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CATCH-ONLY STOCK ASSESSMENT OF PACIFIC MACKEREL (*Scomber japonicus*) FOR U.S. MANAGEMENT IN THE 2025-26 AND 2026-27 FISHING YEARS

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CATCH-ONLY STOCK ASSESSMENT OF PACIFIC MACKEREL (*SCOMBER JAPONICUS*) FOR U.S. MANAGEMENT IN THE 2025-26 AND 2026-27 FISHING YEARS

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1. Introduction

The Pacific Fishery Management Council (PFMC) began an assessment/management schedule for Pacific mackerel (*Scomber japonicus*) based on: 1) conducting a full (benchmark) assessment every four years starting in 2015; 2) conducting a catch-only (biomass) projection assessment every four years starting in 2017; and 3) setting harvest and management guidelines as biennial specifications that serve for two consecutive (fishing) years. Benchmark assessment have been conducted in 2015, 2019, and 2023, separated by catch-only projection assessments conducted in 2017 and 2021. A new catch-only stock assessment is presented here, which provides biomass estimates and harvest guidelines for managing the Pacific mackerel resource for the period between July 2025 and June 2026 (model year 2025) and between July 2026 and June 2027 (model year 2026)[1]. From the most recent benchmark assessment in 2023, the base catch-only assessment uses updated catch values for model years 2008 through 2022 (i.e., catch values begin in July 2008 and end in June 2023) based on best available catch information, provides new catch values for model years 2023 and 2024, but does not include other additional fishery or survey data or any structural model modifications. This assessment was produced per the PFMC's Coastal Pelagic Species Fishery Management Plan (PFMC CPS FMP, 2024), to provide scientific information as required by the Magnuson-Stevens Fishery Conservation and Management Act for federal fishery management.

2. Stock Description

The full range of Pacific mackerel (*Scomber japonicus*, also referred to as chub or blue mackerel) in the northeastern Pacific Ocean is from southeastern Alaska to Banderas Bay (Puerto Vallarta), Mexico, including the Gulf of California (Hart 1971). Although stock structure of this species of the Pacific coast of North America is not known definitively, it is generally hypothesized that three spawning aggregations exist currently: one in the Gulf of California; one in the vicinity of Cabo San Lucas (Baja California, Mexico); and one along the Pacific coast north of Punta Abreojos (Baja California) that extends north to areas of southern California, and even further during favorable oceanographic periods to waters of the U.S. Pacific Northwest. The latter stock is harvested by fishermen in the U.S. and Mexico, and is the population considered in this assessment.

The PFMC manages the stock along the Pacific coast of North America north of Punta Abreojos as a single unit, with no area- or sector-specific allocations. However, the formal FMP harvest control rule does include a stock distribution adjustment, based on a long-term assumption that, on average, approximately 70% of this transboundary stock resides in U.S. waters in any given year (PFMC 1998).

3. Catches

Pacific mackerel are primarily landed by commercial purse-seine vessels operating along the U.S. Pacific coast, as well as a Mexican commercial fishery based in Ensenada, Baja California (e.g., Table 1). A minor recreational fishery, including commercial passenger fishing vessel, small private boat, pier, beach, etc., has traditionally operated in California waters, with limited landings

[1] The assessment model is based on a July to June biological year, with recruitment occurring in July. Due to this configuration, the model or "fishing" year is the 12-month period spanning July 1 to June 30. For example, model year 2024 starts in July 2024, ends in June 2025, and is equivalent to fishing year 2024-25.

of Pacific mackerel relative to the commercial fishery operations (Table 1). Bycatch of Pacific mackerel also occurs in other fisheries, predominantly from the Pacific whiting at-sea fishery. Catch time series from 2008-2024 were used in this assessment, based on landings from both commercial (U.S., Mexico) and recreational (U.S.) fisheries. Recent and assumed landings for purposes of conducting this catch-only projection, including detailed footnotes, are summarized in Tables 2 and 3.

4. History of Recent Assessments

In the past, various age-structured population dynamics models have been used to assess the status of Pacific mackerel off the U.S. Pacific coast, which were generally based on fishery landings, age or length compositions, and relative indices of abundance from fisheries and research surveys. A benchmark assessment for Pacific mackerel was conducted in 2015 for providing management advice for two consecutive fishing years: 2015-16 and 2016-17 (Crone and Hill 2015). This initial benchmark assessment was followed by a catch-only projection assessment in 2017 (Crone and Hill 2017), benchmark assessment in 2019 (Crone et al. 2019), and catch-only assessment in 2021 (Hill and Zwolinski et al. 2021).

The most recent benchmark assessment was conducted in 2023 to provide management advice for fishing years 2023-24 and 2024-25. The final base model represented the reviewed model from the Stock Assessment and Review (STAR) Panel conducted in April 2023. The age-structured modeling framework Stock Synthesis (v3.30.20) was used to develop that base model, which included the following data (2008-2021): fishery landings, age-composition time series associated with the fishery and acoustic-trawl (AT) survey, fishery empirical weight-at-age data, and Acoustic-Trawl (AT) indices of abundance from summer CPS surveys (Kuriyama et al. 2023).

5. 2025 Catch-Only Data and Stock Assessment Methods

This catch-only stock assessment used the same model as applied in the 2023 benchmark stock assessment, with the following changes to data inputs and analyses, in order to provide biomass estimates and harvest guidelines for managing the Pacific mackerel resource for the period between July 2025 and June 2027 (i.e., model years 2025 and 2026):

- Updated Pacific mackerel landings specified in the 2023 assessment for model years 2008-2021 (Tables 1, 2; Fig. 1)
    - Mexican commercial landings from Ensenada (ENS) in Baja California and Magdalena Bay (MAG) in Baja California Sur from the 2023 benchmark assessment for model years 2020 and 2021 were based on preliminary data
    - Commercial landings for California (CA), Oregon (OR), and Washington (WA) for model years 2008-2021 in the 2023 assessment used data from numerous sources, including California Department of Fish and Wildlife wetfish tables, PacFIN (https://pacfin.psmfc.org), and personal communications, and included some 'unspecified' mackerel catch for WA
    - Updated catch values for CA, OR, and WA were reviewed and validated by State representatives
- Added new mackerel landings for model years 2022 and 2023 (Tables 1, 2)
- Added forecasted mackerel landings for model years 2024, 2025, and 2026 using a combination of available data for model year 2024 and assumed catch based on recent landings from model years 2021-2023 (Table 3)
- Conducted model fitting and sensitivity analyses using Stock Synthesis (v3.30.22.1)

    - Bridging analyses were conducted to confirm that moving from Stock Synthesis v3.30.20, as used in the 2023 benchmark assessment, to the most recent released version (v3.30.22.1) did not change model results reported in the 2023 assessment
- No other data or parameterizations were changed in the current base model from the 2023 benchmark, including no changes to the underlying stock-recruitment relationship, growth estimates, natural mortality assumptions, and selectivity parameterizations; weight-at-age was assumed to remain unchanged from the most recent available estimates
    - Base model details are reported in Kuriyama et al. (2023)

Updated and new commercial landings data for MAG and ENS were obtained from data published to the CONAPESCA website (i.e., 2008-2023; https://www.gob.mx/conapesca/documentos/anuario-estadistico-de-acuacultura-y-pesca) and preliminary data for 2024 (i.e., January-September) provided by Instituto Mexicano de Investigación en Pesca y Acuacultura Sustentables (IMIPAS) researchers (Enciso-Enciso, pers. comm. 2024).

Updated and new commercial landings data for Pacific mackerel from CA, OR, WA were obtained from the Comprehensive Fish Tickets (FT) database on PacFIN using R (R Core Team 2024) and the 'RODBC' package (Ripley and Lapsley 2023). Commercial 'At-Sea' landings data (i.e., bycatch from the at-sea Pacific whiting fishery) similarly were obtained from the West Coast At-sea Whiting Fishery (NPAC) database on PacFIN. The 2023 benchmark assessment included At-Sea catch at the request of the STAR Panel but did not explicitly report out annual landings (Kuriyama et al. 2023). Commercial landings data for Pacific mackerel (i.e., species code PMCK) were obtained from PacFIN on 1/8/25 and include landings through December 2024. Although some 'unspecified' or 'unidentified' mackerel were included in commercial landings for the 2023 benchmark assessment, 126 metric tons (mt) of 'unspecified' mackerel landings from WA were eventually excluded from the previous benchmark. To ensure consistency both with previous assessments and in how landings are handled among states, 'unidentified' mackerel (i.e., species code UMCK in PacFIN) landings from CA and WA were excluded from landings in this catch-only assessment.

The California Department of Fish and Wildlife provided new recreational landings data for CA through September 2024 (Lynn, pers. comm. 2024).

The following sensitivity analyses were conducted:

- Changed forecasted catch for model years 2025 and 2026 to the sum of recent average landings from Mexico (i.e., model years 2021-2023) and the annual U.S. harvest guidelines ('HG Landings' scenario); this scenario follows recommended assumptions for projected U.S. catch from the Terms of Reference for the Coastal Pelagic Species Stock Assessment Review Process
    - Average annual landings from Mexico = 15,598 mt
    - Harvest guidelines for model years 2025 and 2026 were obtained from the base model run for this catch-only assessment (Table 4)
- Fixed forecasted recruitment to the average recruitment during the main recruitment period (i.e., model years 2011-2021) ('Fix Avg. Recr.')
- Fixed forecasted recruitment to the average recruitment over the last three years of the main recruitment period (i.e., model years 2019-2021) ('Fix Rec. Recr.')
- Modified empirical age-0 fecundity to equal 0 during forecast years, to prevent age-0 fish from incorrectly contributing to spawning stock biomass ('Fix Age-0 Fec.')

- Discrepancies in estimated summary biomass and recruitment between the 2023 benchmark and 2025 catch-only assessments for model years 2022 and 2023 helped identify this issue and inform the model modification

6. Stock Assessment Results, Stock Biomass and Dynamics, and Recruitment

Estimates of model fit, parameter values, and biomass from this catch-only assessment are presented in Table 5; differences in likelihood and parameter values relative to those presented in Kuriyama et al. (2023) are negligible. The estimated recruitment time series indicates relatively high recruitment success for model years 2011, 2016, and 2018 (Fig. 2). Estimates of recruitment for 2022-onwards are informed primarily by the stock-recruit relationship and are highly uncertain. Estimates of stock (i.e., age-1+) biomass generally declined between 2008 and 2022 (Table 5; Fig. 2). Estimates of biomass for 2023-onwards are informed primarily by the stock-recruit relationship and are highly uncertain. The stock biomass was estimated to be 61,737 mt (SD = 41,422 mt) for fishing year 2025-26 and 67,954 mt (SD = 43,375 mt) for fishing year 2026-27.

7. Modeling Diagnostics and Sensitivity Analyses

Based on multiple metrics, including a positive definite Hessian matrix, a final model gradient less than the threshold of 1e-4, no highly correlated parameters (i.e., >0.95), and no parameter values at specified bounds, the catch-only assessment model converged successfully.

All sensitivity scenarios resulted in forecasted summary biomass values less than the base catch-only assessment (Fig. 3). The scenario in which forecasted recruitment was fixed to the average recruitment value during model years 2019-2021 ('Fix Rec. Recr.') resulted in the largest decrease in summary biomass by fishing year 2026-27 (age-1+ biomass = 56,390 mt). Scenarios in which fecundity of age-0 fish during forecast years was fixed at 0 ('Fix Age-0 Fec.'), recruitment during the forecast period was fixed to average recruitment during the main recruitment era ('Fix Avg. Rec.), and forecasted U.S. landings were based on harvest guidelines ('HG Landings') produced relatively minor differences in biomass by fishing year 2026-27 (age-1+ biomass = 65,708 mt, 63,970 mt, and 63,598 mt, respectively).

The 'Fix Age-0 Fec.' scenario represents a departure from how spawning stock biomass is calculated during forecast years relative to the benchmark and base catch-only assessments, but should be considered as providing best available information. The erroneous inclusion of age-0 fish in the calculation of spawning stock biomass during forecast years has been flagged as an issue in Stock Synthesis; this issue is specific to cases in which age-0 fish have a non-zero fecundity in the empirical weight-at-age file and the model has a single-season structure, such that recruitment and spawning stock biomass are calculated for the same time point. Modifications of the model structure for mackerel to circumvent this issue may be considered for future assessments; these could include changing the model structure from a single-season to a two-season structure.

8. Exploitation Status

Estimated rates of instantaneous fishing mortality (F, yr^{-1}) for Pacific mackerel have fluctuated over the modeled timeframe (i.e., model years 2008-2023), from roughly 0.05 to 0.35 (Fig. 4). Exploitation rate (calendar year catch/mid-year total biomass) time series generally followed the estimated Fs over time, with annual removal rates that ranged from roughly 1 to 27% (Fig. 5). The percent of the harvest guideline harvested by U.S. fisheries from model years 2008-2023 has varied between 7 and 39% (Table 6).

9. Ecosystem Considerations

Pacific mackerel are part of the CPS assemblage of the northeastern Pacific Ocean, which represents an important forage base in the California Current. Pacific mackerel grow rapidly, feeding on plankton (plants and animals) and other CPS, including smaller northern anchovy, Pacific sardine, market squid, etc. The species is prey for various larger fish (shark and tuna spp.), marine mammals, and seabirds. Pacific mackerel do not typically represent a dominant species of the CPS assemblage in most years, with absolute abundance likely less than that characterizing the more productive CPS, such as Pacific sardine and northern anchovy. However, population biomass can increase to relatively high levels during periods of favorable oceanographic conditions, which are hypothesized to be the driving mechanisms related to recruitment success and associated stock abundance of this species, as well as CPS in general.

10. Harvest Control Rules

Harvest guidelines for fishing years 2025-26 and 2026-27 are based on the 2025 and 2026 stock biomass estimates of 61,737 and 67,954 mt, respectively (Table 4). The stock is projected to remain above the 18,200 mt management threshold and the harvest guideline is 9,143 mt for the 2025-26 fishing year.

11. Recent management performance

U.S. landings in the past years have remained below the annual catch limits and harvest guidelines (Table 6). The annual catch limit for Pacific mackerel for fishing year 2024-25, based on the 2023 benchmark assessment, was 10,073 mt.

12. Uncertainties

High uncertainty in estimates of stock biomass in model years 2023-2026 occurs due in part to lack of included AT survey biomass and age composition values for 2020 and 2022, which resulted in increased model reliance on the stock-recruit relationship to inform recruitment. A summer CPS survey was not conducted in 2020, and the biomass estimate from the 2022 survey was not recommended for use in assessments due to logistical challenges in sampling (Stierhoff et al. 2023). Estimated biomass of Pacific mackerel for the 2023 summer AT survey was 7,968 mt, and the preliminary estimate of biomass for the 2024 summer AT survey was 11,129 mt (Stierhoff et al. 2024, *in prep*). There also remains inherent uncertainty in the portion of the stock's distribution in U.S. waters, including expected variability in distribution over time in response to oceanographic drivers. Based on this uncertainty, coverage of the stock's distribution by the AT survey may be variable; accordingly, survey catchability (q) is modeled using an informative prior. Uncertainties regarding differences in the movement and distribution of fish with varying sizes and ages, specifically during periods of low or high abundance, also have been identified in past assessments.

13. Research and data needs

Identified research and data needs include exploring estimates of M for coastal pelagic species similar to Pacific mackerel - this information will be reported in future assessments. Further research to characterize spatial variability in stock structure and distribution can help inform the specification of survey catchability (q). Continuing to prioritize survey data collection in Mexican waters, following the spatial coverage achieved during the 2024 survey, can address this uncertainty in spatial variability.

Acknowledgments

Numerous groups and individuals contributed to and improved this catch-only stock assessment for Pacific mackerel. Thanks to State partners at the California Department of Fish and Wildlife (Trung Nguyen), Oregon Department of Fish and Wildlife (Greg Krutzikowsky), and Washington Department of Fish and Wildlife (Lisa Hillier) that helped verify PacFIN commercial catch data. Recreational landings data from California were collected by the California Department of Fish and Wildlife and provided by Kirk Lynn. Port samples for the Ensenada, Mexico fishery were collected by INAPESCA (Ensenada). Recent landings data from the Ensenada fishery were kindly provided by Concepción Enciso-Enciso (INAPESCA-Ensenada). Thanks finally to Rick Methot for providing model troubleshooting support.

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Tables

Table 1. Comparison of Pacific mackerel landings in the 2025 catch-only stock assessment to values reported in the 2023 benchmark assessment, rounded to the nearest mt. Landings in parentheses represent values reported in the previous benchmark (Kuriyama et al. 2023) for model years 2008-2021, if different than the values supplied for the catch-only assessment; region-specific landings were obtained from Table ES-1 and do not reflect any adjustments for 'unspecified' mackerel landings. At-Sea landings were not separately reported in the previous assessment.

Model year	Commercial						Recreational	Total
	MAG	ENS	CA	OR	WA	At-Sea	CA	
2008	689	114	4,224 (*4,198*)	58	5 (*9*)	0	279	5,369 (*5,346*)
2009	49	0	2,957 (*3,279*)	54	1 (*5*)	0	269	3,331 (*3,656*)
2010	312	1,605	2,038 (*2,047*)	48	1 (*2*)	0	216	4,220 (*4,229*)
2011	1,081	1,151	1,653 (*1,665*)	202	21 (*83*)	0	124	4,232 (*4,305*)
2012	7,219	171	3,171 (*3,202*)	1,588	654 (*719*)	3	99	12,905 (*12,874*)
2013	2,071	482	11,252 (*11,165*)	438	168 (*173*)	0	133	14,544 (*14,461*)
2014	2,757	1,342	3,618 (*3,651*)	1,215	502	39	225	9,697 (*9,707*)
2015	3,663	5,515	4,359 (*4,435*)	7	1	44	243	13,834 (*13,891*)
2016	5,730	5,977	2,470 (*2,523*)	4	22	14	209	14,426 (*14,473*)
2017	2,224	585	1,388 (*1,513*)	45	4	119	245	4,611 (*4,703*)
2018	3,422	12,330	2,196 (*2,199*)	112	10	104	180	18,353
2019	16,777	2,297	3,785 (*3,783*)	50	5	42	78	23,034 (*22,989*)
2020	26,091 (*26,136*)	5,239 (*5,232*)	501 (*500*)	101	3	5	87	32,027 (*32,062*)
2021	9,260 (*7,649*)	1,749 (*1,760*)	847	87 (*86*)	0	206	73	12,222 (*10,528*)
2022	14,116	6,689	526	340	26	150	47	21,895
2023	13,204	1,776	559	161	57	55	53	15,866

Table 2. Pacific mackerel landings included as data in the 2025 catch-only stock assessment, rounded to the nearest mt.

Model	Commercial						Recreational	Total
year	MAG	ENS	CA	OR	WA	At-Sea	CA	
2008	689	114	4,224	58	5	0	279	5,369
2009	49	0	2,957	54	1	0	269	3,331
2010	312	1,605	2,038	48	1	0	216	4,220
2011	1,081	1,151	1,653	202	21	0	124	4,232
2012	7,219	171	3,171	1,588	654	3	99	12,905
2013	2,071	482	11,252	438	168	0	133	14,544
2014	2,757	1,342	3,618	1,215	502	39	225	9,697
2015	3,663	5,515	4,359	7	1	44	243	13,834
2016	5,730	5,977	2,470	4	22	14	209	14,426
2017	2,224	585	1,388	45	4	119	245	4,611
2018	3,422	12,330	2,196	112	10	104	180	18,353
2019	16,777	2,297	3,785	50	5	42	78	23,034
2020	26,091	5,239	501	101	3	5	87	32,027
2021	9,260	1,749	847	87	0	206	73	12,222
2022	14,116	6,689	526	340	26	150	47	21,895
2023	13,204	1,776	559	161	57	55	53	15,866

Table 3. Assumed Pacific mackerel landings included as forecasts in the catch-only stock assessment, rounded to the nearest mt.

Model	Commercial						Recreational	Total
year	MAG	ENS	CA	OR	WA	At-Sea	CA	
2024[a]	20,977	1,660	1,367	13	1	90	54	24,163
2025[b]	12,194	3,405	644	196	28	137	58	16,661
2026[b]	12,194	3,405	644	196	28	137	58	16,661

[a] Catch included 1) observed landings in 2024 for either Jul-Oct (MAG, ENS, CA-REC) or Jul-Dec (CA, OR, WA, At-Sea) and 2) average landings from model years 2021-2023 from either Nov-Jul (MAG, ENS, CA-REC) or Jan-Jun (CA, OR, WA, At-Sea)

[b] Catch based on average annual landings from model years 2021-2023

Table 4. Pacific mackerel harvest control rules (HCR) for the following fishing years from the base model: a) 2025-26, and b) 2026-27. Acronyms follow: OFL is overfishing limit; ABC is acceptable biological catch; HG is harvest guideline; EMSY is proxy for exploitation rate at maximum sustainable yield; and P-star* is the overfishing probability for ABC calculations.

a) Fishing year 2025-26

Harvest Control Rule Formulas							
OFL = BIOMASS * E_{MSY} * DISTRIBUTION							
$ABC_{P\text{-}star}$ = BIOMASS * $BUFFER_{P\text{-}star}$ * E_{MSY} * DISTRIBUTION							
HG = (BIOMASS – CUTOFF) * FRACTION * DISTRIBUTION							
Harvest Guideline Parameters							
BIOMASS (ages 1+, mt)	**61,737**						
P-star	0.45	0.4	0.35	0.3	0.25	0.2	0.15
ABC $Buffer_{Tier\ 1}$	0.8218	0.6732	0.5478	0.4408	0.3487	0.2686	0.1981
ABC $Buffer_{Tier\ 2}$	0.7778	0.6025	0.4627	0.3504	0.2595	0.1858	0.1258
ABC $Buffer_{Tier\ 3}$	0.7778	0.6025	0.4627	0.3504	0.2595	0.1858	0.1258
EMSY (FRACTION)	0.30						
CUTOFF (mt)	18,200						
DISTRIBUTION (U.S.)	0.70						
Harvest Control Rule Values							
OFL =	**12,965**						
$ABC_{Tier\ 1}$ =	10,654	8,728	7,102	5,715	4,521	3,482	2,568
$ABC_{Tier\ 2}$ =	10,084	7,811	5,999	4,543	3,364	2,409	1,631
$ABC_{Tier\ 3}$ =	10,084	7,811	5,999	4,543	3,364	2,409	1,631
HG =	**9,143**						

b) Fishing year 2026-2027

Harvest Guideline Parameters							
BIOMASS (ages 1+, mt)	**67,954**						
P-star	0.45	0.4	0.35	0.3	0.25	0.2	0.15
ABC $Buffer_{Tier\ 1}$	0.8007	0.6388	0.5059	0.3955	0.3033	0.2257	0.1599
ABC $Buffer_{Tier\ 2}$	0.7778	0.6025	0.4627	0.3504	0.2595	0.1858	0.1258
ABC $Buffer_{Tier\ 3}$	0.7778	0.6025	0.4627	0.3504	0.2595	0.1858	0.1258
EMSY (FRACTION)	0.30						
CUTOFF (mt)	18,200						
DISTRIBUTION (U.S.)	0.70						
Harvest Control Rule Values (MT)							
OFL =	**14,270**						
$ABC_{Tier\ 1}$ =	11,426	9,116	7,219	5,644	4,328	3,221	2,282
$ABC_{Tier\ 2}$ =	11,099	8,598	6,603	5,000	3,703	2,651	1,795
$ABC_{Tier\ 3}$ =	11,099	8,598	6,603	5,000	3,703	2,651	1,795
HG =	**10,448**						

Table 5. Summary of model components for the catch-only projection. Any changes from the 2023 benchmark assessment reflect updates to the catch data time series only.

Type	Component	Values
Likelihoods	TOTAL	115.02
Likelihoods	Parm_devs	88.853
Likelihoods	Age_comp	29.555
Likelihoods	Parm_priors	2.791
Likelihoods	Recruitment	0.097
Likelihoods	InitEQ_Regime	0.028
Likelihoods	Parm_softbounds	0.003
Likelihoods	Catch	0
Likelihoods	Equil_catch	0
Likelihoods	Length_comp	0
Likelihoods	Forecast_Recruitment	0
Likelihoods	Crash_Pen	0
Likelihoods	Survey	-6.307
Parameters	NatM_Lorenzen_averageFem_GP_1	0.851
Parameters	SR_LN(R0)	13.732
Parameters	SR_BH_steep	0.75
Parameters	SR_sigmaR	0.75
Parameters	SR_regime_BLK3repl_2007	0.231
Parameters	LnQ_base_AT(2)	-1.803
Parameters	LnQ_base_AT(2)_BLK4repl_2016	-1.118
Parameters	LnQ_base_AT(2)_DEVmult_2008	-0.499
Parameters	LnQ_base_AT(2)_DEVmult_2012	-1.207
Parameters	LnQ_base_AT(2)_DEVmult_2013	1.101
Parameters	LnQ_base_AT(2)_DEVmult_2014	0.986
Parameters	LnQ_base_AT(2)_DEVmult_2015	3.21
Summary biomass	2020	69,823
Summary biomass	2021	50,282
Summary biomass	2022	45,898
Summary biomass	2023	51,060
Summary biomass	2024	58,301
Summary biomass	2025	61,737
Summary biomass	2026	67,954

Table 6. U.S. overfishing limits (OFL), allowable biological catches (ABC), annual catch limits (ACL), and harvest guidelines (HG) for Pacific mackerel, in addition to total U.S. landings and the percentage of HG (or ACL, if no HG is available). Values for 2024 are not finalized, as indicated by *NA*.

Model Year	OFL	ABC	ACL	HG	USA-TOT	PercHG (%)
2008	NA	NA	40,000	NA	4,566	11
2009	NA	NA	10,000	NA	3,281	33
2010	NA	NA	11,000	NA	2,303	21
2011	44,436	42,375	40,514	30,386	2,001	7
2012	44,336	42,375	40,514	30,386	5,515	18
2013	57,316	52,358	52,358	39,268	11,991	31
2014	32,992	30,138	29,170	24,170	5,598	23
2015	25,291	23,104	21,469	20,469	4,655	23
2016	24,983	22,822	21,161	20,161	2,719	13
2017	30,115	27,510	26,293	25,293	1,802	7
2018	27,662	25,269	23,840	22,840	2,601	11
2019	14,931	13,169	11,109	10,109	3,960	39
2020	11,772	10,289	7,950	6,950	697	10
2021	12,145	9,446	8,323	7,323	1,212	17
2022	9,644	7,501	5,822	4,822	1,090	23
2023	11,693	9,754	9,754	7,871	885	11
2024	12,765	10,073	10,073	8,943	*NA*	*NA*

Figures

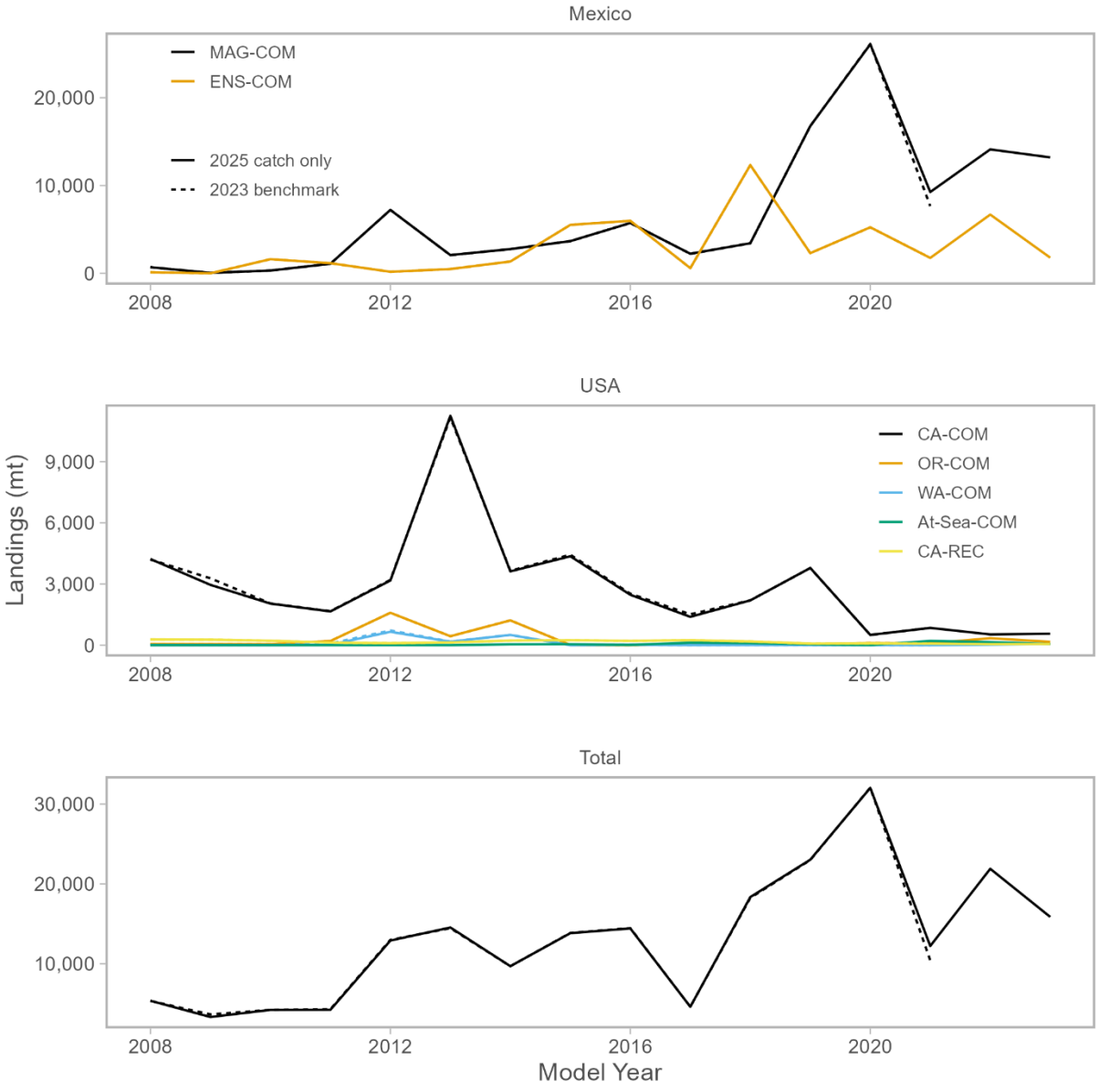

Figure 1. Comparison of Pacific mackerel catch values reported in the 2023 benchmark assessment (dashed lines) and applied in this catch-only stock assessment (solid lines), rounded to the nearest mt.

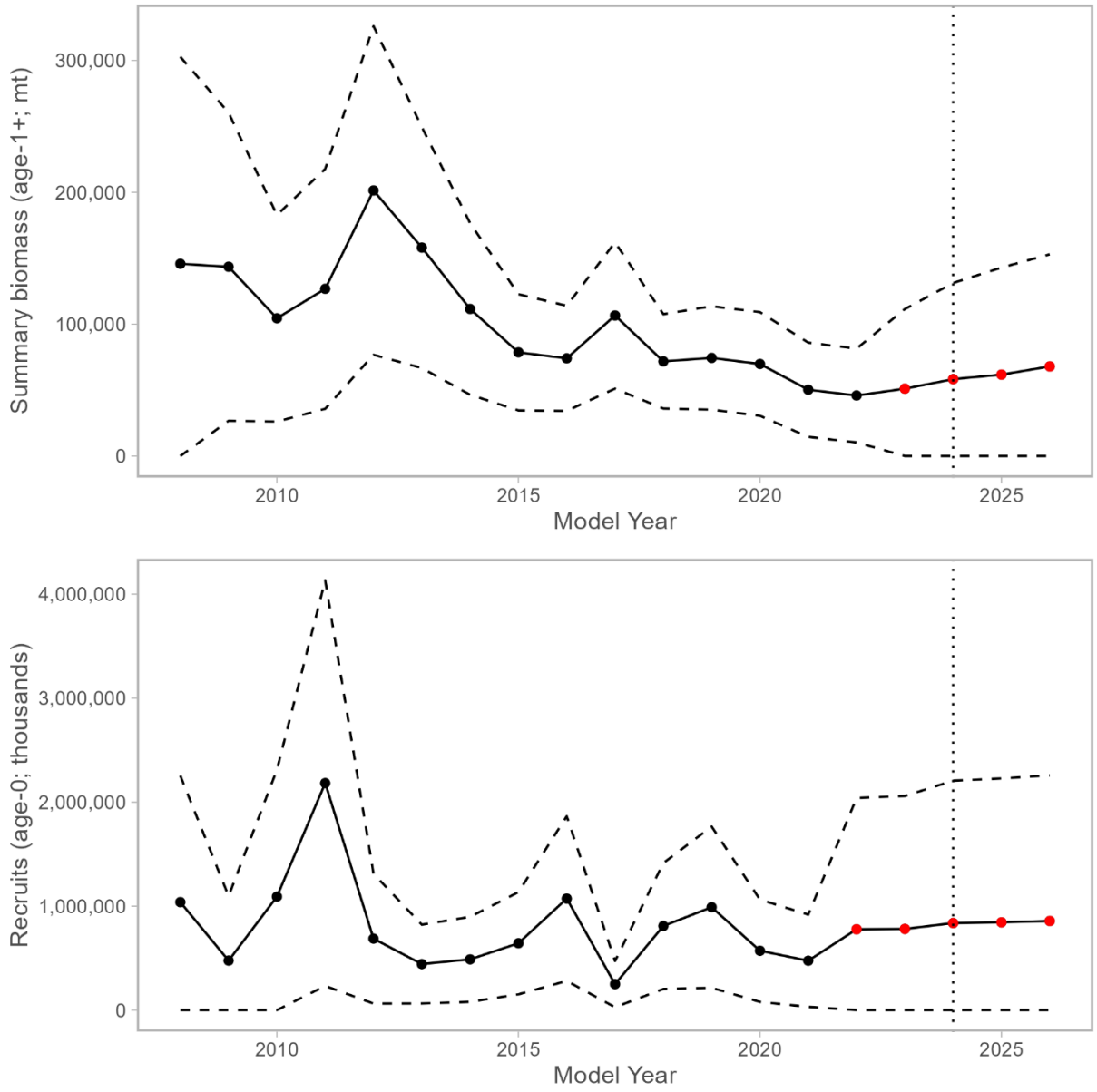

Figure 2. Pacific mackerel stock biomass (age 1+ fish, mt) and recruitment (age-0 fish, 1000s) time series with 95% confidence intervals for this catch-only assessment. Red points indicate values based on recruitment values informed primarily by the stock-recruit relationship, and the vertical dotted line represents the first year of model forecasts.

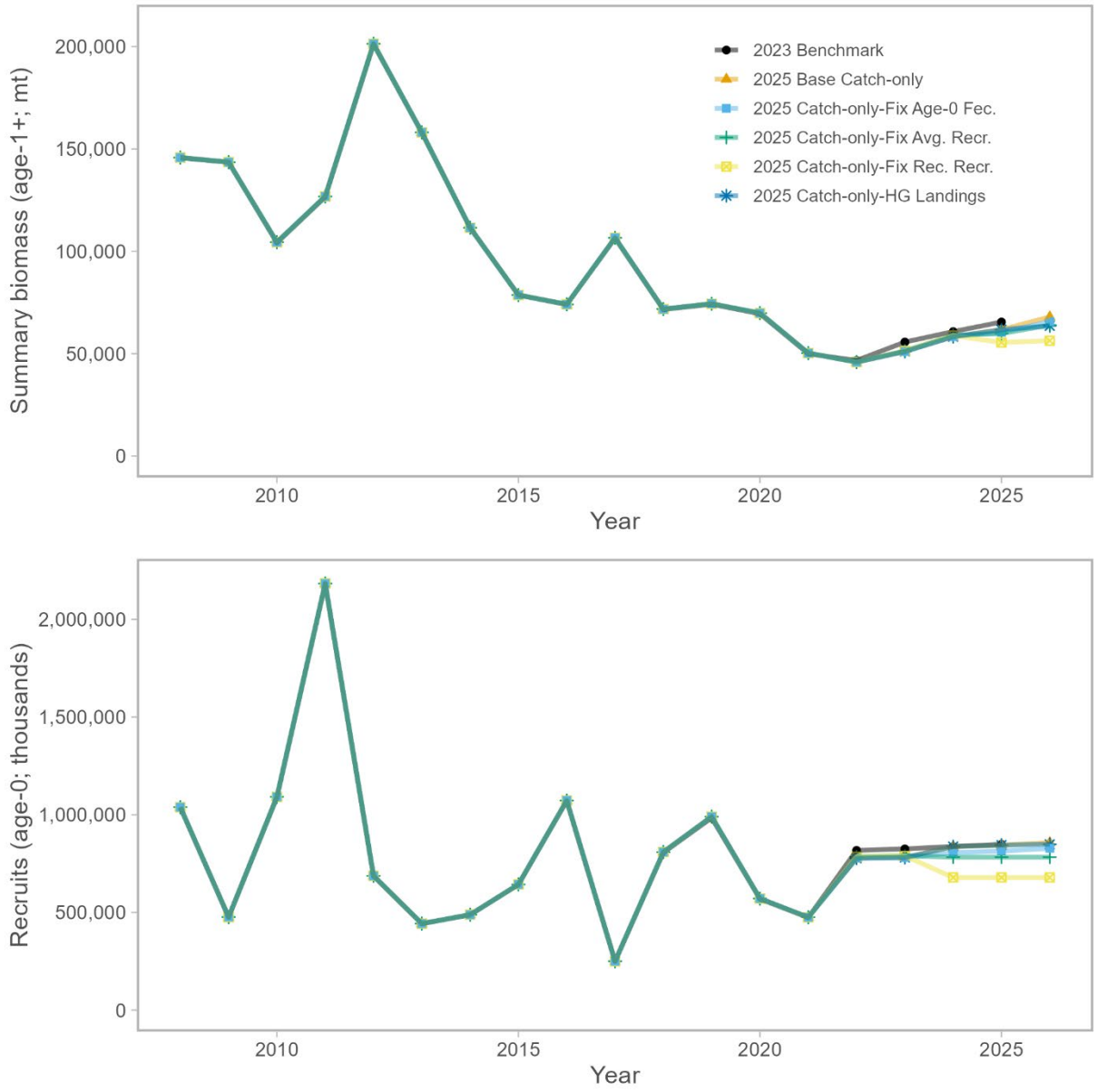

Figure 3. Pacific mackerel stock biomass (age 1+ fish, mt) and recruitment (age-0 fish, 1000s) time series associated with alternative models and sensitivity scenarios.

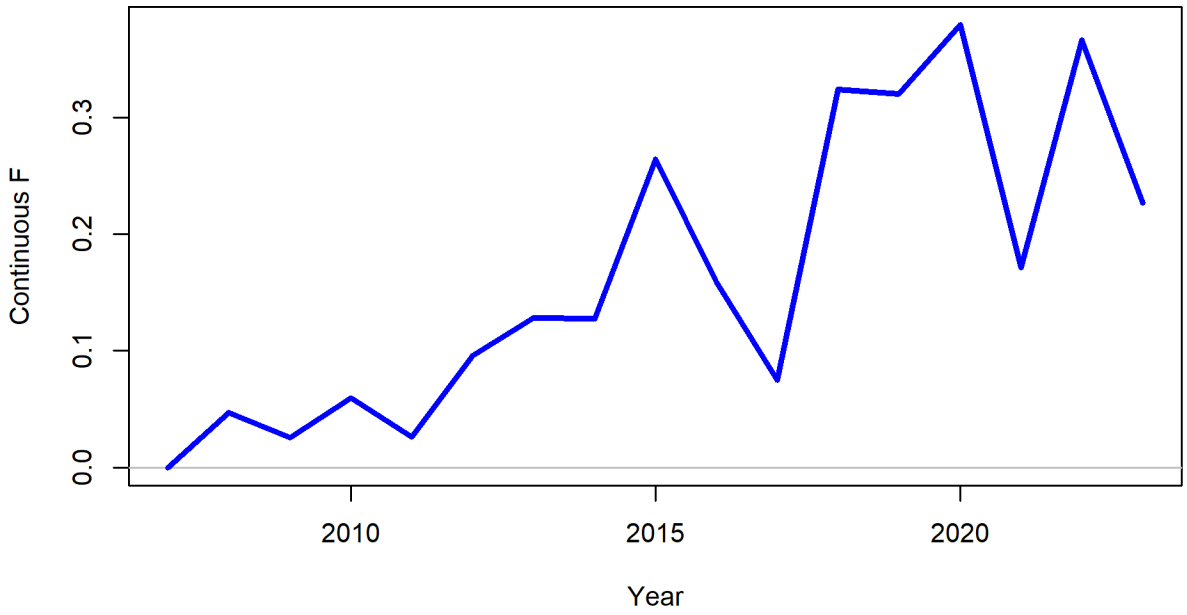

Figure 4. Continuous fishing mortality (F) estimates for the base catch-only assessment.

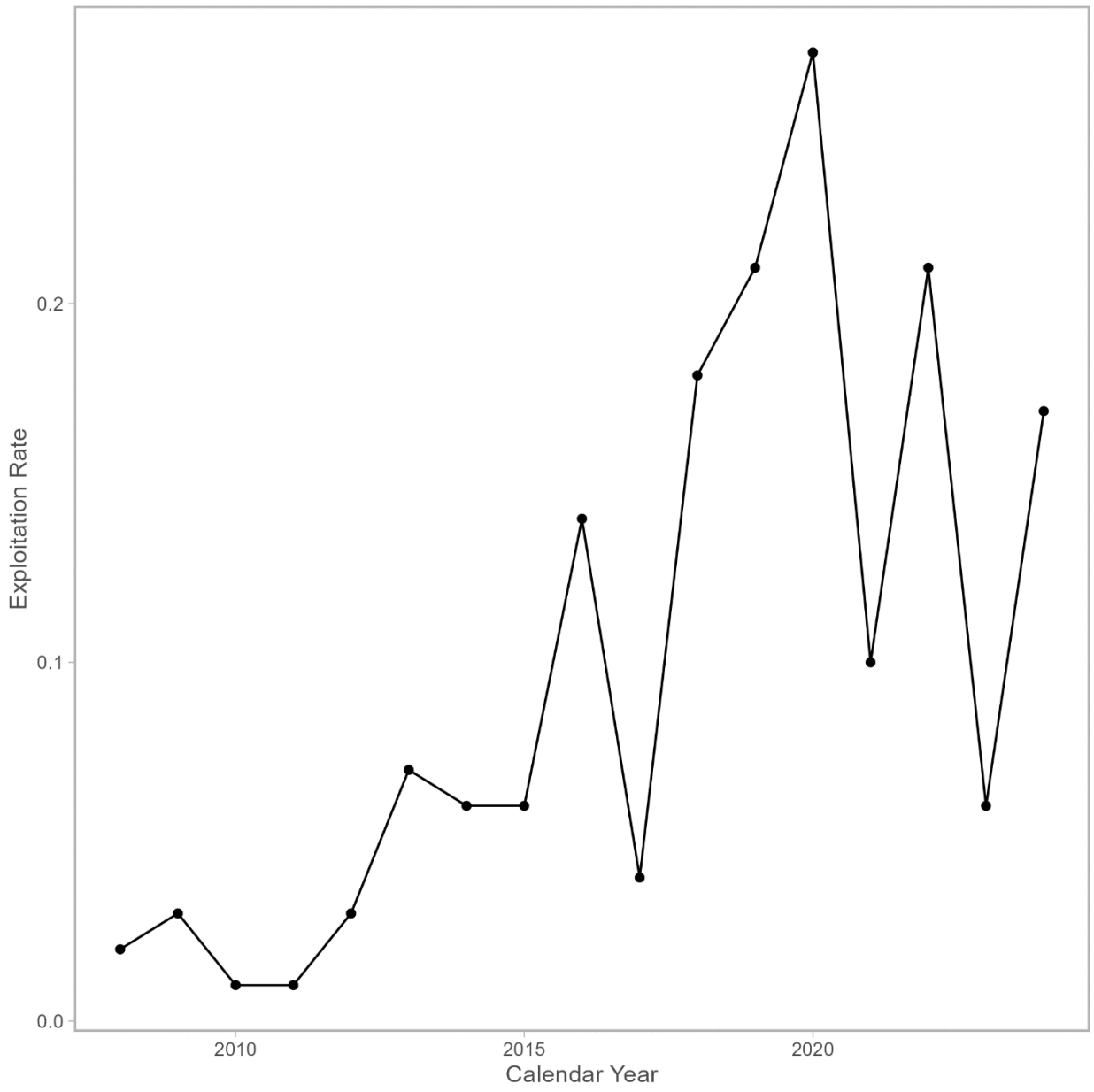

Figure 5. Estimates of annual exploitation rates (calendar year landings / July total biomass).