (all ISC Areas) did not have information on R_0
- Fits to S36 index had relatively similar root mean squared error values
- ASPM-R estimated recruitment deviations (best fit to S36 index)

Hindcast Skill

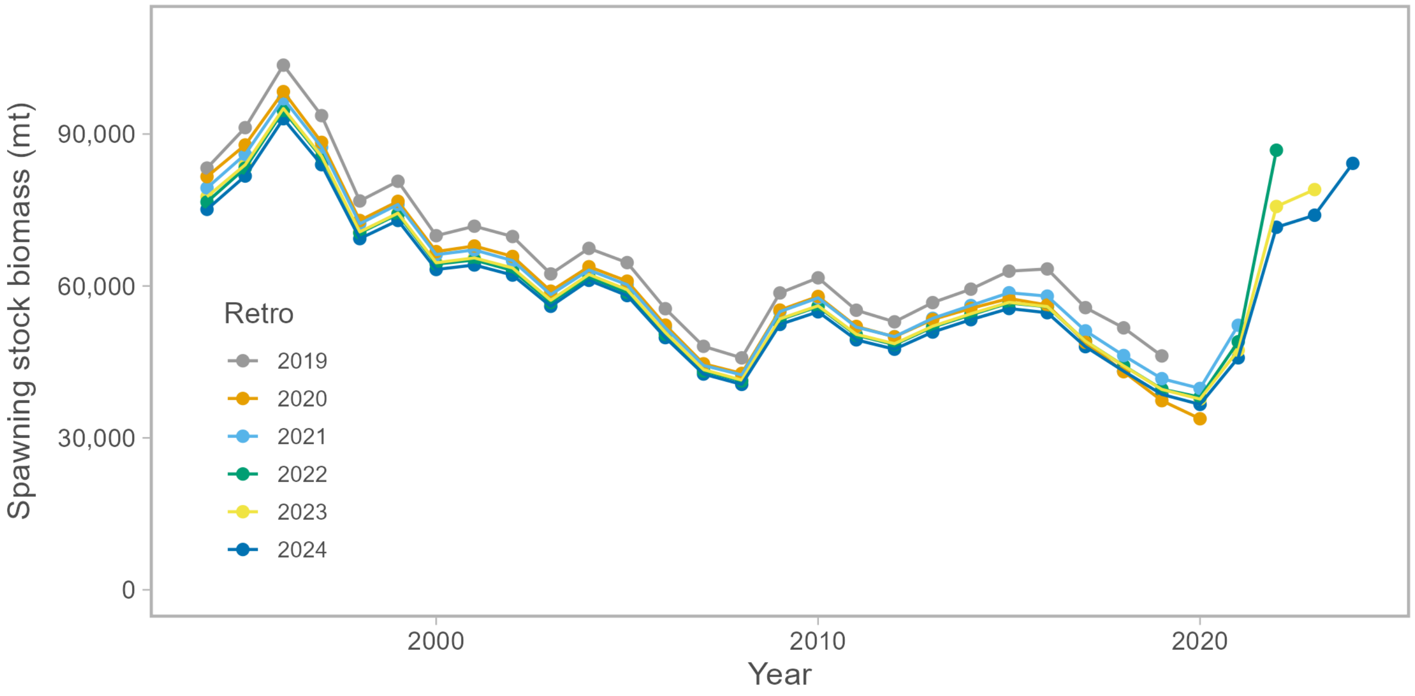
Horizon (year)	Mean absolute prediction error	Mean absolute naive prediction error	Mean absolute fit error	Mean absolute scaled error
1	1.524	1.845	1.171	0.826
2	1.450	1.937	1.178	0.749
3	1.403	1.586	1.178	0.885
4	2.032	2.093	1.169	0.971
5	1.903	1.727	1.187	1.102

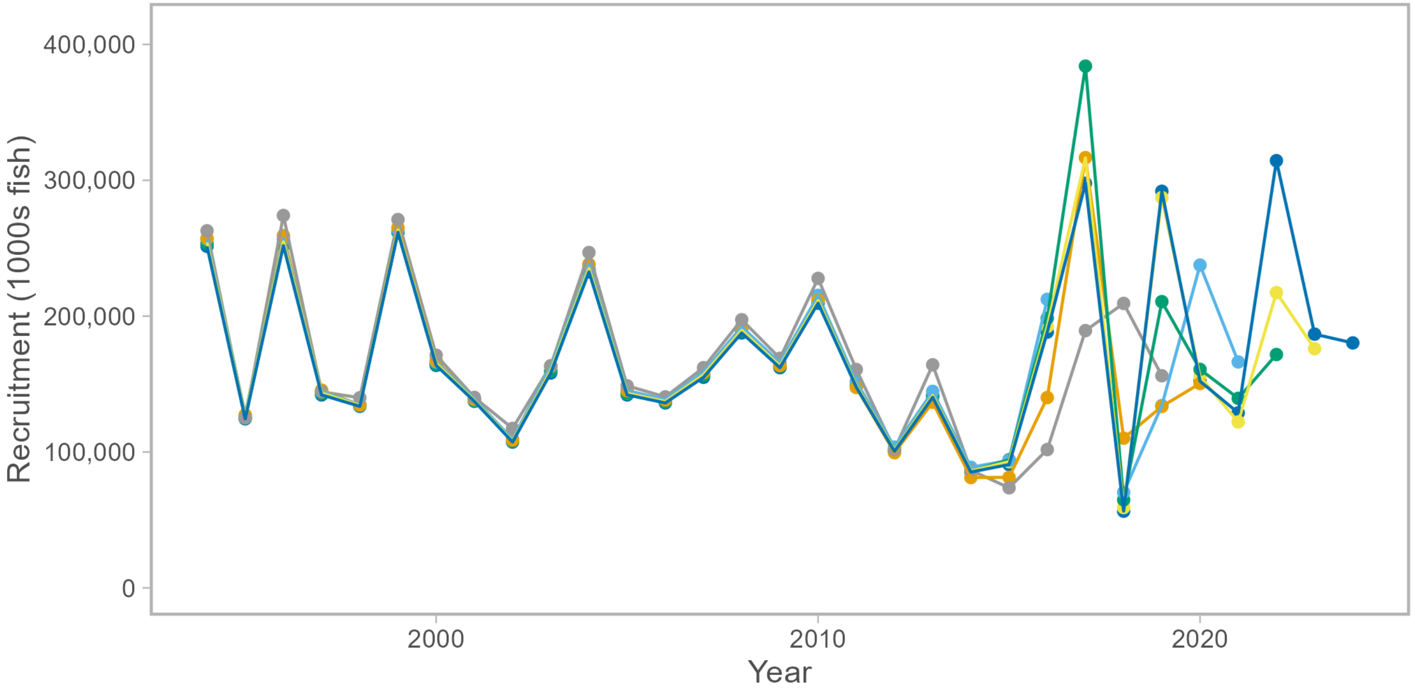
- Assessment demonstrated predictive skill for horizons of 1 to 4 years
  - Mean absolute scaled error (red box) values < 1

Retrospective analysis

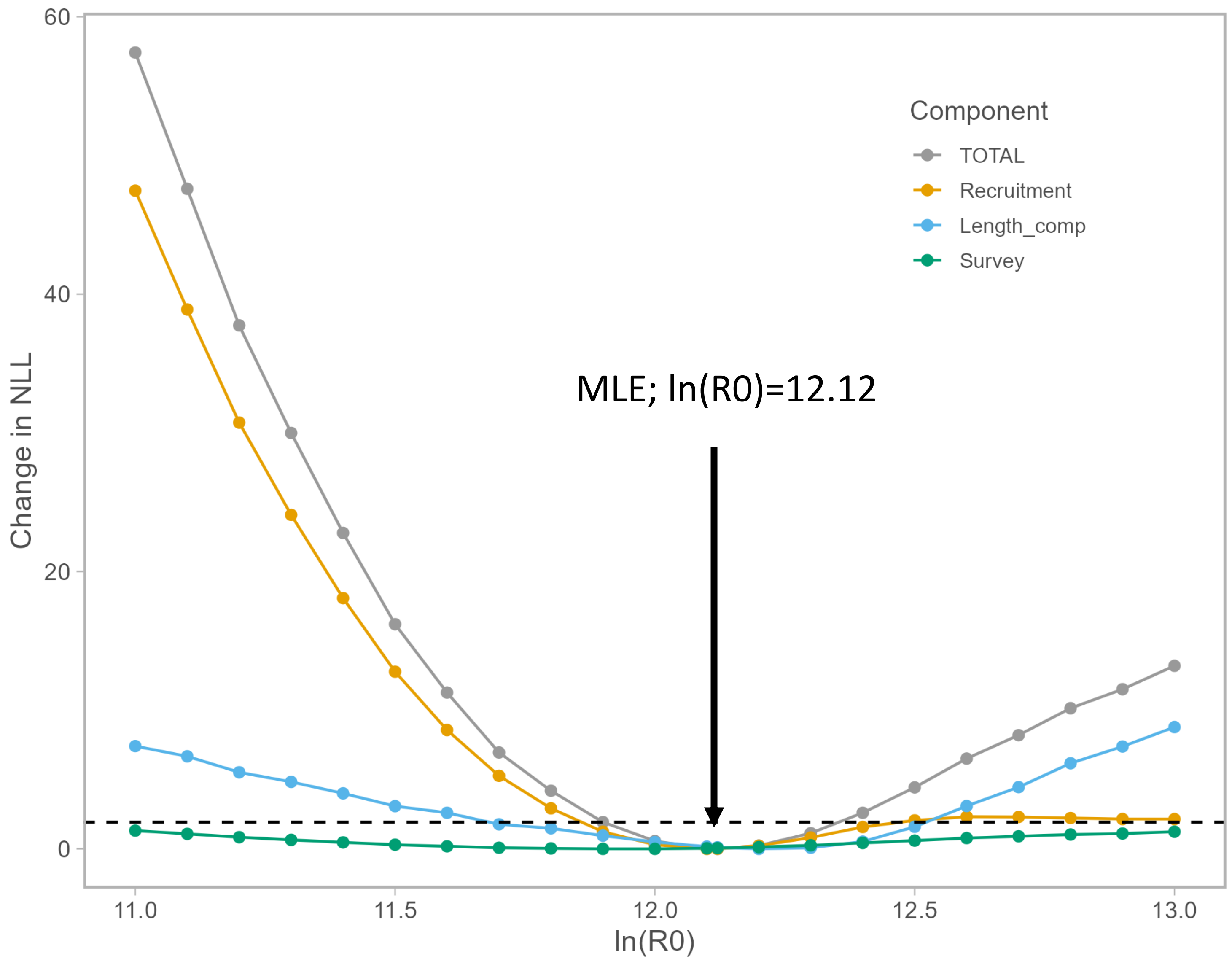
- SSB

Retro year	Mohn's rho
2019	0.197
2020	-0.077
2021	0.140
2022	0.213
2023	0.068



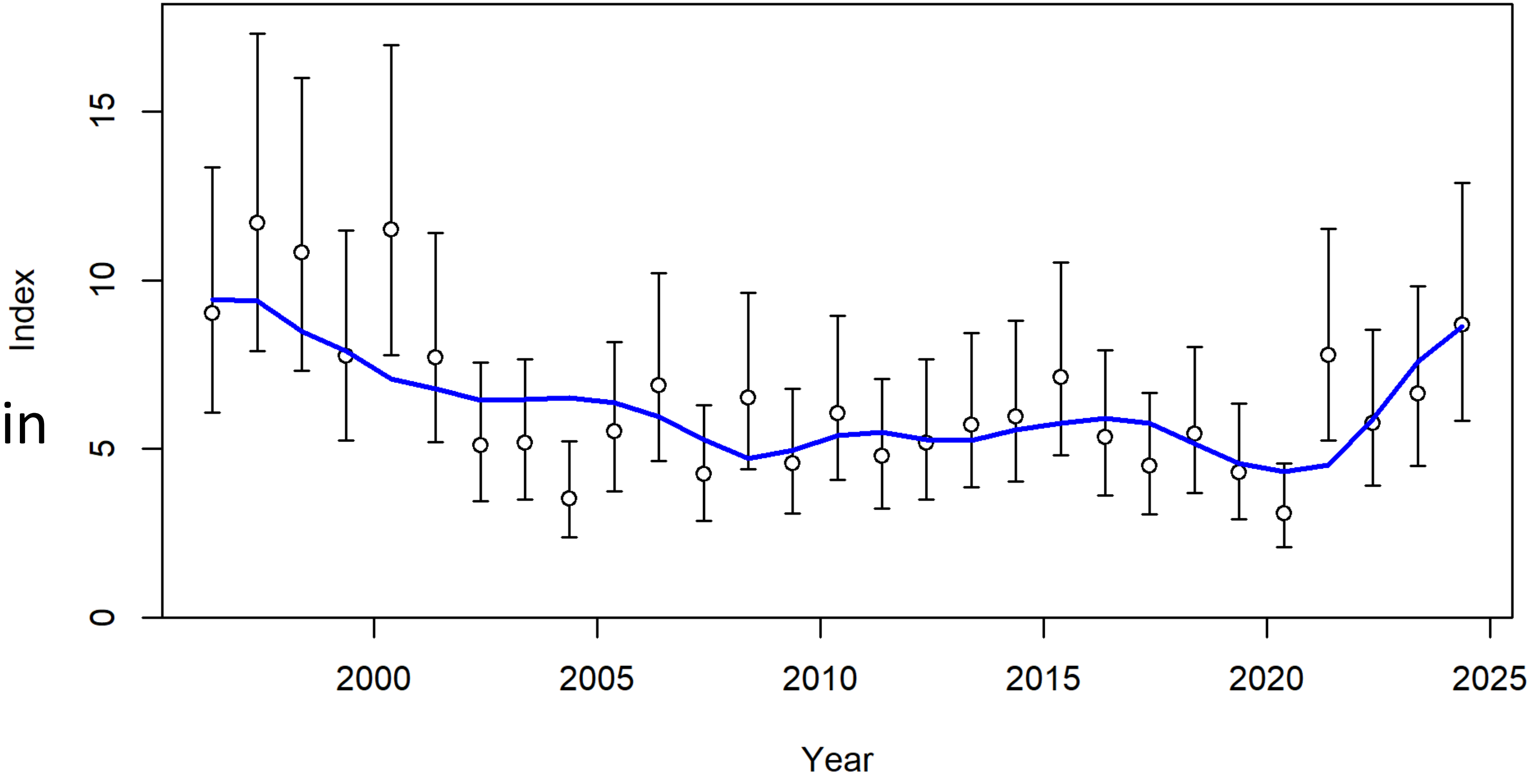


Sensitivities: Likelihood profile of R_0

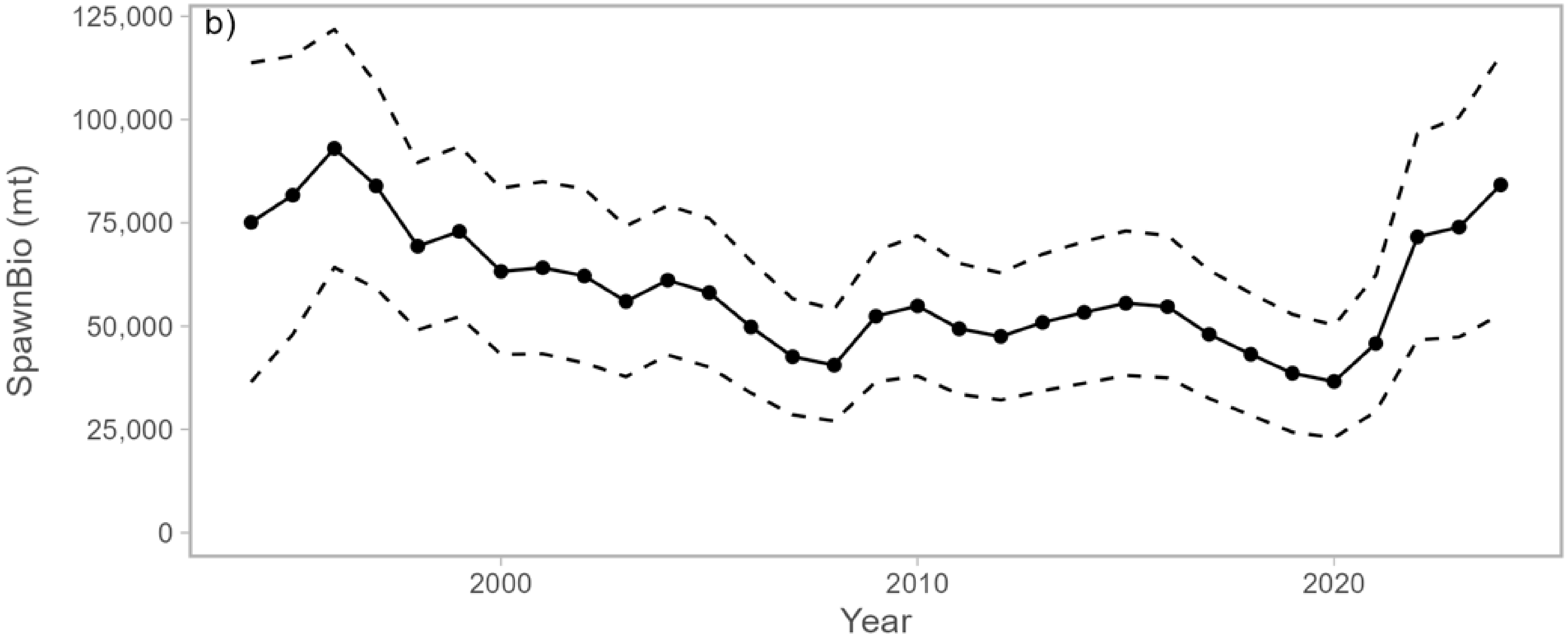


4. Results – Fit to F10 index

- Index of abundance (Japan longline, April-June, Area 2)
- Uncertainty shown in vertical lines (95%CI)
- Assessment model fit in blue line

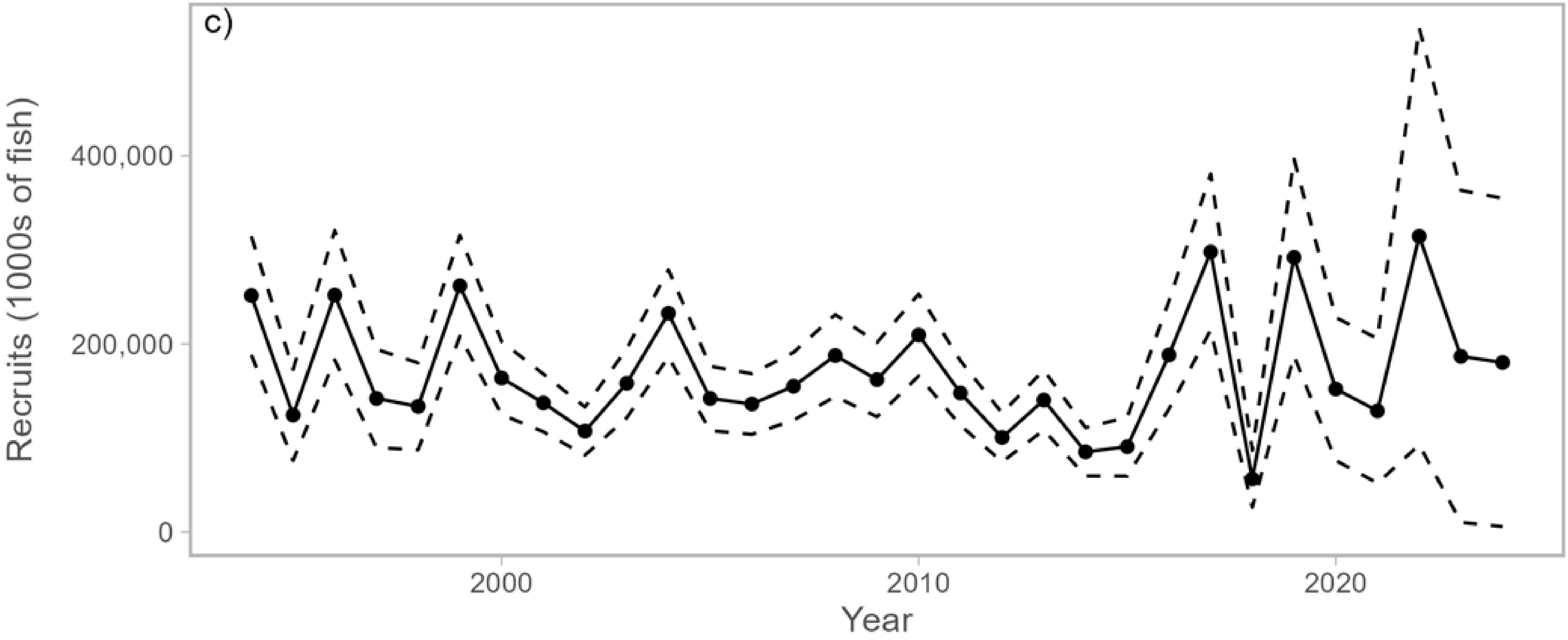


Estimated female spawning stock biomass (mt)



- Increase in early years, followed by relative decline, then somewhat constant, increasing since 2020
- Higher uncertainty at beginning and end of model time period
- Recent increase seen in other data sets (Small-scale longline of Chinese-Taipei and Japan longline indices of abundance)

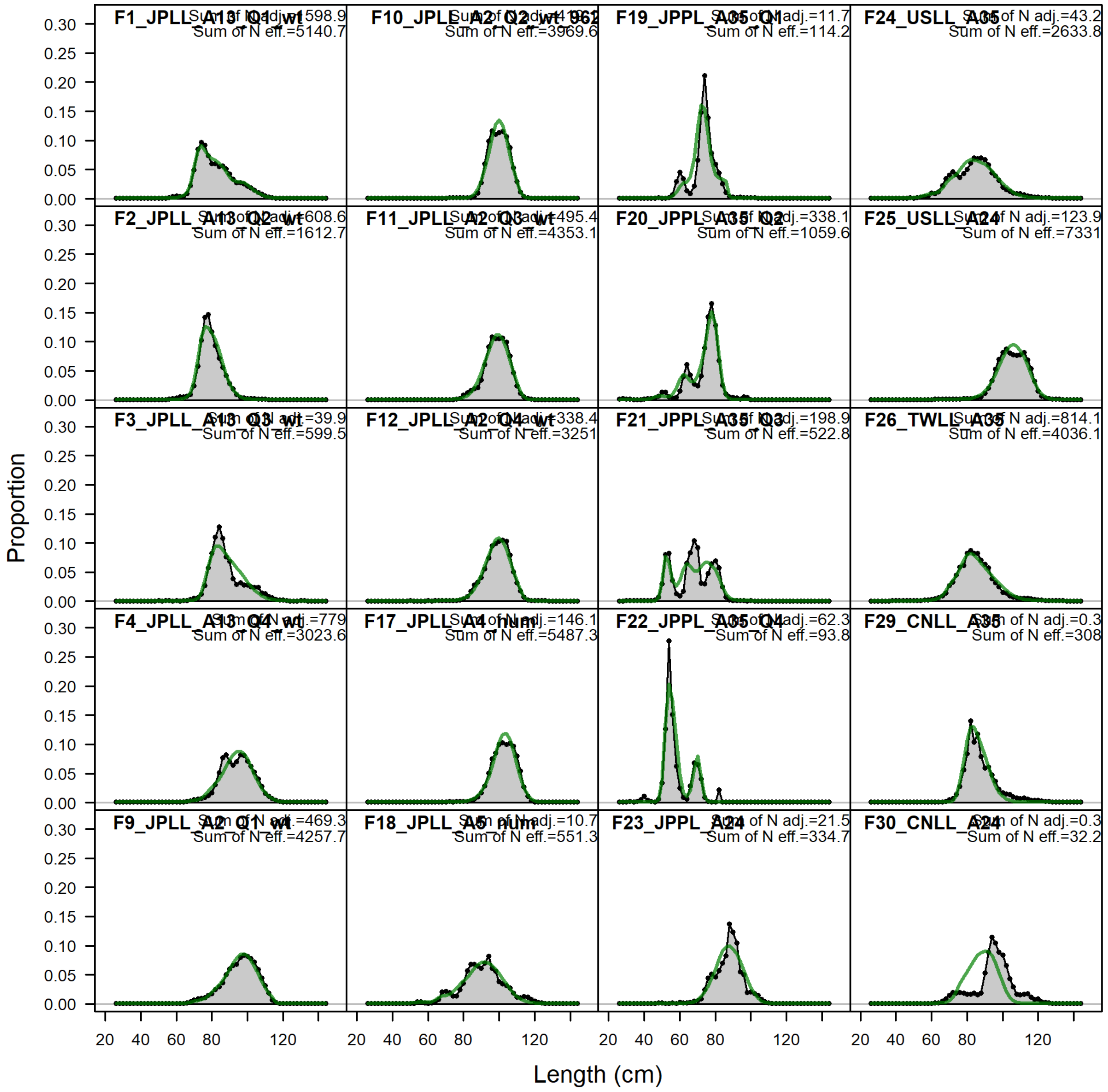
Estimated recruitment (1000s fish)



- Strong recruitment estimated in 2017, 2019, and 2022
- Higher uncertainty at end of model time period

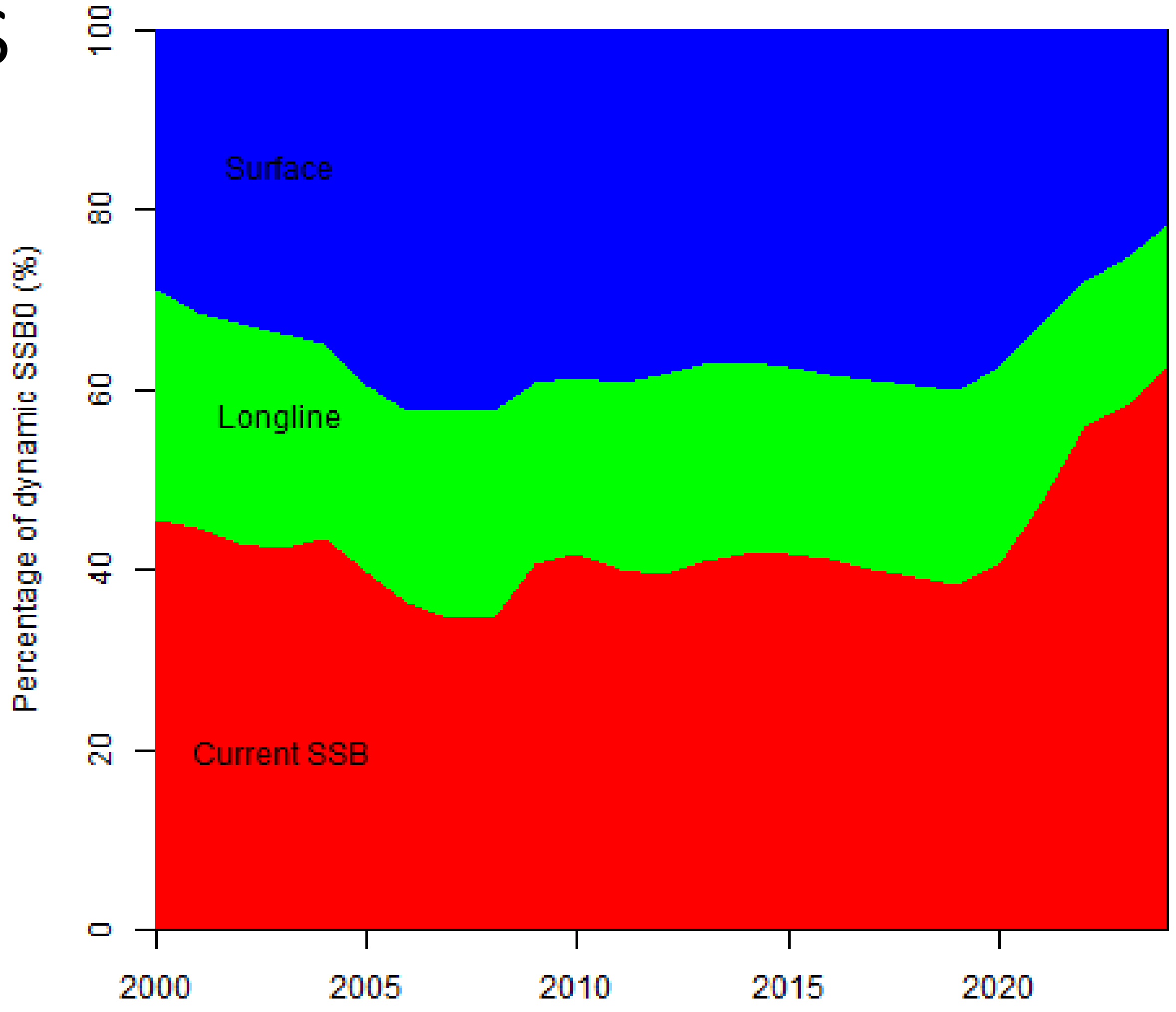
Fits to length comps.

- Flexible selectivity able to on average fit to the multiple modes



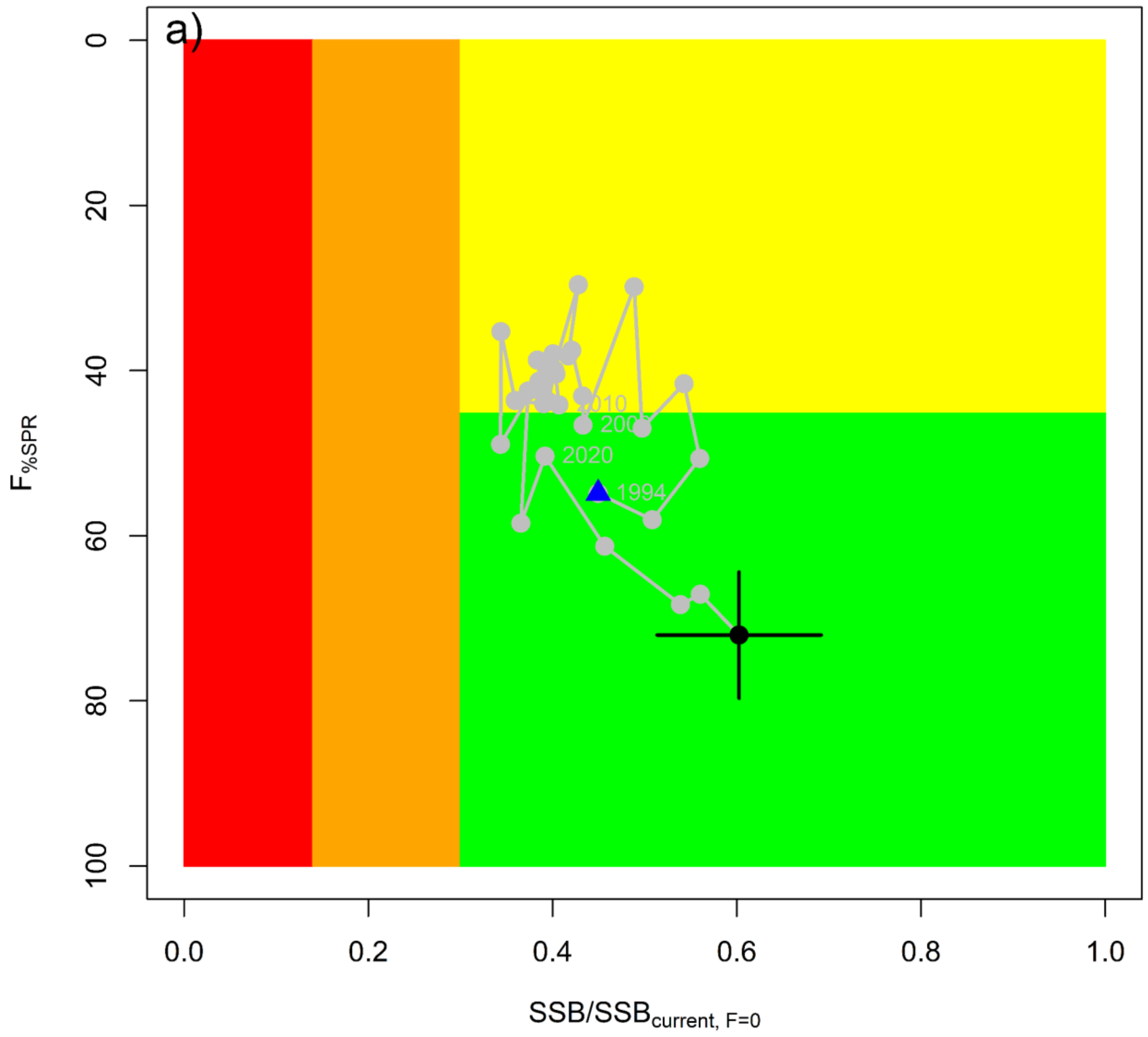
Fishery impact analysis

- SSB as a percentage of dynamic $\mathrm{SSB}_{current,F=0}$
- Relative proportion to surface (blue), longline (green)



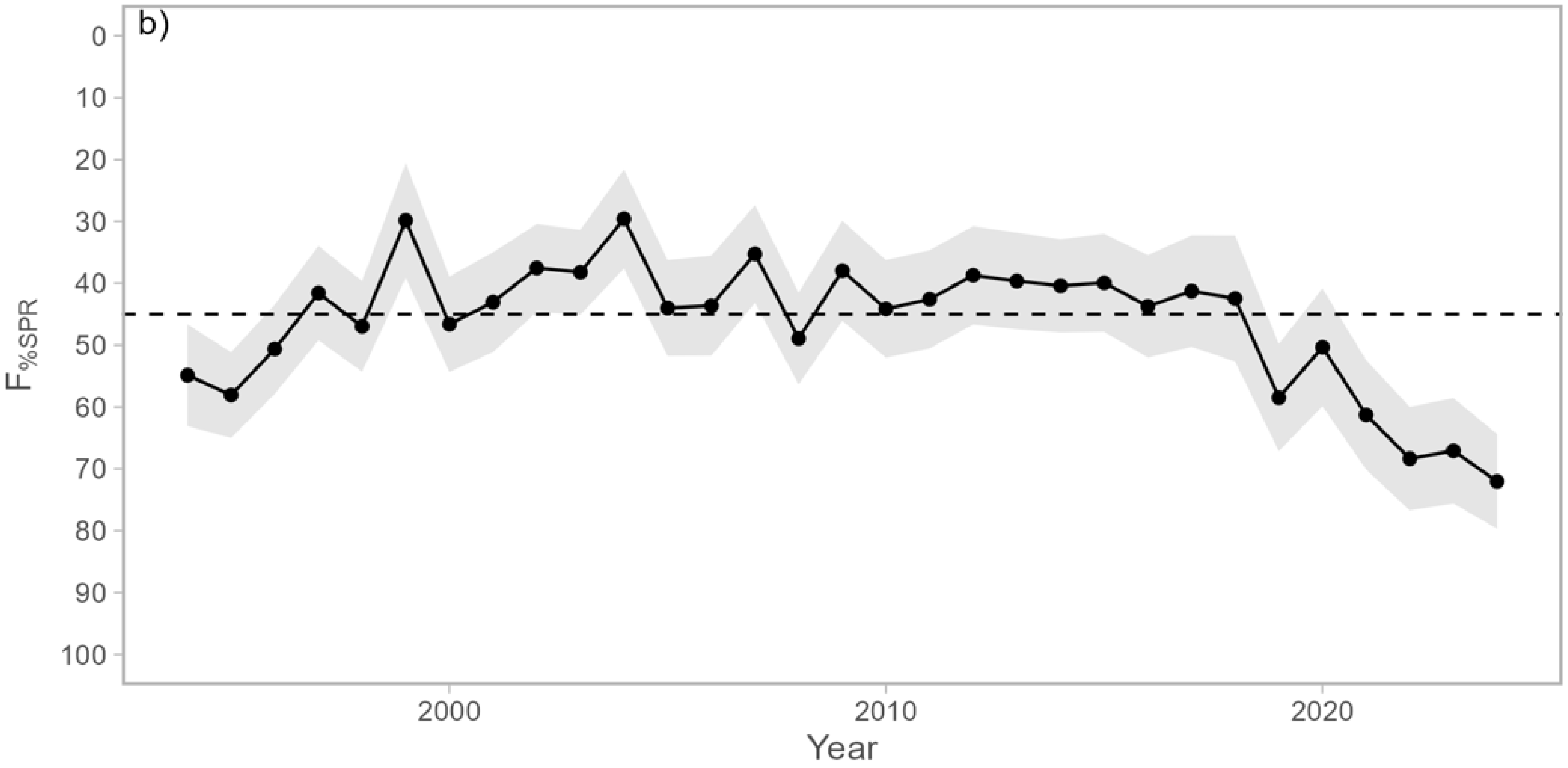
Stock status estimates

- Fishing intensity
  - Target: F45% (yellow)
- Biomass
  - Threshold: 30% $SSB_{current,\ F=0}$ (orange)
  - Limit: 14% $SSB_{current,\ F=0}$ (red)
- Acceptable levels of risk
  - <20% risk



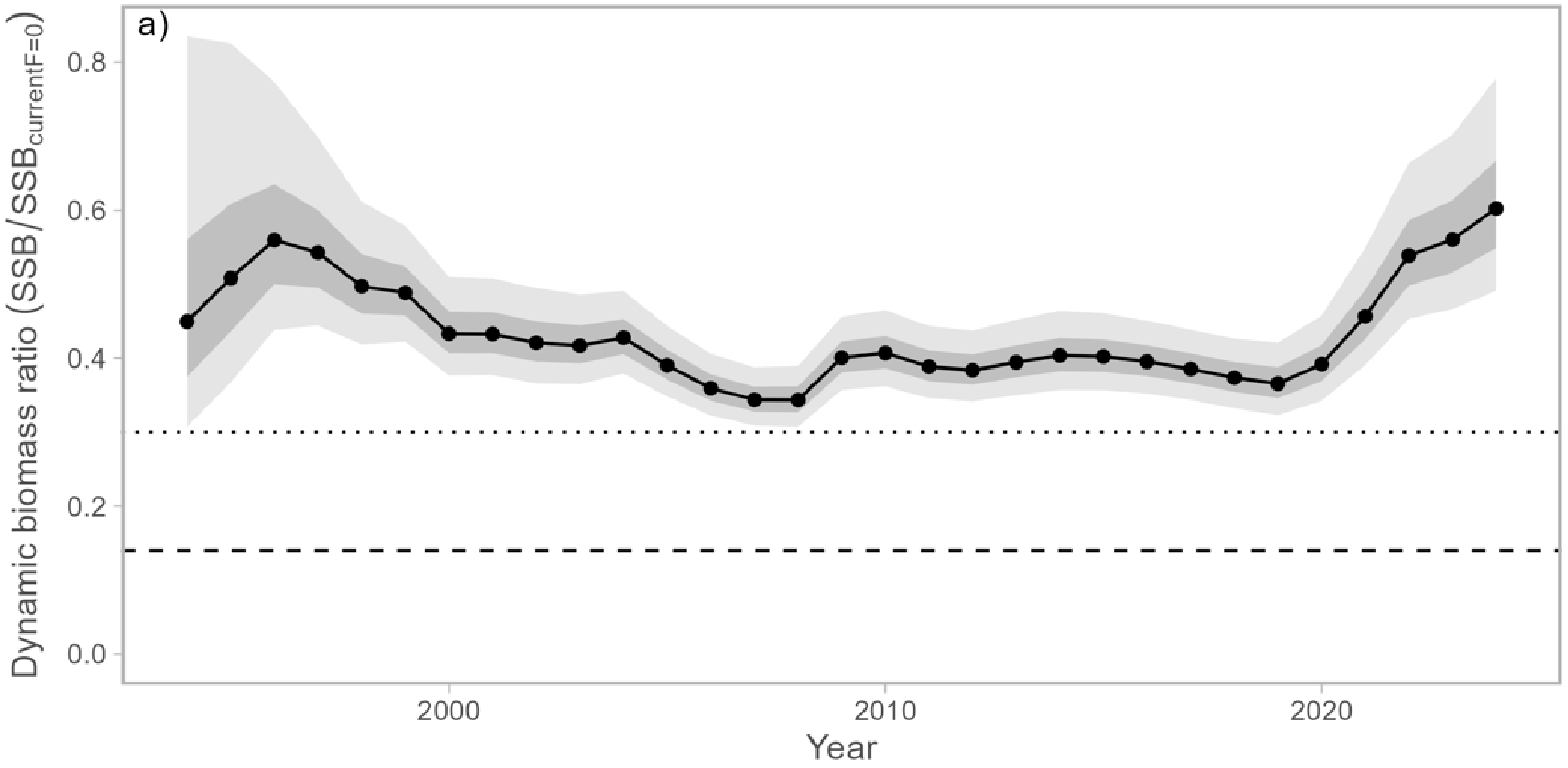
Estimated fishing intensity relative to target

- F45$_{\%SPR}$ target (dashed line)
- 1999-2018: most years above target
- 2019-2024: below target
- Preliminary population scale (R_0) estimate lower than in 2023 assessment

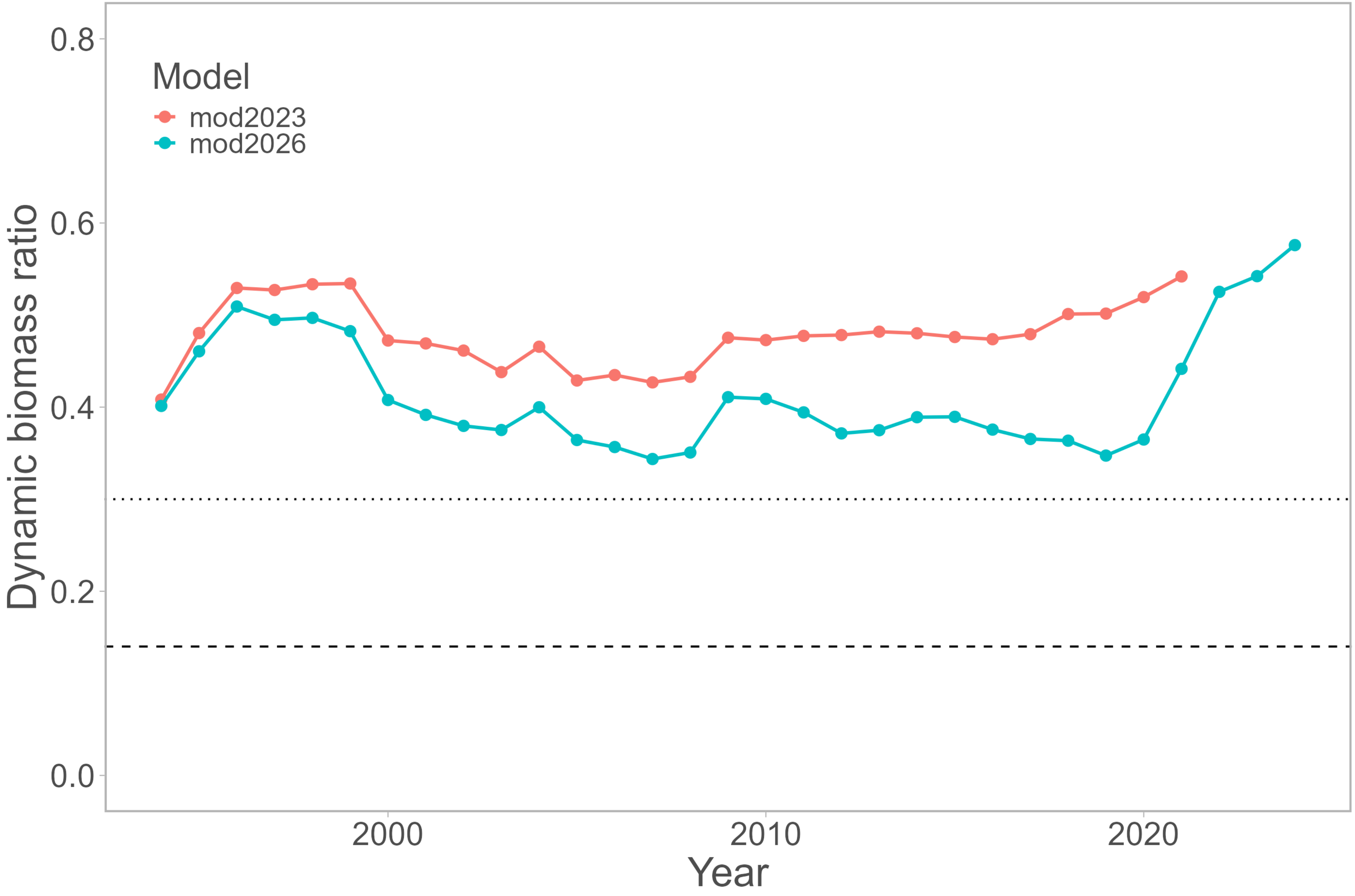


Estimated dynamic biomass ratio

- 30%$SSB_{current,F=0}$ threshold (dotted line)
- 14%$SSB_{current,F=0}$ threshold (dashed line)
- Biomass above both for the whole time period

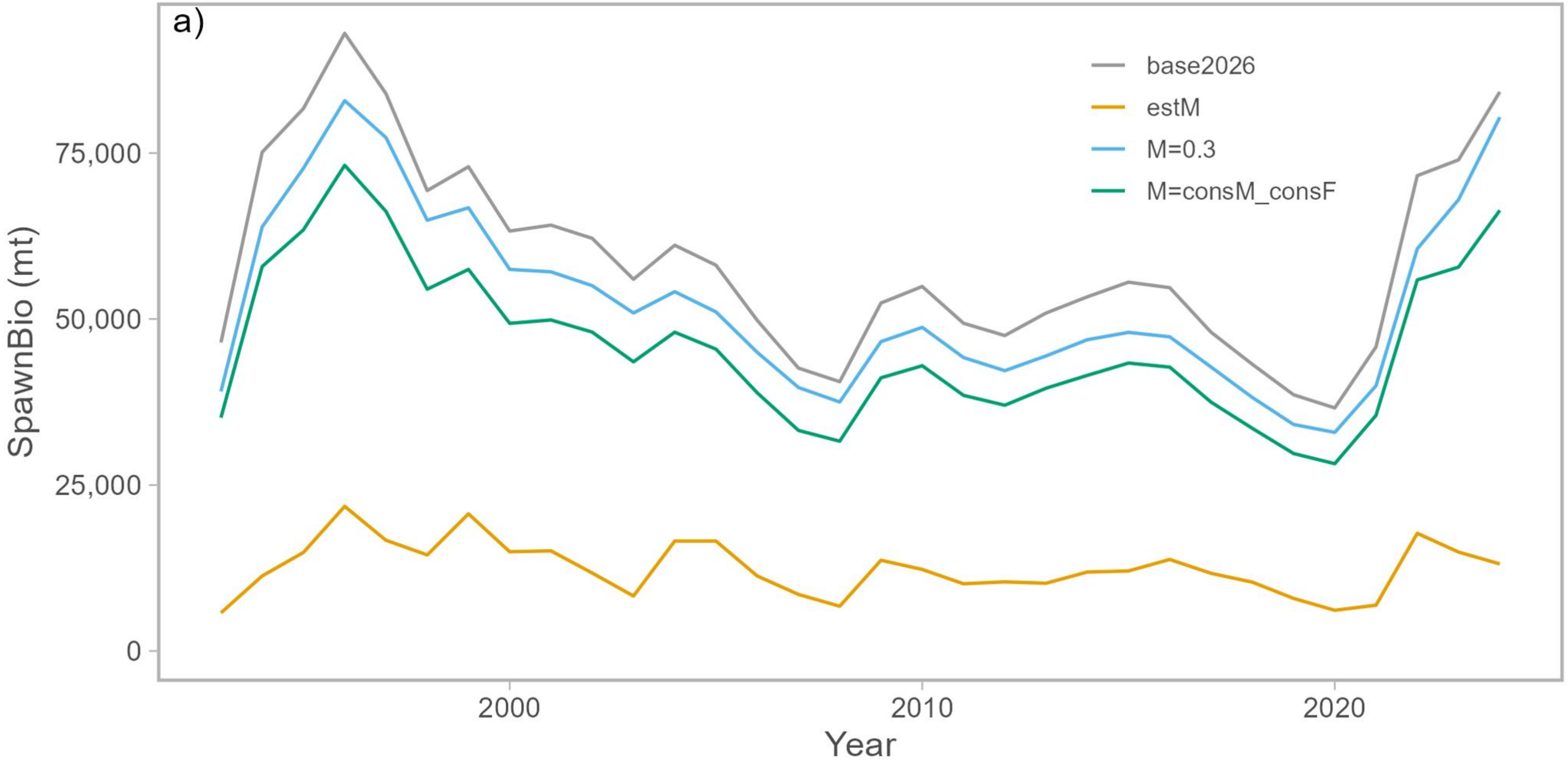


Comparison between 2023 and 2026 models

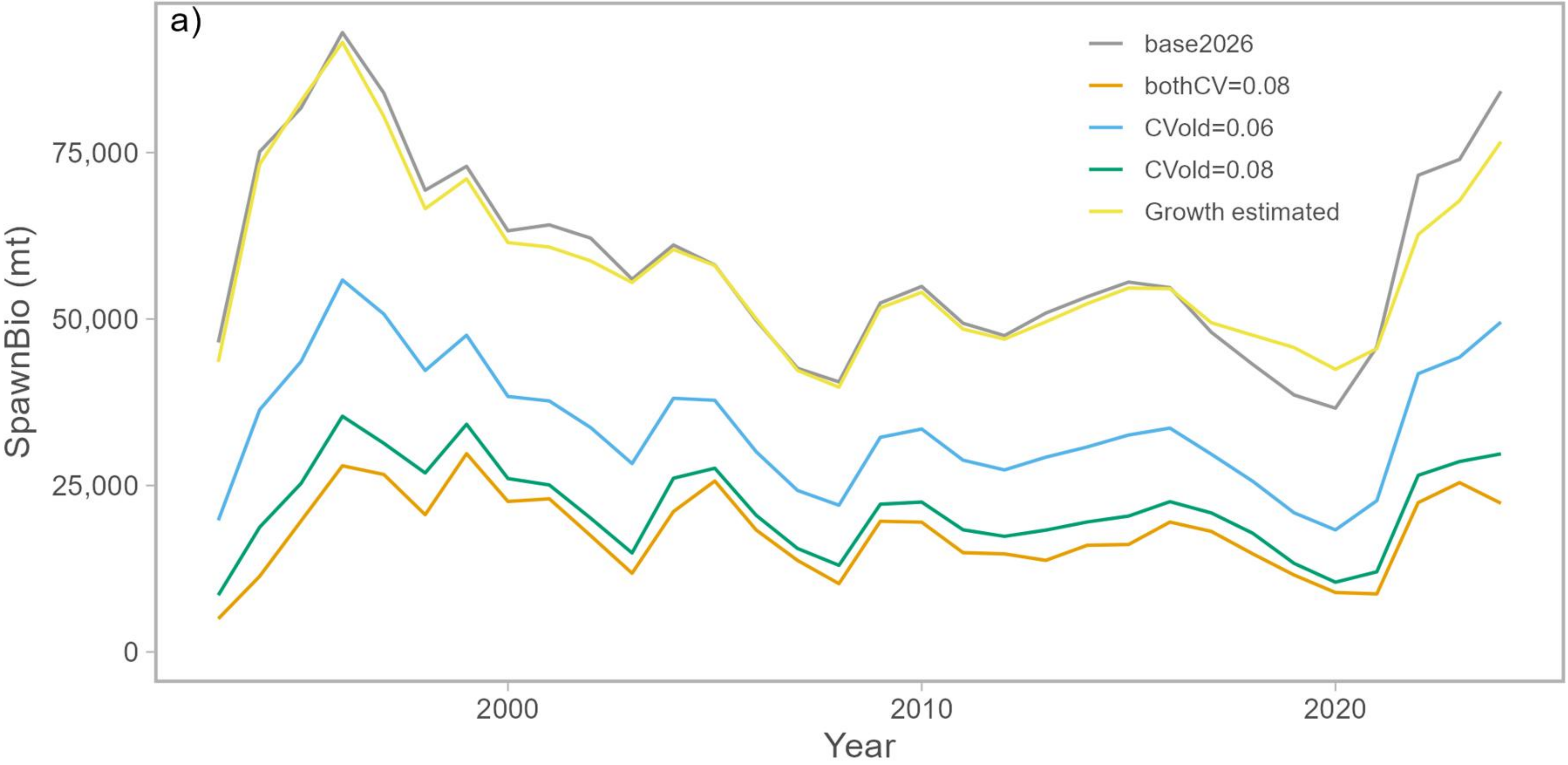


5. Sensitivities; natural mortality

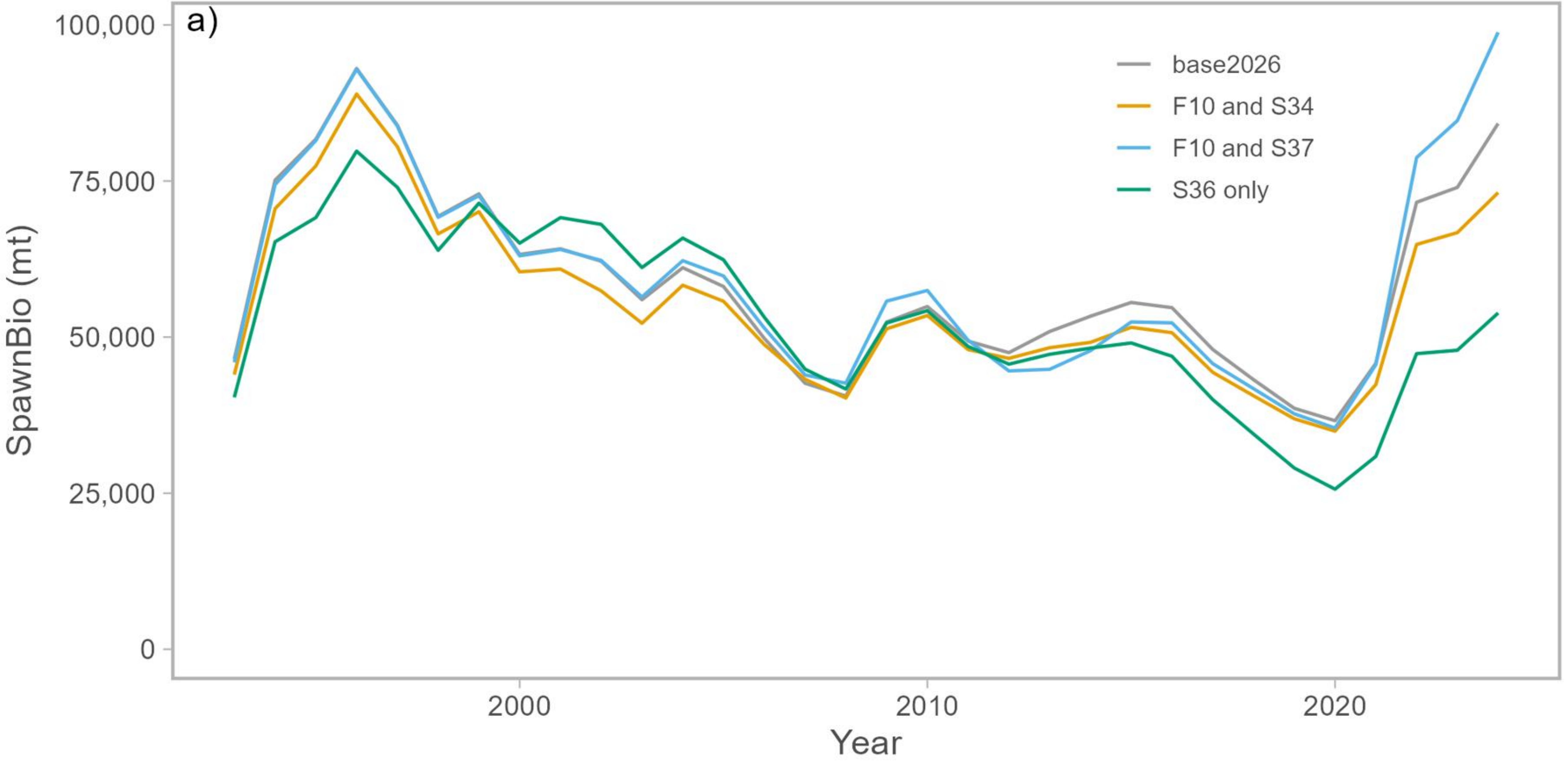
- Estimated (orange; no convergence)
- *M* = 0.3 (blue)
- Constant *M* for males (0.38) and females (0.49; green)



5. Sensitivities; growth parameters

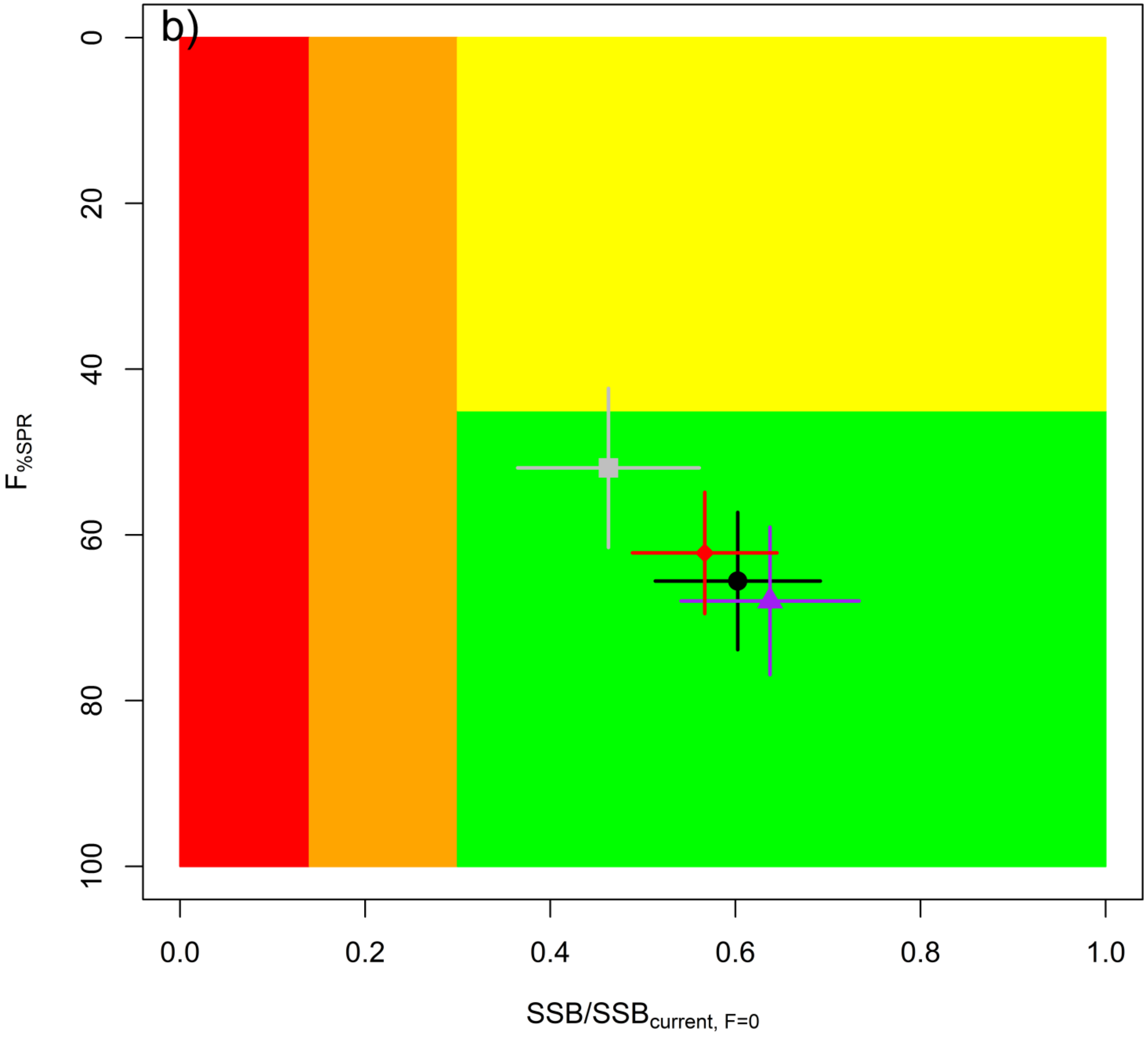


5. Sensitivities; indices of abundance



5. Sensitivities

- Increase CV of old fish 0.06 (gray)
- Estimate two initial fishing mortality values (red)
- Base model (black)
- Update 2023 assessment model with 2026 data (purple)
- All sensitivities in green area



5.1 Research recommendations

- Investigation of adult indices of abundance
  - S36, all-ISC area JPLL index considered likely primary index
    - No information on population scale based on ASPM
    - Size selectivity assumptions and synthetic size compositions for S36
- Continued investigation of candidate juvenile indices
- Growth
  - Revisit growth estimates external to assessment model
    - Sex-specific, conditional age-at-length data
  - Explore estimation of sex-specific growth internal to assessment

NPALB Harvest Strategy

Management Objectives

i. Maintain Spawning Stock Biomass (SSB) above the Limit Reference Point, with a probability of at least 80% over the next 10 years.

ii. Maintain depletion of total biomass around historical (2006-2015) average depletion over the next 10 years.

iii. Maintain fishing intensity (F) at or below the target reference point with a probability of at least 50% over the next 10 years.

iv. To the extent practicable, management changes (e.g., catch and/or effort) should be relatively gradual between years.

Reference Points

i. Target reference point (**TRP**) = $F_{45\%}$, which is the fishing intensity (F) level that results in the stock producing 45% of spawning potential ratio (SPR).

ii. Threshold reference point (**ThRP**) = $30\%SSB_{current,F=0}$, which is 30% of the dynamic unfished spawning stock biomass.

iii. Limit reference point (**LRP**) =$14\%SSB_{current,F=0}$, which is 14% of the dynamic unfished spawning stock biomass.

Western and Central Pacific Fisheries Commission

HARVEST STRATEGY FOR NORTH PACIFIC ALBACORE FISHERY

Harvest Strategy 2023-01

Introduction and scope

This Harvest Strategy, applicable to all fisheries that harvest North Pacific albacore, was developed based on the results of the Management Strategy Evaluation (MSE) completed by the International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean (ISC) in 2021.

INTER-AMERICAN TROPICAL TUNA COMMISSION

101st MEETING

Victoria, B.C., Canada
7-11 August 2023

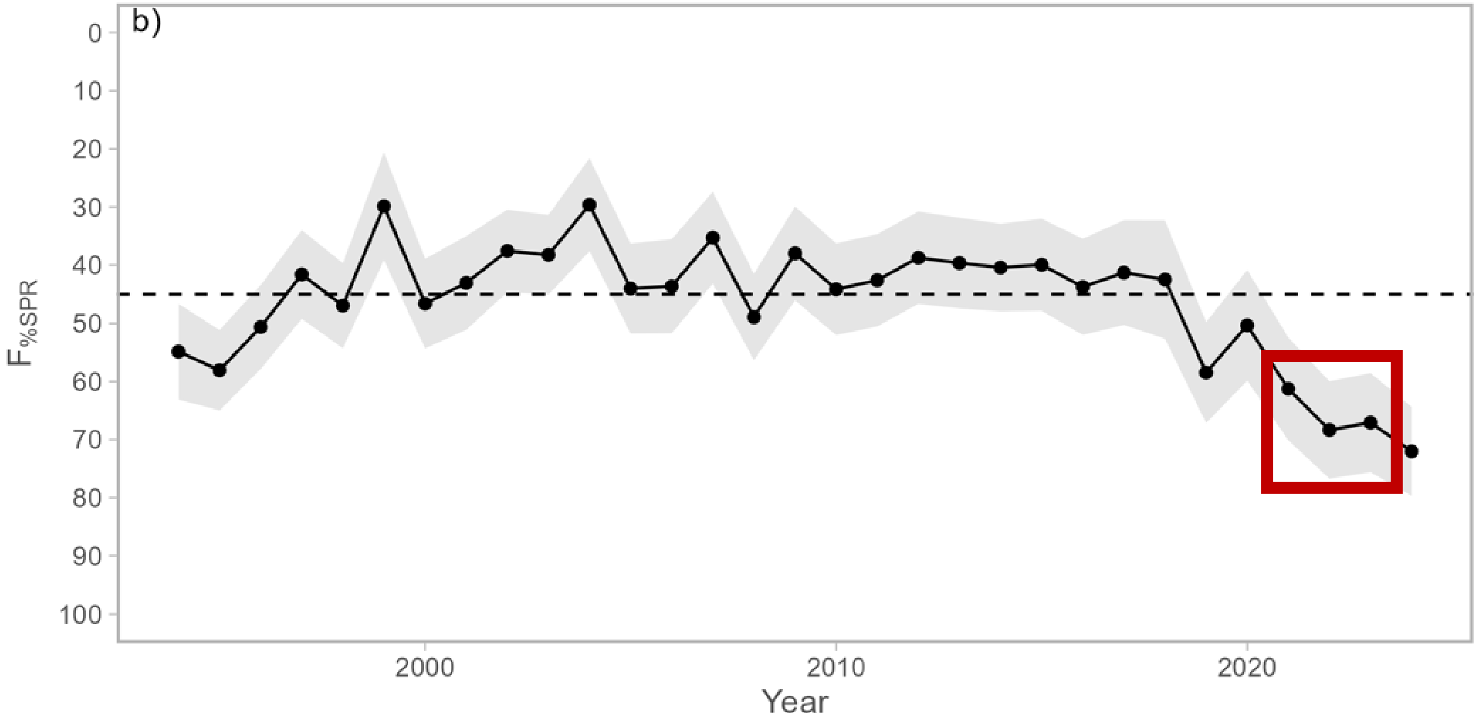
RESOLUTION C-23-02

AMENDMENT TO HARVEST STRATEGY FOR NORTH PACIFIC ALBACORE IN THE EASTERN PACIFIC OCEAN

The Inter-American Tropical Tuna Commission (IATTC), gathered in Victoria, Canada, on the occasion of its 101st Meeting:

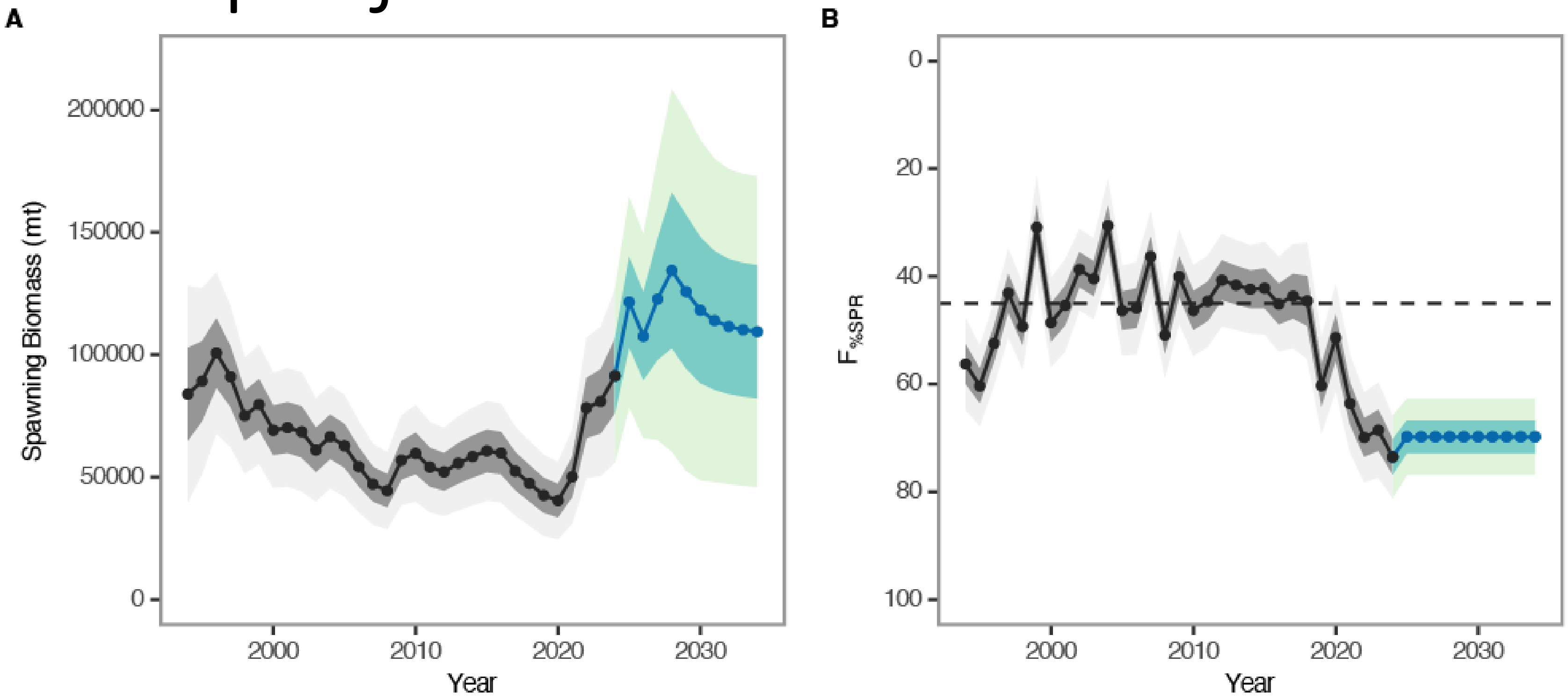
Recalling Resolutions C-05-02, C-13-03, and C-18-03 on North Pacific albacore tuna;

6. Future projections



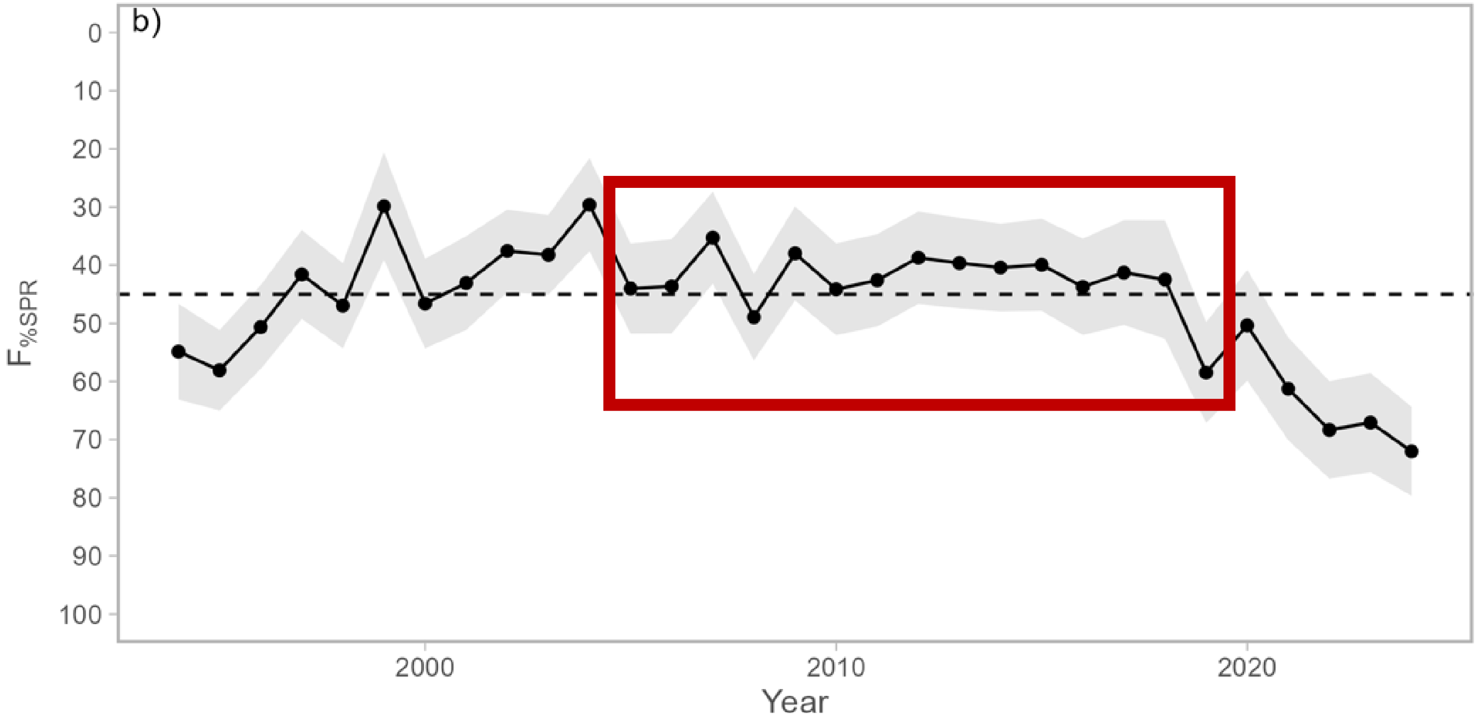
- Constant F Scenario
- Averaged 2021-2023 fishing intensity
- Projected 2025-2034

Future projections



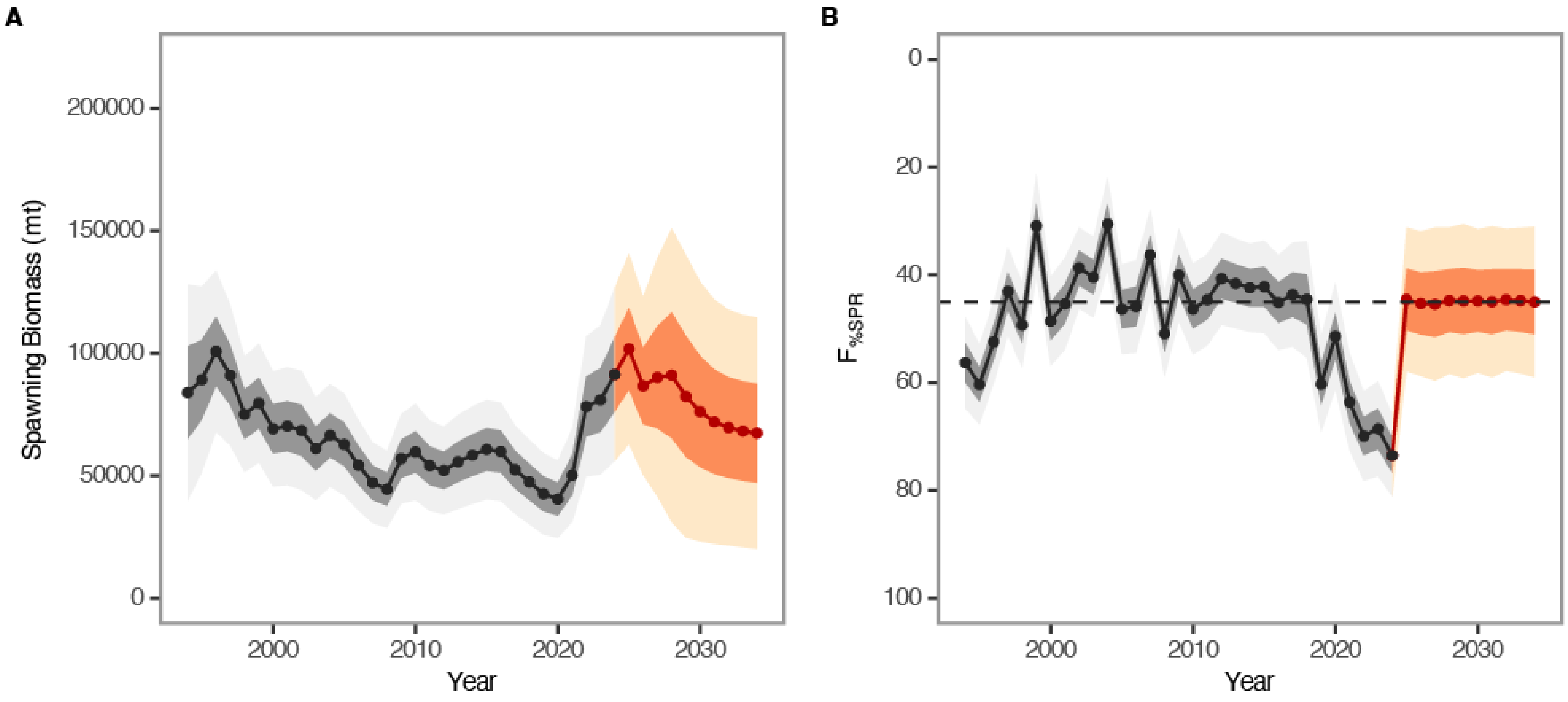
- Averaged 2021-2023 fishing intensity
- Female SSB increases to around 83% of $SSB_{current,F=0}$ by 2034
- 100% probability female SSB above $14\%SSB_{current,F=0}$
- 95.3% chance fishing intensity remains at or below $F45_{\%SPR}$

Future projections



- Randomly resampled fishing intensity scenario
- Sampled from 2005-2019 fishing intensity
- Projected 2025-2034

Future projections



- Randomly sampled 2005-2019 fishing intensity
- Female SSB increases to around 52% of $SSB_{current,F=0}$ by 2034
- 99.1% probability female SSB above $14\%SSB_{current,F=0}$
- 48.8% chance fishing intensity remains at or below $F45_{\%SPR}$

Stock Status - 2026

1. The stock is virtually certain to not be overfished relative to threshold ($30\%SSB_{current,F=0}$) and limit ($14\%SSB_{current,F=0}$) reference points adopted by the WCPFC and IATTC
2. The stock is virtually certain to not be experiencing overfishing relative to the target reference point ($F45_{\%SPR}$)

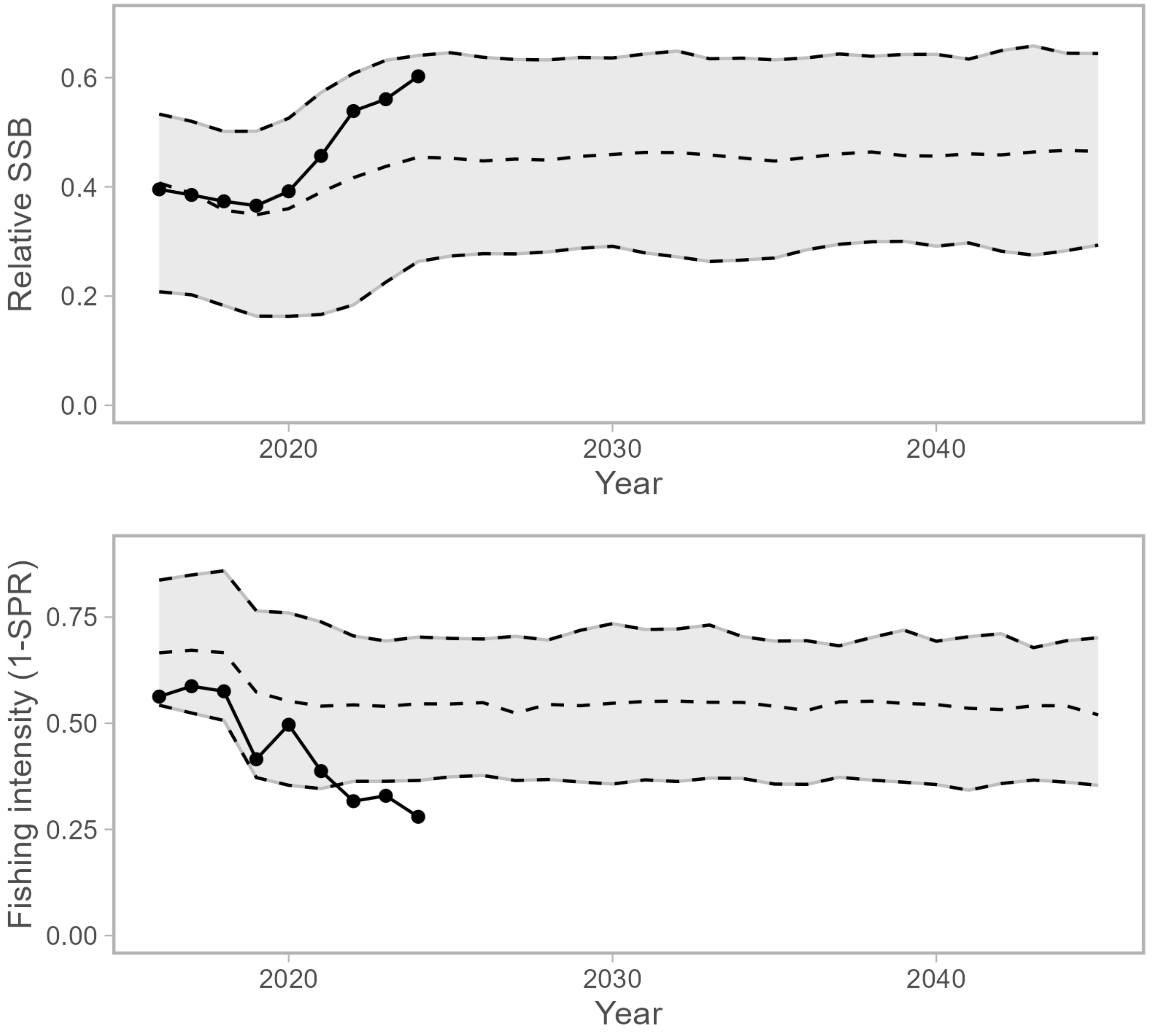
Conservation Information - 2026

1. If fishing intensity over the next 10 years is maintained at the current fishing intensity (F2021-2023), then female SSB is expected to increase to around 83% of $SSB_{current,F=0}$ (109,384 t) by 2034, with a 100.0% probability that female SSB will remain above the 14%$SSB_{current,F=0}$ LRP for all 10 years and the harvest strategy management objectives of the IATTC and WCPFC (IATTC Resolution C-23-02; WCPFC Harvest Strategy 2023-01) will likely be met; and

2. If fishing intensity over the next 10 years is similar to the 2005 – 2019 period, then female SSB is expected to decrease to around 52% of $SSB_{current,F=0}$ (67,340 t), with a 99.1 % probability that female SSB will remain above the 14%$SSB_{current,F=0}$ LRP for all 10 years and the harvest strategy management objectives of the IATTC and WCPFC (IATTC Resolution C-23-02; WCPFC Harvest Strategy 2023-01) will likely be met.

Exceptional Circumstances

- Warrant suspension or modification of current harvest strategies
- ALBWG evaluated adopted criteria for identifying exceptional circumstances
- No evidence that exceptional circumstances present with respect to conservation and management of the stock
- 2026 assessment results plotted relative to range of projections in 2021 MSE (90th percentiles)
- SSB relative to $SSB_{current,F=0}$



ISC26 Plenary

- ISC26 accepted the 2026 benchmark stock assessment as the best available science and supported the updated stock status and conservation information
- Discussions highlighted increasing biomass estimates since 2018, supported by several strong recruitment years and decreasing trends in total catch; however, caution should be used when interpreting magnitude of the biomass trends given the uncertainty in recruitment in terminal years
- ISC26 supported the evaluation of exceptional circumstances criteria and conclusion that there was no current evidence requiring suspension or modification of the harvest strategy
- Research recommendations were identified to investigate for the 2029 benchmark assessment