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Subject to change and approval by the ISC26 Plenary

**List of Acronyms**

| | |
|---|---|
| $14\%SSB_{current,\ F=0}$ | 14% of the current, dynamic SSB under zero fishing. Current limit reference point for North Pacific albacore tuna. |
| $30\%SSB_{current,\ F=0}$ | 30% of the current, dynamic SSB under zero fishing. Current threshold reference point for North Pacific albacore tuna. |
| ALBWG | Albacore Working Group of the ISC |
| ASPM | Age-structured production model, which is used for model diagnostics |
| ASPM-R | Age-structured production model with recruitment deviation estimates |
| CPUE | Catch-per-unit-effort |
| EPO | Eastern Pacific Ocean |
| IATTC | Inter-American Tropical Tuna Commission |
| ISC | International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (https://isc.fra.go.jp/) |
| F-at-age | Instantaneous fishing mortality at age |
| $F_{\%SPR}$ | Fishing intensity in %SPR |
| $F45_{\%SPR}$ | Fishing intensity that results in the population reaching an SPR of 45% at equilibrium. Current target reference point for North Pacific albacore tuna. |
| JPLL | Japan longline |
| JPPL | Japan pole-and-Line |
| MSY | Maximum Sustainable Yield |
| RFMO | Regional Fisheries Management Organization |
| SPR | Spawning Potential Ratio, which is the ratio of the equilibrium SSB per recruit that would result from an F-at-age relative to that of the unfished population. |
| SSB | Spawning Stock Biomass |
| USA | United States of America |
| WCPFC | Western and Central Pacific Fisheries Commission |
| WCPO | Western and Central Pacific Ocean |

# EXECUTIVE SUMMARY

**Stock Identification and Distribution:** For stock assessment purposes, North Pacific albacore tuna (*Thunnus alalunga*) are assumed to constitute a single stock distributed throughout the Pacific Ocean north of the equator to 55°N. The assessment incorporates all available fishery data from this area and uses a fleets-as-areas modeling approach. Population dynamics are represented under the assumption that there is instantaneous mixing of albacore across the modeled stock area on a quarterly time step, i.e., a single, well-mixed population with no explicit internal spatial structure.

**Major changes from the 2023 assessment:** There were four main changes to the base case model compared to the previous assessment in 2023. 1) The F10 JPLL index was recalculated with data from 1996-2024 and an expanded area that matched the spatial definitions in the stock assessment rather than that defined in the historical Japanese longline data. 2) Two JPLL fleets for juvenile and adult fleets (i.e., F1 and F2) in the 2023 assessment were combined into one fleet here (F1 in 2026 assessment) and modelled with time-varying age-based selectivity because having two fleets in the 2023 assessment did not improve fits to the size data and did not remove the need for time-varying selectivity. 3) Time-varying age-based selectivity was estimated with two-dimensional autoregressive selectivity patterns rather than assuming arbitrary time blocks, due to improved fits to length composition data and improved model stability. 4) Size composition data from China longline (CNLL) and Vanuatu longline (VULL) were included and fitted in this assessment. However, selectivity was only estimated for one CNLL fleet (CNLL Area 3 and 5), while CNLL Area 2 and 4 and VULL selectivities were mirrored to Taiwan longline (TWLL) selectivity. As a model sensitivity, the 2023 assessment model was updated with 2026 data (to the extent possible) to illustrate the impact of these structural changes (Table ES1).

**Catches:** During the modeling period (1994-2024), the total reported catch of north Pacific albacore reached a peak of about 119,000 t in 1999 and then declined since the early 2000s,  Catches since 2021 have been about 45,000 t, although catches in 2020 were roughly 75,000t (Fig. ES1). Surface gears (e.g., troll, pole-and-line), which primarily harvest juvenile albacore, have typically accounted for the majority of the albacore catch (Fig. ES2).

**Data and Assessment:** All north Pacific albacore catch and size composition data from ISC member (Canada, China, Chinese-Taipei, Japan, Korea, Mexico, and the USA) and non-member countries (e.g., Vanuatu, Kiribati) were compiled for the assessment. The fleet structure was similar to that of the 2020 assessment, which differs from the fleet structure in the 2023 assessment. Specifically, the 2023 assessment had JPLL fleets operating in Areas 1 and 3 (A13) during Quarter 1 (Q1) separated into juvenile and adult fleets. The 2026 assessment reverts to the 2020 fleet structure with just one fleet for JPLL A13 Q1. The fleet structure was revisited during the development process, as the fits to the length composition data were not notably improved when juveniles and adults were modeled separately. Four relative abundance indices (standardized CPUE) were provided by Japan, the USA, and Chinese-Taipei. Based on a thorough review of all fishery data and preliminary model runs, the ALBWG fitted the base case model to one abundance index: the standardized CPUE of the JPLL fleet operating in Area 2 during Quarter 2 (F10 index; 1996 – 2024). This index was chosen because it represented the best information on trends for adult age-classes of female albacore, had good contrast, and ASPM analyses indicated the index was informative on both population trends and scale. Previous assessments have used an index from the JPLL fleet in the same area but from Quarter 1, which is the primary albacore-targeting season. However, a re-examination of the data indicated that trends in the adult age-classes of female albacore were likely better represented by the CPUE in Quarter 2, which is also the primary spawning season.

The north Pacific albacore tuna stock was assessed using a length-based, age-, and sex-structured Stock Synthesis (SS; Version 3.30.24) model over the 1994-2024 period. Biological parameters like growth and natural mortality (M), were the same as for the 2017, 2020, and 2023 assessments. Sex-specific growth curves were used because of sexually dimorphic growth, with adult males attaining a larger size-at-age than females after maturity. Sex-specific M-at-age vectors were developed from a meta-analysis, with a sex-combined M that scaled with size for ages 0-2, and sex-specific M fixed at 0.48 and 0.39 $y^{-1}$ for age-3+ females and males, respectively. The steepness of the Beverton-Holt stock-recruitment relationship was assumed to be 0.9, based on two prior analyses. The base case model was fitted to the F10 index and all representative size composition data in a likelihood-based statistical framework.

All but one fleet (USA longline in Areas 2 and 4) were assumed to have dome-shaped length selectivity patterns. Some fleets had high year-to-year variability in the size composition data. For these fleets, age-based selectivity was estimated in addition to length-based selectivity. The goal was to account for age-based changes in juvenile albacore availability and movement. Time-varying age-based selectivities were estimated for four surface fleets (JPPL and EPO surface) in order to further improve fits to the size composition data. The base model converged on a maximum likelihood estimate with a positive, definite Hessian matrix and had good ASPM diagnostics.

Maximum likelihood estimates of model parameters, derived outputs, and their variances were used to characterize stock status. Several sensitivity analyses were conducted to evaluate changes in model performance or the range of uncertainty resulting from changes in model parameters, including growth, natural mortality, stock-recruitment steepness, selectivity patterns, and data weighting.

An ASPM diagnostic analysis showed that the estimated catch-at-age and fixed productivity parameters (growth, mortality and stock-recruitment relationships with and without annual recruitment deviates) were able to explain trends in the primary index. Based on these findings, the ALBWG concluded that the base case model was able to estimate the stock production function and the effect of fishing on the abundance of the north Pacific albacore stock. Similar to the 2020 and 2023 assessments, the link between catch-at-age and the primary index adds confidence to the data used and the results of the assessment. Due to the moderate exploitation levels relative to the productivity, the production function was weakly informative about north Pacific albacore stock size. It is important to note that the primary aim of estimating the female SSB in this assessment was to determine if the estimated SSB was lower than the adopted limit and threshold reference points. Since the lower bound is better defined, it adds confidence to the ALBWG's evaluation of stock condition relative to these reference points.

**Conservation and Management:** The WCPFC and IATTC are the tuna RFMOs that manage the north Pacific albacore stock in the WCPO and EPO, respectively, and have adopted similar harvest strategies and biological reference points for this stock (WCPFC HS 2022-01; IATTC Resolution C-22-04). These harvest strategies include target, threshold, and limit reference points. The target reference points are $F45_{\%SPR}$, which is the fishing intensity that results in the stock producing a SPR of approximately 45%. The threshold and limit reference points are $30\%SSB_{current,\ F=0}$ and $14\%SSB_{current,\ F=0}$, respectively, which are 30% and 14% of the current, dynamic SSB under zero fishing, and hence fluctuates with changes in recruitment. Importantly, three of the management objectives in the harvest strategies are to: 1) maintain SSB above the limit reference point, with a probability of at least 80% over the next 10 years; 2) maintain depletion of total biomass around historical (2006 – 2015) average depletion over the next 10 years; and 3) maintain fishing intensity at or below the target reference point with a probability of at least 50% over the next 10 years. In addition, both

RFMOs have current management measures (WCPFC CMM 2019-03; IATTC Resolution C-05-02) that maintain albacore fishing effort at or below the average effort levels during 2002 – 2004.

**Stock Status**: Estimated summary biomass (males and females at age-1+) declined at the beginning of the time series until 2004 (Fig. ES3A). Subsequently, the summary biomass fluctuated without a trend until 2018, after which the biomass increased to values higher than those at the beginning of the model time period. It should be noted that the high summary biomass estimates since 2018 also had increasing uncertainty (Fig. ES3A). These high summary biomass estimates were due to historically high recruitment estimates in 2017 (~297 million fish; 95% CI: 215– 381million fish), 2019 (~292 million fish; 95% CI: 187 to 396 million fish), and 2022 (~314 million fish; 95% CI: 93-536 million fish) (Fig. ES3C). However, it should be noted that the recruitment estimates in the last 5 years (2020-2024) were highly uncertain and should be treated with caution. Estimated female SSB exhibited a similar population trend to the summary biomass, albeit with a lag of several years, and showed an initial decline until 2007 followed by fluctuations without a clear trend through 2020 (Fig. ES3B).

The average fishing intensity during 2021 – 2023 was estimated to be $F66_{\%SPR}$ (95% CI: $F74_{\%SPR}$ – $F57_{\%SPR}$), which was relatively moderate and resulted in a population with an SPR of approximately 66%. Instantaneous fishing mortality at age (F-at-age) was similar in both sexes through age-5, peaking at age-4 and declining to a low at age-6, after which males experienced higher F-at-age than females up to age 14 (Fig. ES4). Juvenile albacore aged 2 to 4 years comprised approximately 76% of the annual catch-at-age in numbers between 1994 and 2024 (Fig. ES5) due to the larger fishery impact of surface fisheries (primarily troll, pole-and-line), which remove juvenile fish, relative to longline fisheries, which primarily remove adult fish (Fig. ES6).

Stock status is depicted in relation to the target ($F45_{\%SPR,}$), threshold ($30\%SSB_{current,\ F=0}$), and limit ($14\%SSB_{current,\ F=0}$) reference points (Fig. ES7A; Table ES1). The estimated female SSB has never fallen below the threshold and limit reference points since 1994, albeit with large uncertainty in the terminal year (2024) estimates. The historical fishing intensity was estimated to have exceeded the target reference point for most years between 1997-2018. However, the estimated fishing intensity has been declining since 2019 and has been below the target reference point for the last six years. Even when alternative hypotheses about key model uncertainties such as growth were evaluated, the point estimate of female SSB in 2024 ($SSB_{2024}$) did not fall below the threshold and limit reference points (Fig. ES7B). Estimated average fishing intensity during 2021-2023 ($F_{2021\text{-}2023}$) did not exceed the target reference point under the alternative hypotheses. (Fig. ES7B; Table ES1). Average fishing intensity from 2021-2023 also did not exceed the average fishing intensity during 2002-2004 (Table ES1).

The $SSB_{2024}$ was estimated to be approximately 60% (95% CI: 38 – 83%) of $SSB_{current,\ F=0}$ and 2.01 (95% CI: 1.26 – 2.76) times greater than the estimated threshold reference point (Table ES1). The estimated current fishing intensity ($F_{2021\text{-}2023}$) was estimated to be $F66_{\%SPR}$ (95% CI: $F74_{\%SPR}$ – $F57_{\%SPR}$) and was lower than both the $F45_{\%SPR}$ target reference point and the average fishing intensity during 2002 – 2004 (Table ES1).

Based on these findings, the following information on the status of the north Pacific albacore stock is provided:

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

**Future Projections**: A new version of the SSfuture C++software package (ssfcpp version 2.0.4) was developed to perform future projections for this assessment. Two 10-yr projection scenarios, constant F2021-2023 and randomly resampled F2005-2019 scenarios, were used to evaluate the impacts of fishing on the management objectives of IATTC and WCPFC. Each projection scenario consisted of 160,000 (400 x 400) runs, starting in 2025 and continuing for 10 years through 2034. For each scenario, 400 initial populations, together with their stock-recruitment relationships, were simulated by sampling from the estimated N-at-age distributions in 2021. Each initial population was in turn projected using 400 runs with an F-at-age and random recruitment. Most of the uncertainties from the base case model, except for estimation uncertainties of the selectivities and recruitment deviates, were incorporated into the projections. The ALBWG considered these projections to be an improvement over projections from previous assessments but more improvements will still be needed in the future. Depending on the scenario, the F-at-age used was either based on the average F-at-age during 2021 – 2023, or randomly resampled from 2005 – 2019. Both projection scenarios showed similar trends. The constant fishing intensity scenario showed that the current fishing intensity (F2021-2023) is expected to result in female SSB increasing to 109,384 t (95% CI: 82,915–136,573 t) by 2034. Over the next 10 years, there was: 1) a 100.0% probability of the female SSB remaining above the $14\%SSB_{current, F=0}$ LRP for all 10 years; 2) a 86.5% probability of the total biomass (age-1+) being above the average of 2006 – 2015 for any year; and 3) a 95.3% probability of the fishing intensity remaining at or below the $F45_{\%SPR}$ TRP for any year (Fig. ES9). Similarly, the randomly resampled fishing intensity scenario showed that if future fishing intensity is similar to the 2005 – 2019 period, it is expected to result in female SSB increasing to 67,340 t (95% CI: 47,082 – 87,597 t) by 2034. Over the next 10 years, there was: 1) a 99.1 % probability of the female SSB remaining above the $14\%SSB_{current, F=0}$ LRP for all 10 years; 2) a 79.9 % probability of the total biomass (age-1+) being above the average of 2006 – 2015 for any year; and 3) a 48.8% probability of the fishing intensity remaining at or below the $F45_{\%SPR}$ TRP for any year (Fig. ES10).

**Conservation Information:** Two harvest scenarios were projected to evaluate impacts on the management objectives of IATTC and WCPFC for this stock: 1) maintain SSB above the limit reference point, with a probability of at least 80% over the next 10 years; 2) maintain depletion of total biomass around historical (2006 – 2015) average depletion over the next 10 years; and 3) maintain fishing intensity at or below the target reference point with a probability of at least 50% over the next 10 years (WCPFC HS 2023-01; IATTC Resolution C-23-02). As a larger cohort is estimated in the latest period of the assessment, all projections show a steep increase of SSB in the first year.

The constant fishing intensity scenario showed that the current fishing intensity (F2021-2023) is expected to result in female SSB increasing to 109,384 t (95% CI: 82,915 – 136,573 t) and a $SSB/SSB_{current, F=0}$ ratio of 0.83 by 2034. Over the next 10 years, there was: 1) a 100.0% probability of the female SSB remaining above the $14\%SSB_{current, F=0}$ LRP for all 10 years; 2) a 86.5% probability of the total biomass (age-1+) being above the average of 2006 – 2015 for any year; and 3) a 95.3% probability of the fishing intensity remaining at or below the $F45_{\%SPR}$ TRP for any year. The randomly resampled fishing intensity scenario showed that if future fishing intensity is similar to the 2005 – 2019 period, it is expected to result in female SSB increasing to 67,340 t (95% CI: 47,082 – 87,597 t) and a $SSB/SSB_{current, F=0}$ ratio of 0.52 by 2034. Over the next 10 years, there was: 1) a 99.1 % probability of the female SSB remaining above the $14\%SSB_{current, F=0}$ LRP for all 10 years; 2) a 79.9 % probability of the total biomass (age-1+) being above the average of 2006 – 2015 for any year; and 3) a 48.8% probability of the fishing intensity remaining at or below the $F45_{\%SPR}$ TRP for any year.

Based on these findings, the following conservation information is provided:

1. If fishing intensity over the next 10 years is maintained at the current fishing intensity ($F_{2021-2023}$), 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) by 2034, 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.

**Key Uncertainties**: The ALBWG notes that the uncertainty in growth and natural mortality and the simplified treatment of the spatial structure of north Pacific albacore population dynamics are important sources of uncertainty in the assessment.

**Exceptional Circumstances**: The adopted harvest strategies of the WCPFC and IATTC for North Pacific albacore tuna include provisions for the identification and evaluation of exceptional circumstances that may warrant suspension or modification of the current strategies. Consistent with this requirement, the ALBWG evaluated the adopted criteria for identifying exceptional circumstances for North Pacific albacore tuna, including indicators related to stock and fleet dynamics, application of the stock assessment, and implementation of management measures. Based on the information available and the evaluation criteria, the ALBWG found no evidence to indicate that exceptional circumstances were present with respect to the conservation and management of the stock.

**Table ES1**. Estimates of maximum sustainable yield (MSY), female spawning stock biomass (SSB), fishing intensity (F), and reference point ratios for north Pacific albacore tuna for: 1) the base case model; 2) one important sensitivity model due to uncertainty in growth parameters; 3) a model representing an update of the 2023 base case model to 2026 data; and 4) a model representing uncertainty in the specification of initial fishing mortality. $SSB_0$, $SSB_{current, F=0}$ and $SSB_{MSY}$ are the expected female SSB of a population in the equilibrium, unfished state; in the current, dynamic, unfished state; and at MSY, respectively. The Fs in this table are indicators of fishing intensity based on spawning potential ratio (SPR) and calculated as %SPR. SPR is the ratio of the equilibrium SSB per recruit that would result from the estimated F-at-age relative to that of an unfished population. Depletion is calculated as the proportion of the age-1+ biomass during the specified period relative to an unfished age-1+ equilibrium biomass. The model representing an update of the 2023 base case model is similar to but not identical to the 2026 base case model due to changes in data preparation and model structure. †A value of >1 for the depletion ratio indicates higher age-1+ biomass in 2024 relative to the 2006 – 2015 period. §Higher %SPR values indicate lower fishing intensity levels. ¶Values of >1 for ratios of $F_{\%SPR}$ to $F_{\%SPR}$-based reference points indicate fishing intensity levels lower than the reference points.

| Quantity | Base Case | Growth CVold = 0.06 | Update of 2023 base case model to 2026 data | Initial Conditions initF F20 F24 |
|---|---|---|---|---|
| MSY (t) | 106,578 | 86,675 | 113,793 | 100,322 |
| $SSB_{MSY}$ (t) | 19,360 | 15,878 | 20,524 | 18,316 |
| $SSB_0$ (t) | 139,466 | 113,685 | 147,874 | 131,221 |
| $SSB_{2024}$ (t) | 84,209 | 49,547 | 96,362 | 73,236 |
| $SSB_{current, F=0}$ (2024 estimate) | 139,777 | 107,072 | 151,193 | 129,224 |
| $SSB_{2024}/SSB_{current, F=0}$ | 0.60 | 0.46 | 0.64 | 0.57 |
| $SSB_{2024}/30\%SSB_{current, F=0}$ | 2.01 | 1.54 | 2.12 | 1.89 |
| $SSB_{2024}/14\%SSB_{current, F=0}$ | 4.30 | 3.31 | 4.55 | 4.05 |
| † $Depletion_{2024}/Depletion_{2006-2015}$ | 1.45 | 1.40 | 1.61 | 1.45 |
| § $F_{\%SPR, 2021-2023}$ (%SPR) | 65.6 | 51.9 | 68.0 | 62.2 |
| § $F_{\%SPR, 2013-2023}$ (%SPR) | 50.3 | 36.7 | 53.6 | 46.6 |
| ¶ $F_{\%SPR, 2021-2023}/F_{\%SPR, MSY}$ | 4.03 | 3.17 | 4.18 | 3.80 |
| ¶ $F_{\%SPR, 2013-2023}/F45_{\%SPR}$ | 1.12 | 0.82 | 1.19 | 1.04 |
| ¶ $F_{\%SPR, 2021-2023}/F45_{\%SPR}$ | 1.46 | 1.15 | 1.51 | 1.38 |
| ¶ $F_{\%SPR, 2021-2023}/F_{\%SPR, 2002-2004}$ | 1.87 | 2.13 | 1.78 | 1.95 |

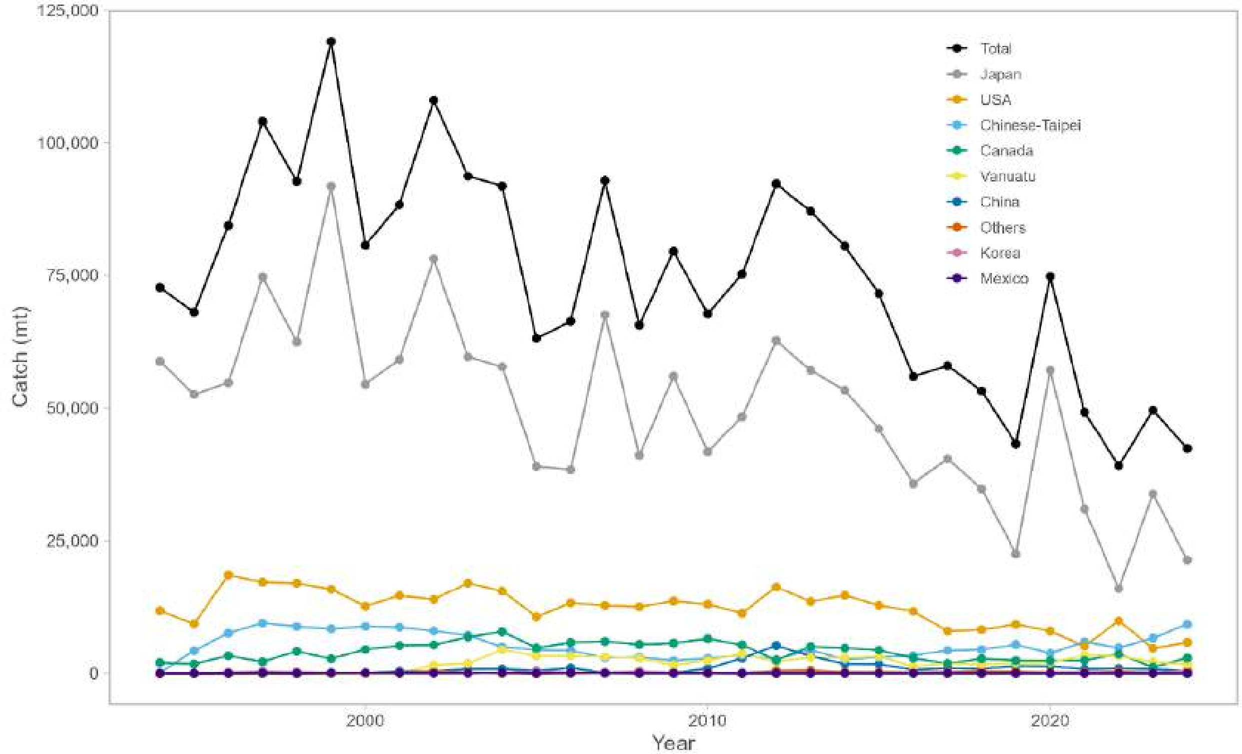


**Figure ES1.** Estimated total annual catch of north Pacific albacore (*Thunnus alalunga*) by all countries harvesting the stock, 1994-2024. Catches in the "Others" categories includes small amount of catch by other countries such as Kiribati, Belize, Panama, and Marshall Islands.

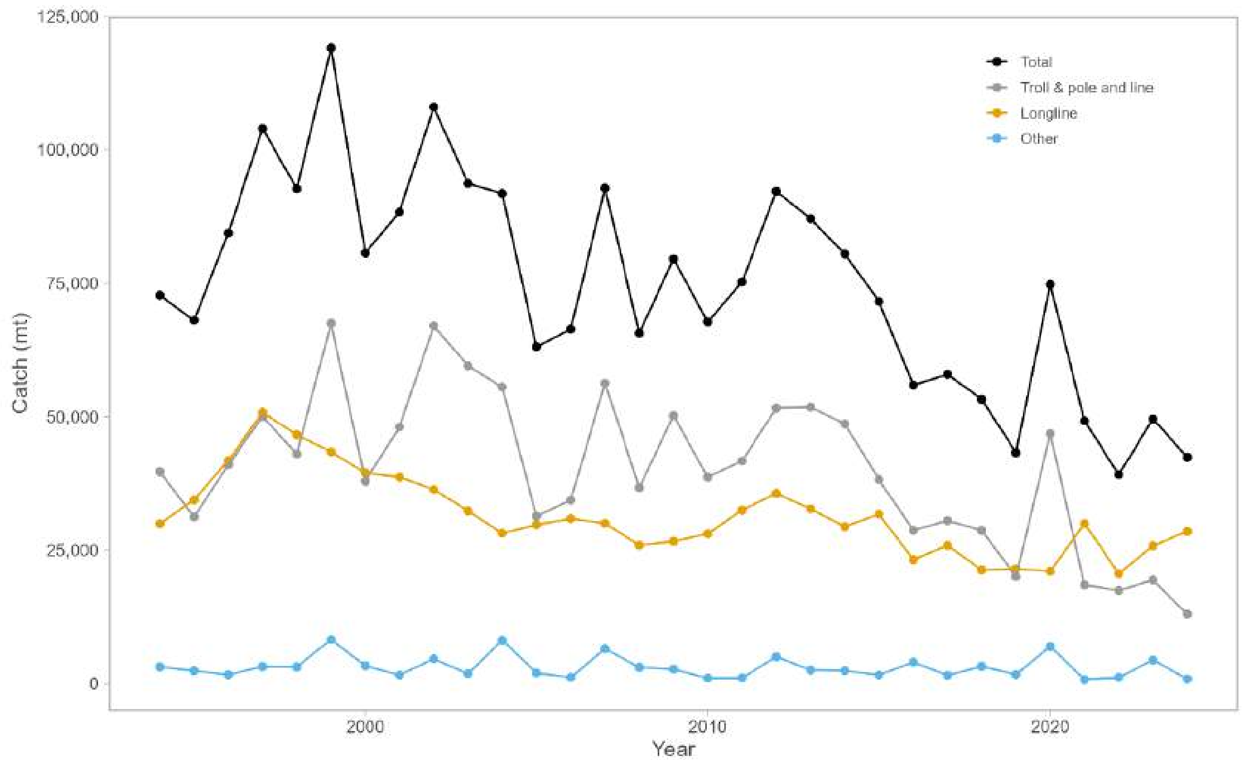


**Figure ES2.** Estimated catches of north Pacific albacore (*Thunnus alalunga*) by major gear types, 1994-2024. The Other gear category includes catches with purse seine, gillnet, hand lines, and harpoons.

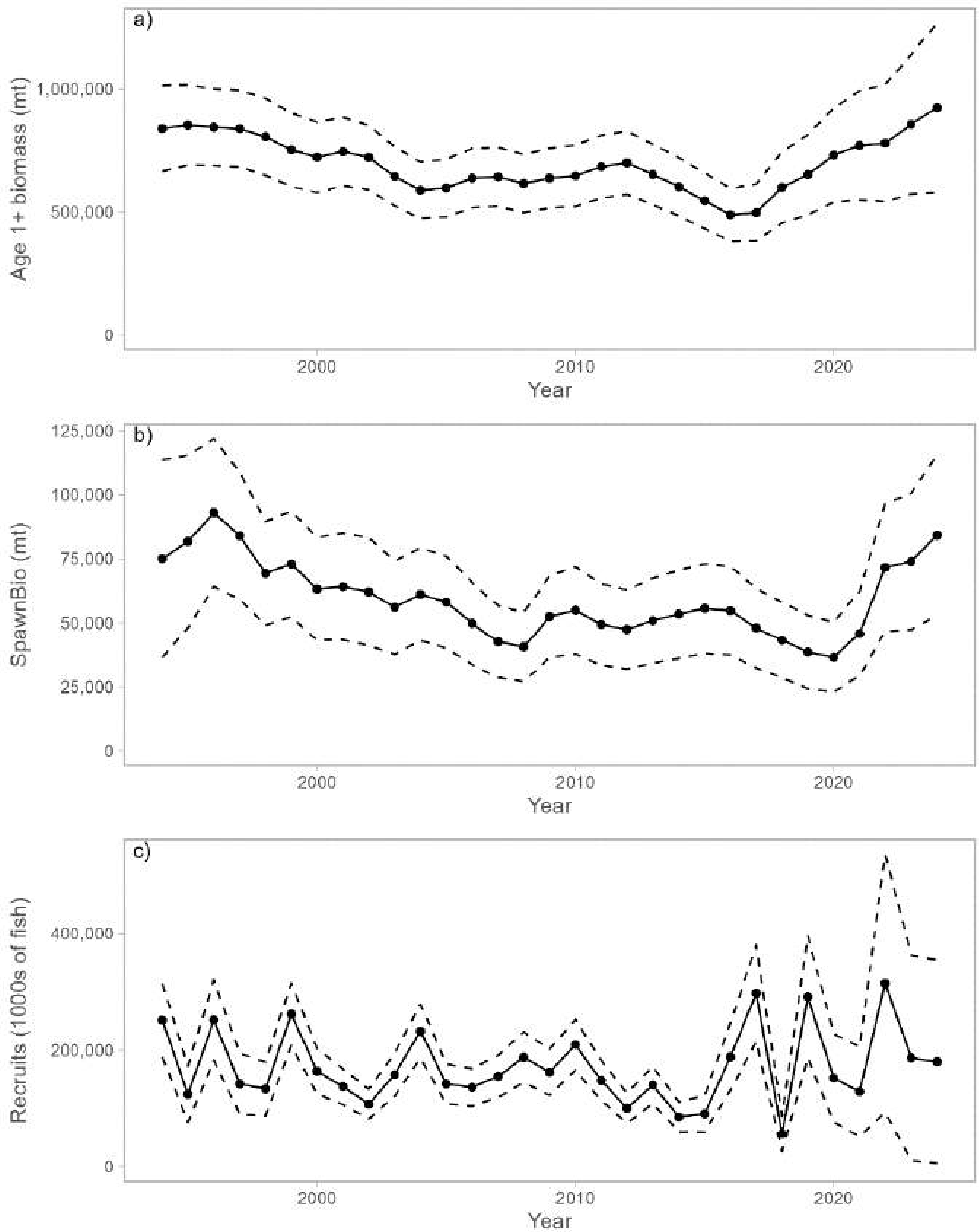


**Figure ES3.** Maximum likelihood estimates of (A) age-1+ biomass (B), female spawning biomass (SSB), and (C) age-0 recruitment of north Pacific albacore tuna (*Thunnus alalunga*). Dashed lines indicate 95% confidence intervals.

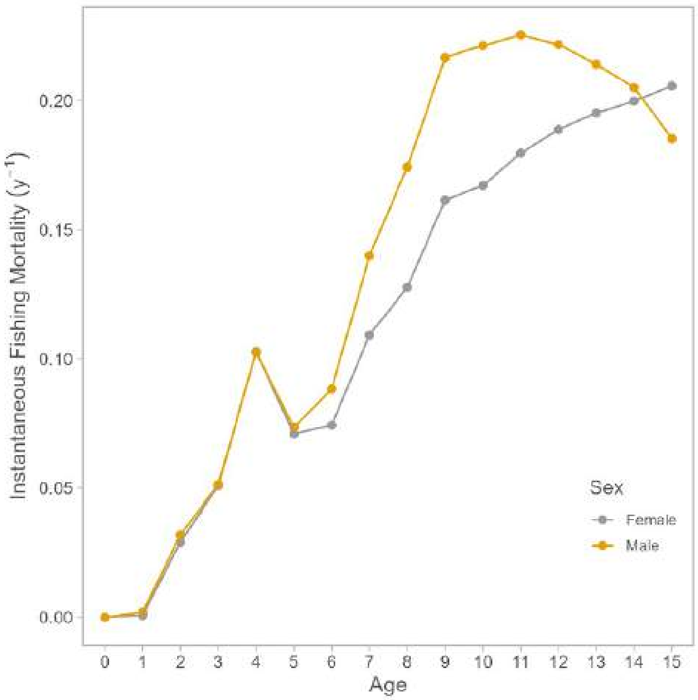


**Figure ES4.** Estimated sex-specific instantaneous fishing mortality-at-age (F-at-age) for the 2026 base case model, averaged across 2021-2023.

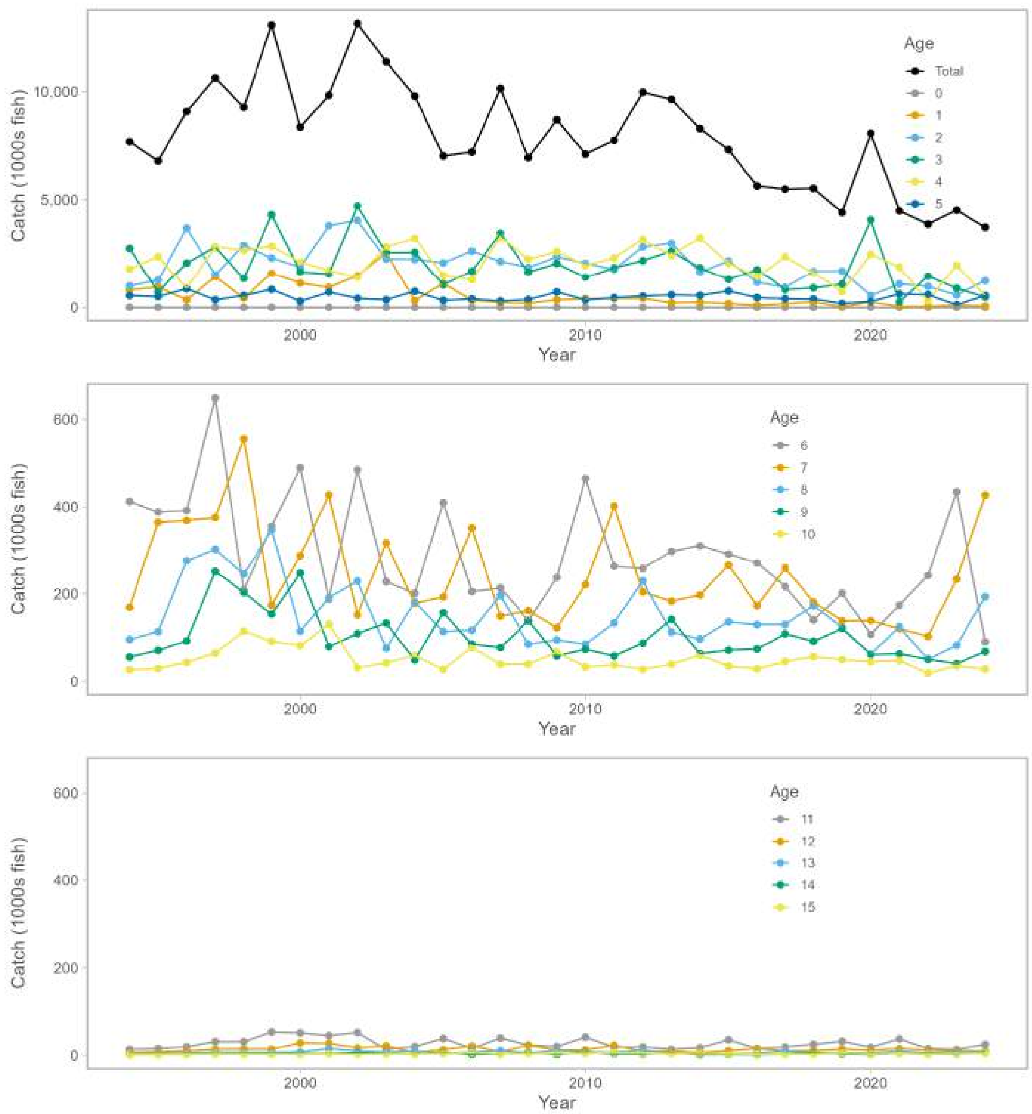


**Figure ES5.** Historical catch-at-age of north Pacific albacore (*Thunnus alalunga*) estimated by the 2026 base case model. Panels are arranged for the total catch and ages 0-5 (top), 6-10 (middle), and 11-15 (bottom). Note the difference in y-axis scale between the top panel and middle and bottom panels.

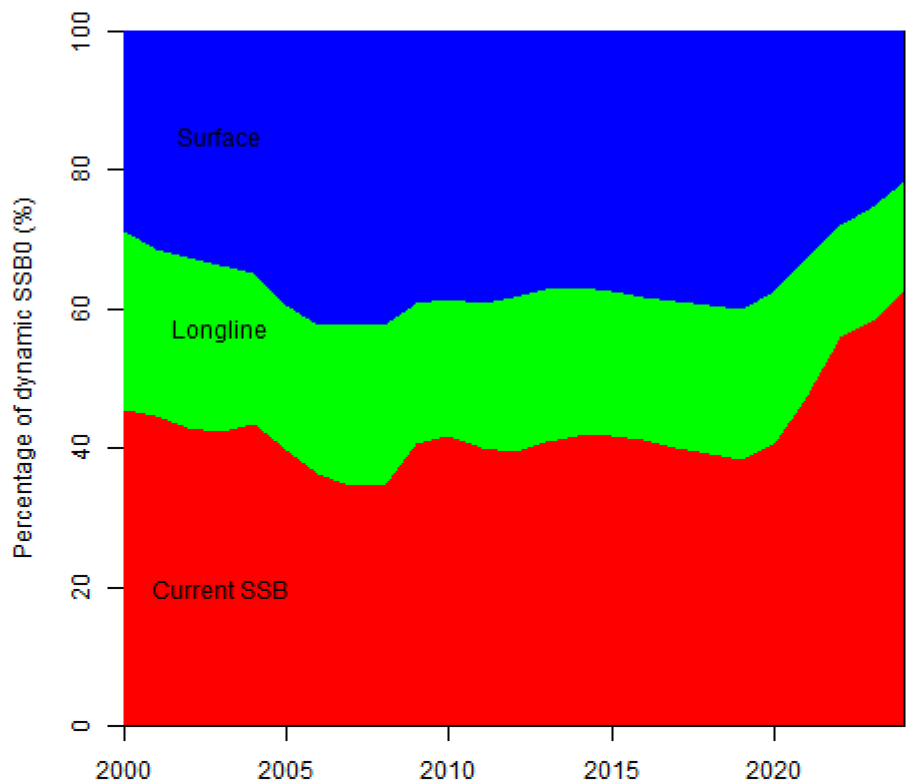


**Figure ES6.** Fishery impact analysis on north Pacific albacore (*Thunnus alalunga*) showing female spawning biomass (SSB) (red) estimated by the 2026 base case model as a percentage of dynamic, unfished female SSB ($SSB_{current,\ F=0}$). Colored areas show the relative proportion of fishing impact attributed to longline (green) and surface (blue) fisheries (primarily troll and pole-and-line gear, but including all other gears except longline).

**A.** **B.**

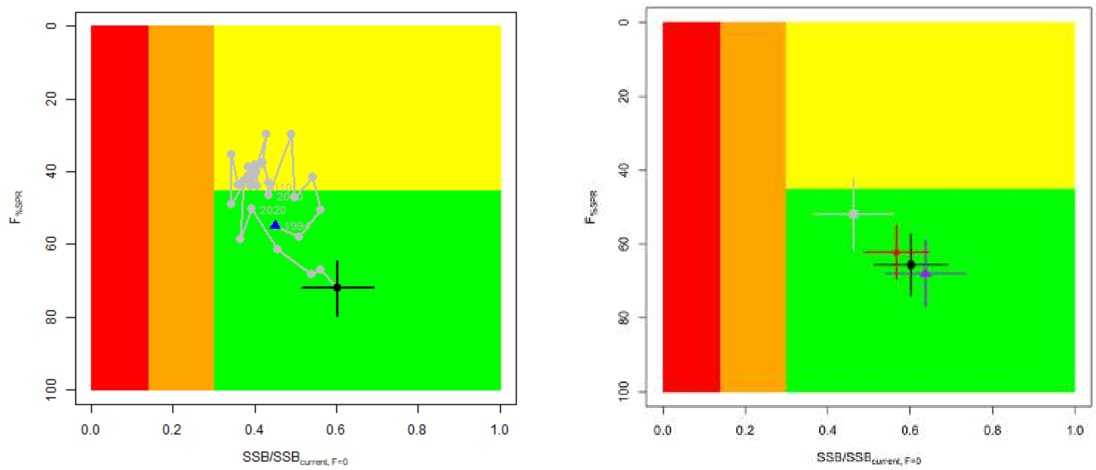


**Figure ES7.** (**A**) Stock status phase plot showing the status of the north Pacific albacore (*Thunnus alalunga*) stock relative to the biomass-based threshold ($30\%SSB_{current, F=0}$) and limit ($14\%SSB_{current, F=0}$) reference points, and fishing intensity-based target reference point ($F45_{\%SPR}$) over the modeling period (1994 – 2024). Blue triangle indicates the start year (1994) and black circle with 95% confidence intervals indicates the terminal year (2024). (**B**) Stock status plot showing current stock status and 95% confidence intervals of the base case model (black circle), a sensitivity run an important sensitivity run of CV = 0.06 for $L_{inf}$ in the growth model (gray), an important sensitivity run with two initial fishing mortality parameters (red), and a model representing an update of the 2023 base case model to 2026 data (purple). Red zones in both panels indicate female SSBs falling below the limit reference point while the orange zones indicate female SSBs between the threshold and limit reference points. Green zones indicate female SSBs above the threshold reference point and fishing intensity levels below the target reference point. Yellow areas indicate female SSBs above the threshold reference point and fishing intensity levels above the target reference point. The Fs in this figure are indicators of fishing intensity based on spawning potential ratio (SPR) and calculated as %SPR. SPR is the ratio of the equilibrium SSB per recruit that would result from the estimated F-at-age relative to that of an unfished population. A higher %SPR indicates lower fishing intensity. Current fishing intensity values and $SSB/SSB_{current,F=0}$ ratios in (B) were calculated as the average during 2021-2023 ($F_{\%SPR, 2021-2023}$) and 2024 ($SSB_{2024}/SSB_{current, F=0}$), respectively. The model representing an update of the 2023 base case model is similar to but not identical to the 2023 base case model due to changes in data preparation and model structure.

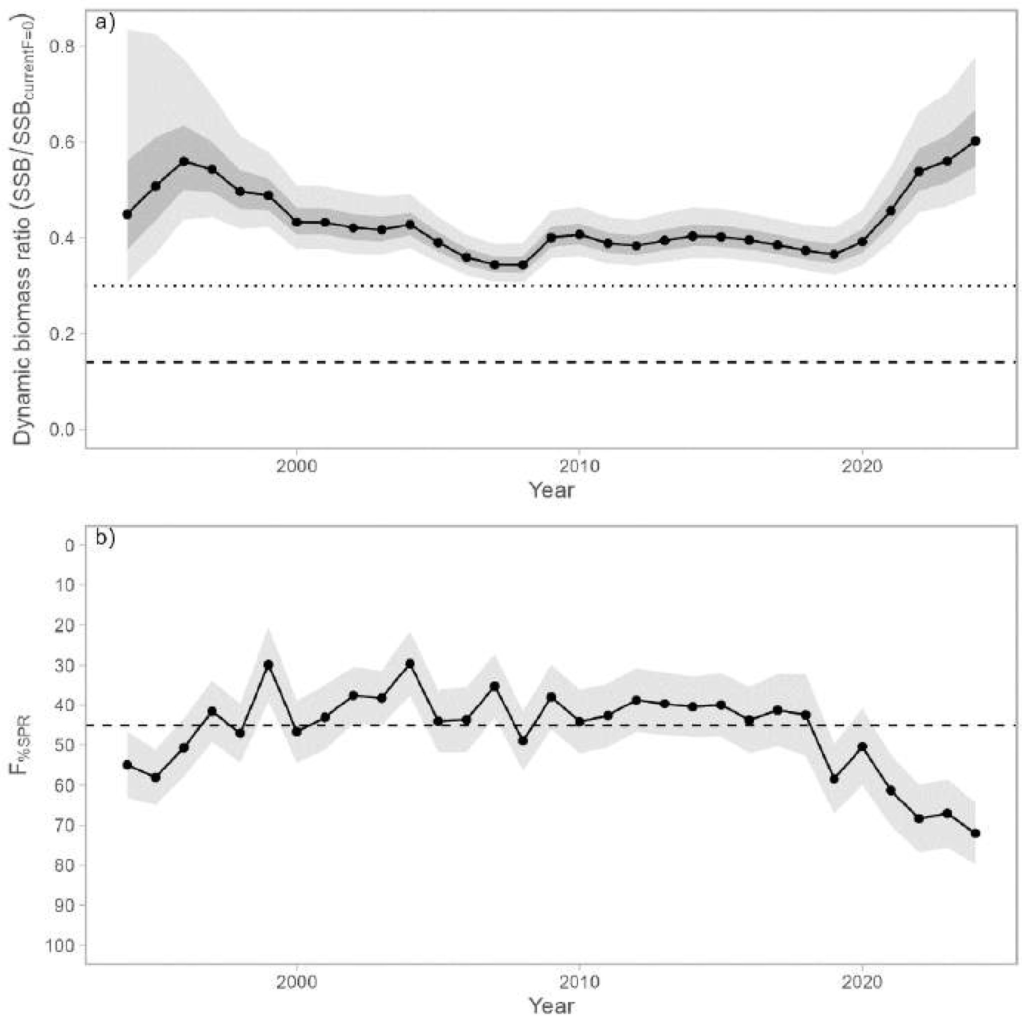


**Figure ES8.** (**A**) Estimated dynamic biomass ratio ($SSB/SSB_{current,\ F=0}$) of north Pacific albacore relative to biomass-based threshold ($30\%SSB_{current,\ F=0}$; dotted line) and limit ($14\%SSB_{current,\ F=0}$; dashed line) reference points over the modeling period (1994 – 2024). 95% confidence intervals are indicated by the lighter gray bands and 60% confidence intervals are indicated by the darker gray bands. **(B)** Estimated fishing intensity relative to the fishing intensity-based target reference point ($F45_{\%SPR}$) over the modeling period (1994 – 2024). The gray area indicates the 95% confidence intervals. The limit reference point is considered to be breached if the lower bound of the 60% confidence intervals overlaps the limit reference point.

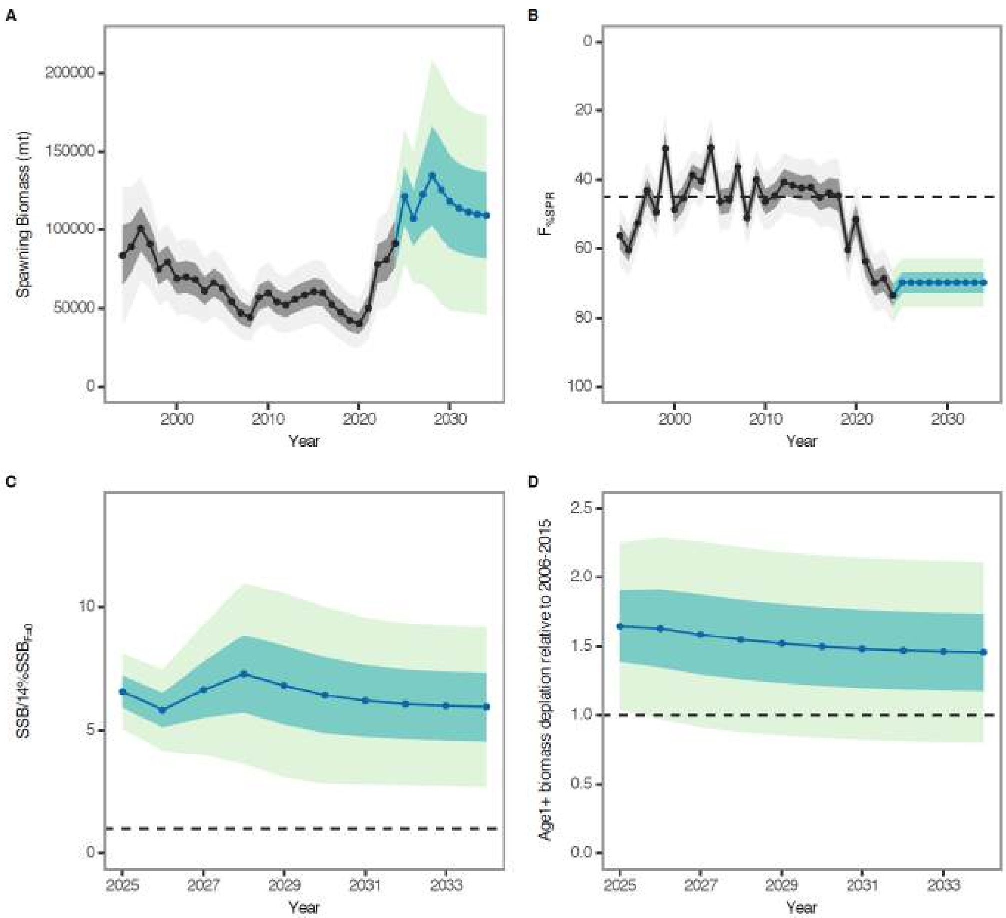


**Figure ES9**. Future projection results under a constant fishing intensity ($F_{2021-2023}$) harvest scenario. Solid lines indicate mean values, uncertainty ranges indicate 60% and 95% confidence intervals, and the dashed line is the reference point, respectively. (A) Annual changes in spawning biomass; (B) Interannual changes in fishing mortality ($F_{\%SPR}$); (C) Projected ratios to the limit reference point thresholds; and (D) Projected ratios to management targets for the total biomass.

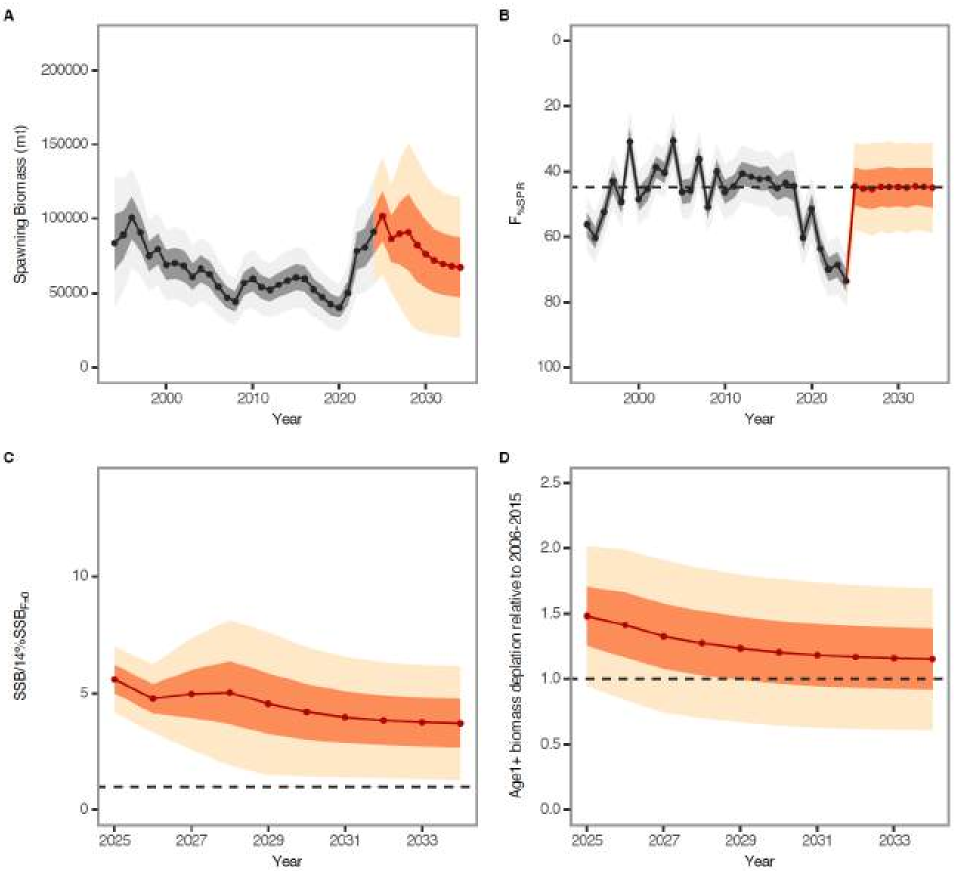


**Figure ES10.** Future projection results under a randomly F (2005-2019) scenario. Solid lines indicate mean values, and uncertainty ranges indicate 60% and 95% confidence intervals, and the dashed line is the reference point, respectively. (A) Annual changes in spawning biomass; (B) Interannual changes in fishing mortality ($F_{\%SPR}$); (C) Projected ratios to the limit reference point thresholds; and (D) Projected ratios to management targets for the total biomass.