Aleutian Islands Golden King Crab Stock Assessment 2026

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Executive Summary

1. **Stock**: Golden king crab, *Lithodes aequispinus*, Aleutian Islands, east of 174° W longitude (EAG) and west of 174° W longitude (WAG).

2. **Catch**: The Aleutian Islands golden king crab (AIGKC) commercial fishery has been prosecuted every year since 1981/82. Retained catch peaked in 1986/87 at 2,686 t (5,922,425 lb) and 3,999 t (8,816,319 lb), respectively, for the EAG and WAG, but the retained catch dropped sharply from 1989/90 to 1990/91. The fishery has been managed separately east (EAG) and west (WAG) of 174° W longitude since 1996/97, and Guideline Harvest Levels (GHLs) of 1,452 t (3,200,000 lb) for the EAG and 1,225 t (2,700,000 lb) for the WAG were introduced into management. The GHL was subsequently reduced to 1,361 t (3,000,000 lb) beginning in 1998/99 for the EAG. The reduced harvest levels remained at 1,361 t (3,000,000 lb) for the EAG and 1,225 t (2,700,000 lb) for the WAG through 2007/08 but were increased to 1,429 t (3,150,000 lb) for the EAG and 1,294 t (2,835,000 lb) for WAG beginning with the 2008/09 fishing season following an Alaska Board of Fisheries (BOF) decision. The management specification changed from GHL to TAC (Total Allowable Catch) with adoption of the Crab Rationalization Program in 2005/06 (NPFMC 2007b). The TACs were increased by another BOF decision to 1,501 t (3,310,000 lb) for EAG and 1,352 t (2,980,000 lb) for WAG beginning with the 2012/13 fishing season. The below par fishery performance in WAG in 2014/15 and 2015/16 lead to reduction in TAC to 1,014 t (2,235,000 lb), which reflected a 25% reduction in the TAC for WAG, while the TAC for EAG was kept at the same level, 1,501 t (3,310,000 lb) for the 2016/17 through 2017/18 fishing seasons. With the improved fishery performance and stock status in 2017/18, the TACs were further increased to 1,134 t (2,500,000 lb) for WAG and 1,749 t (3,856,000 lb) for EAG beginning with the 2018/19 fishing season. With the implementation of a revised state harvest strategy in 2019, the TACs were further increased to 1,302 t (2,870,000 lb) for WAG and 1,955 t (4,310,000 lb) for EAG. In the 2025/26 the TAC was 1,506 t (3,320,000 lb) in the EAG and 395 t (870,000 lb) in the WAG. At the time of this report, both fisheries were completed with the 1,549 t (3,325,249 lb) and 394 t (867,942 lb) of retained catch in the EAG and WAG, respectively.

   Total catch mortality includes retained catch, discard mortality in the directed fishery, and bycatch mortality in groundfish fixed gear and trawl fisheries. Directed fishery discard mortality and groundfish fishery bycatch have remained low and stable in recent history, with the exception of several pulses in groundfish bycatch during 2016 and 2020 in the EAG and 2022 in the WAG. Catch per unit effort (CPUE, i.e., crab per pot lift) of retained legal males was low from the 1980s into the mid-1990s, but increased after 1999/00, particularly with the initiation of the Crab Rationalization Program in 2005/06. Although CPUE for the two areas showed similar trends through 2010/11, CPUE trends have since diverged (increasing for the EAG and decreasing for the WAG). EAG CPUE in 2025/26 (32 crab / pot) was the lowest since 2017, though CPUE in the WAG (18 crab / pot) was the second highest during the same time period, rebounding from a near post-rationalization low.

3. **Stock biomass**: Estimated mature male biomass (MMB) decreased rapidly through 1988 in the EAG and until 1992 in the WAG. MMB remained at low levels for several years before steady increases

starting in 1995 (in both areas) and reaching a peak during the early (EAG) to mid (WAG) 2000s. Since then, estimated MMB has remained somewhat stationary in the EAG, though undergoing a dip from about 2011 - 2020. MMB in the EAG has slightly decreased since 2022, but remains relatively stationary over time. MMB in the WAG has steadily decreased since 2008, with a small increase from 2014 - 2017 and larger increase in 2024 and 2025.

4. **Recruitment**: Estimated recruitment has remained stationary in the EAG and has undergone a slow decreasing trend in the WAG from the early 1990s - 2021, after which there has been an increaing trend. The largest recruitment pulse occurred during 1989 in the EAG and 1985 in the WAG, and the lowest in 2003 in the EAG, and 2021 in the WAG. Model 26.0a suggests decreasing recruitment in the EAG, except during the terminal year, though increasing recruitment in the WAG since 2021.

5. **Management performance**: AIGKC has been managed as a Tier 3 stock since 2017. Biological reference points computed for EAG and WAG subdistricts separately are summed for the full stock prior to stock status determination. The stock was above the minimum stock size threshold (MMST; 50% of $B_{35\%}$) in 2025/26, and thus was not overfished, nor has ever been overfished at any point in its history. Total fishing mortality during the 2025/26 season was 1,794 t (3.955 mil lb) in the EAG and 547 t (1.206 mil lb) in the WAG (2,341 t; 5.161 mil lb combined). At the time of writing this document groundfish bycatch fisheries are ongoing. Completed fishery totals are not anticipated to exceed the OFL of 3.166 kt (6.980 mil lb). Estimated fully selected fishing mortality (F) and MMB relative to fishing mortality and biomass targets suggest fishery management has been conservative in recent history in the EAG, and somewhat aggressive in the WAG. Based on all model scenarios, estimated F exceeded the F_{OFL} control rule in a number of seasons, but most recently 2018/19 - 2023/24.

Status and catch specifications for models EAG and WAG combined. Model 26.0a was used for 2026/27 reference points.

1,000 t

Year	MSST	Biomass (MMB_{mating})	TAC	Retained Catch*	Total Catch*	OFL	ABC
2022/23	5.832	13.600	2.291	2.369	2.612	3.761	2.821
2023/24	5.772	12.716	2.508	2.578	2.765	4.182	3.137
2024/25	5.632	11.087	2.214	2.287	2.426	3.725	2.794
2025/26	5.579	10.858	1.901	1.943	2.341	3.166	2.374
2026/27		10.670				3.493	2.620

Million lb

Year	MSST	Biomass (MMB_{mating})	TAC	Retained Catch*	Total Catch*	OFL	ABC
2022/23	12.857	29.983	5.051	5.223	5.758	8.292	6.219
2023/24	12.725	28.034	5.530	5.684	6.096	9.220	6.916
2024/25	12.417	24.443	4.881	5.042	5.348	8.212	6.159
2025/26	12.300	23.938	4.191	4.284	5.161	6.980	5.234
2026/27		23.523				7.701	5.776

2022/23 refence points were estimated before the WAG fishery was completed.
2023/24 refence points were estimated before EAG and WAG fisheries were completed.
2025/26 refence points were estimated before the EAG fishery was completed.
Does not include confidential state water fishery catch in 2025/26.

6. **Basis for the OFL**:

Basis for the OFL from EAG accepted models.
1000 t

Year	Tier	B_{MSY}	(MMB_{mating})	Stock Status	F_{OFL}	Basis for B_{MSY}	Natural Mortality
2022/23	3a	6.630	7.390	1.12	0.52	1987 - 2017	0.21
2023/24	3a	6.680	7.490	1.12	0.59	1987 - 2017	0.22
2024/25	3a	6.905	7.551	1.09	0.55	1987 - 2020	0.22
2025/26	3a	6.734	6.906	1.03	0.52	1987 - 2021	0.22
2026/27	3b	6.687	6.680	0.96	0.49	1987 - 2022	0.22

Million lb

Year	Tier	B_{MSY}	(MMB_{mating})	Stock Status	F_{OFL}	$\bar{R}$ Basis for B_{MSY}	Natural Mortality
2022/23	3a	14.617	16.292	1.12	0.52	1987 - 2017	0.21
2023/24	3a	14.727	16.513	1.12	0.59	1987 - 2017	0.22
2024/25	3a	15.223	16.647	1.09	0.55	1987 - 2020	0.22
2025/26	3a	14.847	15.224	1.03	0.52	1987 - 2021	0.22
2026/27	3b	14.742	14.728	0.96	0.49	1987 - 2022	0.22

Basis for the OFL from WAG accepted models.
1,000 t

Year	Tier	B_{MSY}	(MMB_{mating})	Stock Status	F_{OFL}	$\bar{R}$ Basis for B_{MSY}	Natural Mortality
2022/23	3b	5.090	4.550	0.89	0.49	1987 - 2017	0.21
2023/24	3b	4.982	4.570	0.92	0.50	1987 - 2017	0.22
2024/25	3b	4.638	3.837	0.83	0.44	1987 - 2020	0.22
2025/26	3b	4.530	3.570	0.79	0.39	1987 - 2021	0.22
2026/27	3b	4.470	3.990	0.96	0.50	1987 - 2022	0.22

Million lb

Year	Tier	B_{MSY}	(MMB_{mating})	Stock Status	F_{OFL}	$\bar{R}$ Basis for B_{MSY}	Natural Mortality
2022/23	3b	11.222	10.031	0.89	0.49	1987 - 2017	0.21
2023/24	3b	10.983	10.075	0.92	0.50	1987 - 2017	0.22
2024/25	3b	10.226	8.460	0.83	0.44	1987 - 2020	0.22
2025/26	3b	9.986	7.870	0.79	0.39	1987 - 2021	0.22
2026/27	3b	9.855	8.796	0.96	0.50	1987 - 2022	0.22

A. Summary of Major Changes

1. Changes in management of the fishery

There are no new changes in management of the fishery in federal waters. In March 2025 the Alaska Board of Fisheries established an open-access commercial fishery for golden king crab in state waters (0–3 nm) of King Crab Registration Area O, east of 169°W longitude. The fishing season is from September 1 to April 30 with a guideline harvest limit (GHL) of 23 t (50,000 lb). The fishery is limited to a total of 400 individually buoyed pots (i.e., no long lining) and participating vessels must be 58 ft or less. Pots are limited to a maximum of 90 per vessel. Operators are required to report catch and pot lifts, but there is no at-sea observer coverage. The state waters GHL was intended to utilize a the portion of the ABC not captured by the TAC of the federal waters fishery, and does not influence the size of the EAG TAC. Only one vessel made landings during the 2025-26 state waters fishery so catch data are confidential and not reported here.

2. Changes to the input data

a) Updated directed fishery total catch 1990 - 2025 (Appendix A);

b) Updated directed fishery total length composition data 1990 - 2025 (Appendix A);

c) Updated observer CPUE index 2005 - 2025 (Appendix B);

d) Retained catch for the directed fishery during the 2025/26 season;

e) Total catch for the directed fishery during the 2025/26 season;

f) Bycatch in groundfish fisheries during the 2025 crab year;

g) Retained and total length composition data for the directed fishery during the 2025/26 season;

h) Observer size composition data include data from all rectangular shaped pots to better estimate total size composition in the WAG in 1993 (Jackson 2024b).

3. Changes in assessment methodology

a) Update to GMACS version 2.20.34b;

b) Average recruitment reference period for calculation of $B_{35\%}$ updated to 1987 - 2022;

c) Four models are compared in this report (See Section E.3.a for details):

- **23.1c**: 2024 base model, with updated time series data, and alternative bias correction on recruitment deviations from 1960 - 1981;
- **26.0**: Model 23.1c, with spatiotemporal standardized CPUE index, catchability time-blocks 1995 - 2004 and 2005 - 2024;
- **26.0a**: Model 26.0, non-equilibrium initial conditions starting in 1981 and equal emphasis factors ($\lambda = 1$) on all likelihood components;
- **26.1**: Model 26.0a, with additional subdistrict-specific time blocks on directed fishery selectivity (see Section E.3.a).

4. Changes in assessment results

Model 23.1c was recommended by the CPT to replace the 2024 accepted model as the 'base' model since it corrected 1993 size composition data in the WAG and bias correction of recruitment deviations in years preceding data (Jackson 2024b). The alternative models explored here use a spatiotemporal model to standardize the input observer CPUE time series (26.0), initial conditions and catch data weighting (26.0a), and explore time varying selectivity following changes in fleet dynamics during post-rationalization (26.1). The spatiotemporal CPUE standardization better resolved spatial autocorrelation than did the non-spatial general additive models used in the base model (Appendix A). Non-equilibrium initial conditions slightly reduced the number of estimated parameters resulted in marginal change in fits to data components or derived quantities after 1985. Time varying selectivity resulted in some improvements in fits to observer EAG CPUE data, but did not substantially improve the retrospective pattern in MMB. Because the choice of post-rationalization selectivity time blocks was based largely on subjective interpretations of changes in vessel participation and fishing locations, model 26.0a was recommended for the 2025/26 harvest specifications. While the exploration of alternative selectivity time blocks was informative, additional work is needed to better characterize fleet dynamics and the implications of consolidation before adopting a model with more complex selectivity time-block structure for management use.

B. Response to Comments

SSC December 2025

Comment: "*The SSC recommends that the author continue to explore the unaccounted spatially or temporally varying process in the EAG post-rationalized period that was resulting in large additional variance and poor fits.*"

Response: See model 26.1 here. Investigation into time varying processes, especially relating to fishing and fleet consolidation will continue to develop in future cycles.

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Comment: "*The SSC continues to recommend that a future modeling effort incorporate the cooperative industry survey data, but this is not a priority over continued efforts on resolving data conflicts.*"

Response: Noted.

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Comment: "*The author also addressed previous SSC recommendations to calculate a combined OFL by evaluating stock status relative to a combined MMB reference point, then using that status to adjust the F_{OFL} control rule in each area to compute OFLs and summing. The SSC continues to support this method of OFL estimation for 2026. However, CPT was concerned that this approach may not be appropriate now that the EAG and WAG are diverging in population trajectories, and expressed an interest in management approaches that could respond to these diverging trends. The SSC recommends that the CPT explore methods to obtain an overall OFL and ABC to address these concerns. For example, area-specific ABCs could be developed by area to reflect area-specific concerns, then the area ABCs would be summed for an overall ABC.*"

Response: The combined $\mathrm{F_{OFL}}$ method was used here. The CPT did not recommend area specific ABC buffers at this time.

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Comment: "*The SSC recommends revisiting the criteria in the stock structure table and reconsider whether M should be expected to be similar in the EAG and WAG, perhaps through a more simple diagnostic model.*"

Response: The combined EAG/WAG model will be revisited during the next assessment cycle and this can be explored then.

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Comment: "*The SSC agrees with the CPT that the bootstrapping analysis should continue to be explored to address the results but recommends that the author first assess the value of considering chela data with the limited link between physiological and functional maturity, and review of molt increment data and selectivity in fitting tag-recapture data given the issues with model fits to growth.*"

Response: This can be addressed during the next cycle.

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CPT November 2025

Comment: "*The CPT recommended that Tyler bring forward an approach that combines the two areas when considering stock status, but uses area-specific corrections between the F_{MSY} proxy and F_{OFL}.*"

Response: The approach used here uses a combined stock status and subdistrict specific $\mathrm{F_{MSY}}$ proxy to come up with a subdistrict specific $\mathrm{F_{OFL}}$ (though based on a shared stock status).

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Comment: "*For the January modelling workshop the CPT recommended that Tyler explore a combined modelling approach that moves to sex specific fleets, and to run the model using combined vs. area using* *the initial values for the model parameters to check that all the penalties and likelihood components are the same.*"

Response: A more detailed bridging analysis will be done in the next assessment cycle.

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Comment: "*The CPT recommended that the bootstrap analysis should be further explored before bootstrapping is excluded from consideration.*"

Response: This will be revisited during the next cycle.

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SSC June 2025

Comment: "*The SSC supports the recommended OFL calculation approach as specified in the current assessment. For future consideration, the SSC recommends returning to calculation of a single OFL and ABC for the combined model results (as in 2017)*"

Response: The 2017 combined calculation method was used here.

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Comment: "*The SSC recommends continued exploration into either a single-area or a two-area spatially explicit model, noting that a two-area spatially explicit model may serve as a bridge between previous separate model approaches and a combined model approach.*"

Response: The current GMACS framework is not able to accommodate subpopulation dynamics. A combined model was explored by Jackson (2025) which considers the EAG and WAG subdistricts as different sexes. It was not recommended for the final assessment, but will be revisited during the next cycle.

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Comment: "*The authors and CPT should provide a table reporting the historical OFL buffers used in this stock to inform future discussions on the incorporation of uncertainty (see General BSAI Crab Comments)*"

Response: This was not done in time for the final assessment, but can be produced during a future assessment cycle.

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Comment: "*The author and CPT should explore metrics to determine if changes in CPUE are due to changes in fishing behavior (e.g. changes in number of strings or number of pots per boat) as was suggested during public testimony*"

Response: Data confidentiality requirements limit what data and analyses can be shown to address this public testimony. Data were reviewed by ADF&G staff.

In a catch limit managed fishery, totals in the number of pots fished during a season is inextricably linked to CPUE and thus abundance. Instead, I summarized the number of declared pots at vessel registration and used daily fish log (DFL) data since 2017. DFL data contain the location, set date, haul date, number of pots and CPUE of each string. Thus, I could ascertain the number, density, and performance of active pots for each vessel at any point in the season. As a conservative approach, I summarized number of active pots in the context of the mid-point of each vessel's operations within a specific location. This is typically when they have the most active gear in the water, since number of active pots by day is approximately dome-shaped. Precise timing varies by vessel and location. Data were examined at locations that were fished by multiple vessels - though not necessarily always at the same time. Spatial scale included both statistical area and 10 sq km bins based on the center latitude and longitude of each string.

The *Aleutian No 1* consistently declares more pots at registration than the *Alaska Trojan*, and did increase pots markedly in 2023 after transferring gear from the *Patricia Lee*. The *Alaska Trojan* has also increased their declared pots gradually since 2010. In all years (except 2017), the *Aleutian No 1* has fished more pots on any given day during their season, than did the *Alaska Trojan*. On an annual basis, the number of actively fishing pots at the mid-point of the season has increased for both vessels in recent years, but more drastically for the *Aleutian No 1* in 2023, which aligns with what was declared at vessel registration. While the *Alaska Trojan* has seen a decrease in CPUE that started bottoming out in 2022, the *Aleutian No 1* saw a small CPUE increase after a period of decline, despite increasing the number of pots fished.

Only a handful of statistical areas have vessel overlap for most years in which DFL data are available. Among these, it is not clear that the *Aleutian No 1* considerably displaced the *Alaska Trojan*, except for maybe in 2023. In many of these stat areas, the CPUE of the *Alaska Trojan* did not appear to be negatively impacted. On a finer scale, I combined 10 sq km bins that did or did not have overlap with other vessels fishing concurrently. The trend in CPUE during the last few seasons for these designations is not necessarily the same, but not in stark contrast. **Taken together, it doesn't appear that lack of cooperation in the WAG is impacting fishing performance in a way that would downwardly bias the overall index of abundance used in the assessment**. That said, this is a very cursory look at the data. These data were not collected to monitor vessel overlap (i.e., no sampling design) and it is difficult to disentangle the appropriate spatial scale and timing of in-season overlap that is relevant.

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Comment: "*The author should explore mechanisms for examining the impact on CPUE from within crab fleet gear conflicts or fishing behavior as well as conflicts between crab fleet gear and the gear of the trawl fleet. The current bycatch data in the trawl fisheries may not be sufficient for this, but perhaps could be augmented with data on changes in effort or catch distribution changes*"

Response: This will be explored during a future assessment cycle.

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Comment: "*The author is encouraged to work with ESR authors on developing risk recommendations related to environmental changes. The SSC notes there have been long term environmental changes taking place in the Western Aleutian region*"

Response: The author coordinated with ESR authors prior to the 2026 final assessment.

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Comment: "*The author should create a timeline of the various model changes that have occurred as the models have evolved to map those changes to the historical retrospective changes (see General BSAI Crab Comments)*"

Response: This will be provided during a future final assessment.

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Comment: "*A spatio-temporal model is encouraged. However, the inclusion of the interaction term between soak time and year may alias changes in relative abundance. Some rationale should be given as to including that interaction or this element should be eliminated*"

Response: Better rationale for a soak time:year interaction was included in Appendix A of Jackson (2025). To avoid convergence issues, the iteration used rationalization period instead of year. The purpose in estimating the effect of soak time temporally is to capture a more meaningful effect of soak time, as the functional form of that relationship changes as vessel dynamics in the fishery change. It is possible that soak time is as much a reflection of fishery dynamics, as it is of relative abundance. An interaction between rationalization period and soak time was not used here.

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Comment: "*Keep the SSC informed about future updates on the results from skipper surveys for informing the stock assessment about changes in fishing behavior*"

Response: Updates will be provided when available.

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Comment: "*Continue to work toward developing fishery-independent indices for this stock*"

Response: Development of the 2016 - 2024 fishery independent index was not prioritized during this cycle. There was no 2025 cooperative survey.

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CPT May 2025

Comment: "*Examine time-varying selectivity as a possible solution to the retrospective pattern for the EAG*"

Response: See model 26.1.

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Comment: "*Routinely report "historical analyses" in assessment reports*"

Response: Will present historical analyses in final SAFE documents.

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Comment: "*Explore refinement of the estimates of size-at-maturity (separately for the WAG and EAG and for both areas combined)*"

Response: See Appendix B of Jackson (2025).

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Comment: "*Average stage-1 sample sizes using the harmonic mean and not the arithmetic mean when calculating inputs for the stock assessment*"

Response: Harmonic mean will be used if bootstrap estimated sample sizes are considered again.

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Comment: "*When reporting jitter analyses, restrict the x-axis range so that it is possible to detect non-convergences to objective function values close to the putative MLE*"

Response: A table was present her, rather than a figure, showing all putative converged minima.

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Comment: "*Investigate the possible use of the cooperative Aleutian Islands survey in the EAG for inclusion in future assessments*"

Response: The cooperative survey index was not prioritized this cycle. See models 25.1 and 25.1b in September 2024 (Jackson 2024, link in Literature Cited).

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Comment: "*Tyler should meet with the ESR group to identify potential indicators that could be applicable to AI golden king crab.*"

Response: The author coordinated with ESR authors prior to the final assessment.

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C. Introduction

1. Scientific Name

Golden king crab, (*Lithodes aequispinus*), J.E. Benedict, 1895.

2. Distribution

General distribution of golden king crab is summarized by NMFS (2004). Golden king crab, also called brown king crab, occur from the Sea of Japan to the northern Bering Sea (ca. 61° N latitude), around the Aleutian Islands, generally in high-relief habitat such as inter-island passes, on various sea mounts, and as far south as northern British Columbia (Alice Arm) (Jewett et al. 1985). They are typically found on the continental slope at depths of 300 - 1,000 m on extremely rough bottom. They are frequently found on coral bottom.

The Aleutian Islands king crab stock boundary is defined by the boundaries of the Aleutian Islands king crab Registration Area O (Figure 1). In this chapter, "Aleutian Islands Area" means the area described by the current definition of Aleutian Islands king crab Registration Area O. Nichols et al. (2021) define the boundaries of Aleutian Islands king crab Registration Area O:

> *The Aleutian Islands king crab Registration Area O eastern boundary is the longitude of Scotch Cap Light (164°44.72'W long); the northern boundary is a line from Cape Sarichef (54°36'N lat) to 171°W long, north to 55°30'N lat; and the western boundary the United States–Russia Maritime Boundary Line of 1990.*

During 1984/85 - 1995/96, the Aleutian Islands king crab populations had been managed using the Adak and Dutch Harbor Registration Areas, which were divided at 171° W longitude, but from the 1996/97 season to present the fishery has been managed using a division at 174° W longitude (Figure 1). In March 1996, the Alaska Board of Fisheries (BOF) replaced the Adak and Dutch Harbor areas with the newly created Aleutian Islands Registration Area O and directed ADF&G to manage the golden king crab fishery in the areas east and west of 174°W longitude as two distinct stocks. That re-designation of management areas was intended to reflect golden king crab stock distribution, congruent with the longitudinal pattern in fishery production prior to 1996/97. The longitudinal pattern in fishery production relative to 174° W longitude since 1996/97 is like that observed prior to the change in management area definition, although there have been some changes in the longitudinal pattern in fishery production within the areas east and west of 174° W longitude.

Commercial fishing for golden king crab in the Aleutian Islands Area typically occurs at depths of 100 - 275 fathoms (183 - 503 m) (Gaeuman 2014). Pots sampled by at-sea fishery observers during 1990/91 - 2022/23 were fished at an average depth of 181 fathoms (331 m; N = 57,792) in the area east of 174° W longitude and 178 fathoms (326 m; N = 62,062) for the area west of 174° W longitude.

3. Evidence of stock structure

Given the expansiveness of the Aleutian Islands Area and the existence of deep (> 1,000 m) canyons between some islands, at least some weak structuring of the stock within the area would be expected. Data for making inferences on stock structure of golden king crab within the Aleutian Islands are largely limited to the geographic distribution of commercial fishery catch and effort. Catch data by statistical area from fish tickets and catch data by location from pots sampled by observers suggest that habitat for legal-sized males may be continuous throughout the waters adjacent to the islands in the Aleutian chain. However, regions of low fishery catch suggest that availability of suitable habit may vary longitudinally. Catch has been low in the fishery in the area between 174° W longitude and 176° W longitude (the Adak Island area) in comparison to adjacent areas, a pattern that is consistent with low CPUE for golden king crab between 174° W longitude and 176° W longitude during the 2002, 2004, 2006, 2010, and 2012 NMFS Aleutian Islands bottom trawl surveys (von Szalay et al. 2011, 2017). In addition to longitudinal variation in density, there is also a gap in fishery catch and effort between the Petrel Bank-Petrel Spur area and the Bowers Bank area; both of those areas, which are separated by Bowers Canyon, have reported effort and catch. Recoveries during commercial fisheries of golden king crab tagged during ADF&G surveys (Blau and Pengilly 1994; Blau et al. 1998; Watson and Gish 2002; Watson 2004, 2007) provided no evidence of substantial movements by crab in the size classes that were tagged (males and females $\geq$ 90 mm carapace length [CL]). Maximum straight-line distance between release and recovery location of 90 golden king crab released prior to the 1991/92 fishery and recovered through the 1992/93 fishery was 61.2 km (Blau and Pengilly 1994). Of the 4,567 recoveries reported through April 12, 2016, for the male and female golden king crab tagged and released between 170.5° W longitude and 171.5° W longitude during the 1991, 1997, 2000, 2003, and 2006 ADF&G Aleutian Island golden king pot surveys, none of the 3,807 with recovery locations specified by latitude and longitude were recovered west of 173° W longitude and only 15 were recovered west of 172° W longitude (V. Vanek, ADF&G, Kodiak, pers. comm.). Similarly, of 139 recoveries in which only the statistical area of recovery was reported, none were recovered in statistical areas west of 173° W longitude and only one was in a statistical area west of 172° W longitude. Thus, little mixing of crab found in Dutch Harbor and Adak areas provide a reason for undertaking a separate stock assessment in each area. A population genetic study of golden king crab throughout Alaska suggested heterogeneity separating Aleutian and southeast Alaska regions, but no substructuring within the Aleutian Islands (Grant and Siddon 2018).

4. Life history characteristics relevant to management

There is a paucity of information on golden king crab life history characteristics due in part to the deep depth distribution (~200 - 1000 m) and the asynchronous nature of life history events (Otto and Cummiskey 1985; Somerton and Otto 1986). The reproductive cycle is thought to last approximately 24 months and at any time of year ovigerous females can be found carrying egg clutches in highly disparate developmental states (Otto and Cummiskey 1985). Females carry large, yolk-rich, eggs, which hatch into lecithotrophic larvae (i.e., the larvae can develop successfully to juvenile crab without eating; Shirley and Zhou 1997) that are negatively phototactic (Adams and Paul 1999). Molting and mating are also asynchronous and protracted (Otto and Cummiskey 1985; Shirley and Zhou 1997) with some indications of seasonality (Hiramoto 1985). Molt increment for large males (adults) in Southeast Alaska is 16.3 mm CL per molt (Koeneman and Buchanan 1985) and was estimated at 14.4 mm CL for legal males in the eastern Aleutian Islands (Watson et al. 2002). Annual molting probability of males decreases with increasing size, which results in a protracted inter-molt period and creates difficulty in determining annual molt probability (Watson et al. 2002). Male size-at-maturity varies among stocks (Webb 2014) and declines with increasing latitude from about 130 mm CL in the Aleutian Islands to 92 mm CL in the Saint Matthew Island section (Somerton and Otto 1986).

5. Summary of management history

A complete summary of the management history through 2015/16 is provided in Leon et al. (2017). The first commercial landing of golden king crab in the Aleutian Islands was in 1975/76 but directed fishing did not occur until 1981/82.

The Aleutian Islands golden king crab fishery was restructured beginning in 1996/97 to replace the Adak and Dutch Harbor areas with the newly created Aleutian Islands Registration Area O and golden king crab in the areas east and west of 174° W longitude were managed separately as two stocks (ADF&G 2002). Hereafter, the east of 174° W longitude stock segment is referred to as EAG and the west of 174° W longitude stock segment is referred to as WAG. Tables 1 and 2 provide the historical summary of number of vessels, GHL/TAC, harvest, effort, CPUE, and average weight of crab in the Aleutian Islands golden king crab fishery.

The fisheries in 1996/97 - 1997/98 were managed with GHLs of 1,452 t (3,200,000 lb) in EAG and 1,225 t (2,700,000 lb) in WAG (Table 2). During 1998/99 - 2004/05 the fisheries were managed with GHLs of 1,361 t (3,000,000 lb) for EAG and 1,225 t (2,700,000 lb) for WAG. During 2005/06 - 2007/08 the fisheries were managed with a total allowable catch (TAC) of 1,361 t (3,000,000 lb) for EAG and a TAC of 1,225 t (2,700,000 lb) for WAG. By state regulation (5 AAC 34.612), TAC for the Aleutian Islands golden king crab fishery during 2008/09 - 2011/12 was 1,429 t (3,150,000 lb) for EAG and 1,286 t (2,835,000 lb) for WAG. In March 2012, the BOF changed 5 AAC 34.612 so that the TAC beginning in 2012/13 would be 1,501 t (3,310,000 lb) for EAG and 1,352 t (2,980,000 lb) for WAG. Additionally, the BOF added a provision to 5 AAC 34.612 that allows ADF&G to lower the TAC below the specified level if conservation concerns arise.

The TAC for 2016/17 (and 2017/18) was reduced by 25% for WAG to 1,014 t (2,235,000 lb) while keeping the TAC for EAG at the same level as the previous season.

During 1996/97 - 2022/23 the annual retained catch during commercial fishing (including cost-recovery fishing that occurred during 2013/14 - 2022/23) has averaged 2% below the annual GHL/TACs but has ranged from as much as 13% below (1998/99) to 6% above (2000/01) the GHL/TAC.

A summary of other relevant State of Alaska fishery regulations and management actions pertaining to the Aleutian Islands golden king crab fishery is provided below:

Beginning in 2005/06, the Aleutian Islands golden king crab fishery has been prosecuted under the Crab Rationalization Program. Accompanying the adoption of the crab rationalization program was implementation of a community development quota (CDQ) fishery for golden king crab in the eastern Aleutians (i.e., EAG) and the Adak Community Allocation (ACA) fishery for golden king crab in the western Aleutians (i.e., WAG; Hartill 2012; Nichols et al. 2021). The CDQ fishery in the eastern Aleutians is allocated 10% of the golden king crab TAC for the area east of 174° W longitude and the ACA fishery in the western Aleutians is allocated 10% of the golden king crab TAC for the area west of 174° W longitude. The CDQ fishery and the ACA fishery are managed by ADF&G and prosecuted concurrently with the individual fishing quota (IFQ) fishery.

Golden king crab may be commercially fished only with king crab pots (defined in state regulation 5 AAC 34.050). Pots used to fish for golden king crab in the Aleutian Islands Area must be longlined and, since 1996, each pot must have at least four escape rings of five and one-half inches minimum inside diameter installed on the vertical plane or at least one-third of one vertical surface of the pot composed of not less than nine-inch stretched mesh webbing to permit escapement of undersized golden king crab [5 AAC 34.625 (b)]. Prior to the regulation requiring an escape mechanism on pots, some participants in the Aleutian Islands golden king crab fishery voluntarily sewed escape rings (typically 139 mm [5.5 inches]) into their gear or, more rarely, included panels with escape mesh (Beers 1992). Regarding the gear used since the establishment of 5 AAC 34.625 (b) in 1996, Linda Kozak, a representative of the industry, reported in a 19 September 2008 email to the Crab Plan Team, *"...the golden king crab fleet has modified their gear to allow for small crab sorting,"* and provided a written statement from Lance Nylander, of Dungeness Gear Works (DGW) in Seattle, who *"believes he makes all the gear for the golden king crab harvesting fleet,"* saying that *"Since 1999, DGW has installed 9[inch] escape web on the door of over 95% of Golden Crab pot orders manufactured."* A study to estimate the contact-selection curve for male golden king crab was conducted aboard one vessel commercial fishing for golden king crab during the 2012/13 season, and found gear and fishing practices used by that vessel were highly effective in reducing bycatch of sublegal-sized males and females (Vanek et al. 2013). In March 2011 (effective for 2011/12), the BOF amended 5 AAC 34.625 (b) to relax the "biotwine" specification for pots used in the Aleutian Islands golden king crab fishery relative to the requirement in 5 AAC 39.145 that *"(1) a sidewall...of all shellfish and bottom fish pots must contain an opening equal to or exceeding 18 inches in length...The opening must be laced, sewn, or secured together by a single length of untreated, 100 percent cotton twine, no larger than 30 thread."* Regulation 5 AAC 34.625 (b)(1) allows the opening described in 5 AAC 39.145 (1) to be *"laced, sewn, or secured together by a single length of untreated, 100 percent cotton twine, no larger than 60 [rather than 30] thread."*

Regulation (5 AAC 34.610 (b)) sets the commercial fishing season for golden king crab in the Aleutian Islands Area as 1 August through 30 April. That regulatory fishing season became effective in 2015/16 (the commercial fishing season was set in regulation as 15 August through 15 May during 2005/06 - 2014/15).

Current regulations (5 AAC 39.645 (d)(4)(A)) stipulate that onboard observers are required on catcher vessels during the time that at least 50% of the retained catch is captured in each of the three trimesters of the 9 month fishing season. Onboard observers are required for 100% of fishing activity on catcher-processor vessels during the crab fishing season.

In addition, the commercial golden king crab fishery in the Aleutian Islands Area may only retain males at least 6.0 inches (152.4 mm) carapace width (CW), including spines [5 AAC 34.620 (b)], which is at least one annual molt increment larger than the 50% maturity length of 120.8 mm CL for males as estimated by Otto and Cummiskey (1985). A carapace length (CL) $\geq$ 136 mm is used to identify legal-size males when CW measurements are not available (Table 3-5 in NPFMC 2007b). Note that the size limit for golden king crab has been 6 inches (152.4 mm) CW for the entire Aleutian Islands Area since the 1985/86 season. Prior to the 1985/86 season, the legal-size limit was 6.5 inches (165.1 mm) CW for at least one of the now-defunct Adak or Dutch Harbor Registration Areas.

The male maturity size using 1991 pot survey measurements of carapace length and chela height in EAG and 1984 NMFS measurements in WAG were re-evaluated (Siddeek et al. 2018). Bootstrap analysis of chela height and carapace length data provided the median 50% male maturity length estimates of 107.02 mm CL in EAG and 107.85 mm CL in WAG. The knife-edge maturity size of 111.0 mm CL, which is the lower limit of the next upper size bin, has been used for mature male biomass (MMB) estimation. Recently collected (2018 to 2020) chela height and carapace length data were analyzed and proposed a higher knife-edge maturity length of 116.0 mm CL for MMB calculation, which was accepted by the CPT/SSC in 2022 (Siddeek et al. 2022).

Daily catch and catch-per-unit effort (CPUE) are determined in-season to monitor fishery performance and progress towards the respective TACs. Increases in CPUE were observed during the late 1990s through the early 2000s, and with the implementation of crab rationalization in 2005. This was likely due to changes in gear configurations in the late 1990s (crab harvesters, personal communication, 1 July 2008), and after rationalization due to increased soak time (Siddeek et al. 2015) and decreased competition. Decreased competition could allow crab vessels to target only the most productive fishing areas. Trends in fishery nominal CPUE within the areas EAG and WAG generally paralleled each other during 1985/86 - 2010/11 but diverged thereafter (EAG CPUE exceeded one and half times of that in WAG). A moderate decreasing trend in CPUE was observed since 2014 in EAG and since 2019 in WAG. EAG CPUE in 2025/26 (32 crab per pot) was the lowest since 2017, though CPUE in the WAG (18 crab per pot) was the second highest during the same time period, rebounding from a near post-rationalization low (Table 1 and 2).

In March 2025 the Alaska Board of Fisheries established an open-access commercial fishery for golden king crab in state waters (0–3 nm) of King Crab Registration Area O, east of 169°W longitude. The fishing season is from September 1 to April 30 with a guideline harvest limit (GHL) of 23 t (50,000 lb). The fishery is limited to a total of 400 individually buoyed pots (i.e., no long lining) and participating vessels must be 58 ft or less. Pots are limited to a maximum of 90 per vessel. Operators are required to report catch and pot lifts, but there is no at-sea observer coverage. The state waters GHL was intended utilize the portion of the ABC of the federal waters fishery not captured by the TAC, and does not influence the size of the EAG TAC. Only one vessel made landings during the 2025-26 state waters fishery so catch data are confidential and not reported here.

6. Brief description of the annual ADF&G harvest strategy

In March 2019, the BOF adopted a revised harvest strategy (Daly et al. 2019). The annual TAC is set by state regulation, 5 AAC 34.612 (Harvest Levels for Golden King Crab in Registration Area O), per:

a. In that portion of the Registration Area O east of 174° W longitude, the total allowable catch level shall be established as follows:

   (a) if MMA_E is less than 25% of $MMA_{E,1985-2017}$, the fishery will not open;

   (b) if MMA_E is at least 25% but not greater than 100 percent of $MMA_{E,1985-2017}$, the number of legal male golden king crab available for harvest will be computed as (0.15) x ($MMA_E/MMA_{E,1985-2017}$) x (MMA_E) or 25% of LMA_E, whichever is less; and

   (c) if MMA_E is greater than 100 percent of $MMA_{E,1985-2017}$, the number of legal male golden king crab available for harvest will be computed as (0.15) x (MMA_E) or 25% of LMA_E, whichever is less.

b. (b) In that portion of the Registration Area O west of 174° W longitude, the total allowable catch level shall be established as follows:

   (a) if MMA_W is less than 25% of $MMA_{W,1985-2017}$, the fishery will not open;

(b) if MMA_W is at least 25% but not greater than 100 percent of $\text{MMA}_{W,1985-2017}$, the number of legal male golden king crab available for harvest will be computed as (0.20) x ($\text{MMA}_W/\text{MMA}_{W,1985-2017}$) x ($\text{MMA}_W$) or 25% of LMA_W, whichever is less; and

(c) if MMA_W is greater than 100 percent of $\text{MMA}_{W,1985-2017}$, the number of legal male golden king crab available for harvest will be computed as (0.20) x (MMA_W) or 25% of LMA_W, whichever is less.

c. In implementing this harvest strategy, the department shall consider the reliability of estimates of golden king crab, the manageability of the fishery, and other factors the department determines necessary to be consistent with sustained yield principles and to use the best scientific information available and consider all sources of uncertainty as necessary to avoid overfishing.

d. In this section,

(a) MMA_E means the abundance of male golden king crab in the portion of the Aleutian Islands Management Area O east of 174° W longitude that are greater than or equal to 116 millimeters in carapace length estimated by the stock assessment model for the time prior to the start of the fishery;

(b) $\text{MMA}_{E,1985-2017}$ means the mean value of the abundance of male golden king crab in the portion of the Aleutian Islands Management Area O east of 174° W longitude that are greater than or equal to 116 millimeters in carapace length estimated by the stock assessment model for the time prior to the start of the fishery for the period 1985 – 2017;

(c) LMA_E means the abundance of male golden king crab in the portion of the Aleutian Islands Management Area O east of 174° W longitude that are greater than or equal to 136 millimeters in carapace length estimated by the stock assessment model for the time prior to the start of the fishery;

(d) MMA_W means the abundance of male golden king crab in the portion of the Aleutian Islands Management Area O west of 174° W longitude that are greater than or equal to 116 millimeters in carapace length estimated by the stock assessment model for the time prior to the start of the fishery;

(e) $\text{MMA}_{W,1985-2017}$ means the mean value of the abundance of male golden king crab in the portion of the Aleutian Islands Management Area O west of 174° W longitude that are greater than or equal to 116 millimeters in carapace length estimated by the stock assessment model for the time prior to the start of the fishery for the period 1985 – 2017;

(f) LMA_W means the abundance of male golden king crab in the portion of the Aleutian Islands Management Area O west of 174° W longitude that are greater than or equal to 136 millimeters in carapace length estimated by the stock assessment model for the time prior to the start of the fishery.

In addition to the retained catch that is limited by the TAC established by ADF&G under 5 AAC 34.612, ADF&G has authority to annually receive receipts up to $500,000 through cost-recovery fishing on Aleutian Islands golden king crab. The retained catch from that cost-recovery fishing is not counted against attainment of the annually established TAC.

7. Summary of the history of the basis and estimates of MMB_{MSY} or proxy MMB_{MSY}

The $\text{MMB}^{35\%}$ is estimated as a proxy for MMB_{MSY} using the Tier 3 estimation procedure, which is explained in a subsequent section.

8. Justification for assessing Aleutian Islands golden king crab as two sub stocks

We modeled EAG and WAG stocks separately for several reasons:

1. Fishery catch data (e.g., CPUE magnitude and CPUE temporal trends) suggest that the productivity is different between the two areas;
2. WAG has a wider area of stock distribution compared to limited area distribution in EAG;
3. The fishing areas are spatially separated with an area gap between EAG and WAG. Regions of low fishery catch suggest that availability of suitable habitat may vary longitudinally;
4. Tagging studies have shown little mixing between the two areas (Watson and Gish 2002);
5. Currents are known to be strong around the Aleutian Islands, thus larval mixing between the two regions may occur. Yet needed data to confirm larval drift trajectories or horizontal displacement are lacking. Unlike other king crabs, golden king crab females carry large, yolk-rich, eggs, which hatch into lecithotrophic (non-feeding) larvae that do not require a pelagic distribution for encountering food items. Depth at larval release, the lecithotrophic nature of larvae, and swimming inactivity in lab studies implies benthic distributions, which may limit larval drift between areas if horizontal current velocities are reduced at depth;
6. Integrating contrasting data in one single model may provide parameter estimates in between the two extremes which would not be applicable to either (Richards 1991; Schnute and Hilborn 1993);
7. Area specific assessment is superior to a holistic approach for this stock because of the patchy nature of golden king crab distribution;
8. Alaska Board of Fisheries decided to manage the two areas with separate total allowable catches;
9. Genetic analysis shows no significant differentiation between areas within the Aleutian Island population (Grant and Siddon 2018), thus there is no genetic support for subdividing this population; however, the above listed factors support separate stock assessments in the two regions.

D. Data

1. Summary of new information

- Directed fishery retained and total catch, retained and total catch size compositions, and CPUE index from the 2025/26 season.
- Male bycatch from 2025 groundfish fisheries.

2. Time series data

Prior to the crab rationalization, AIGKC regulatory seasons did not conform to the end of the post-rationalization 'crab year' (July - June). Time series data prior to 2005 were date corrected so that data collected after the end of the crab year (i.e., the June following the season opening) were applied to the next crab year. In practice, this affects data collected prior to the 2000/01 season.

a. Directed fishery catch

Retained catch (t) in the directed fishery was summarized from fish ticket data for 1981 - present. Retained catch is only available in units of numbers from 1981 - 1984. Total catch (t) of male crab was estimated from a combination of fish ticket and observer data for 1990 - present. Handling mortality for directed fishery discards is assumed to be 20%.

Total catch estimates for 1993/94 are not used in EAG models. The 1993/94 season in the EAG (east of 171° W lon) was open from September 1, 1993 to March 1, 1994, and there was no observer coverage in the

EAG during that season. Observer data that are assigned to the 1993/94 EAG season were actually from the easternmost portion (174° W lon - 171° W lon) of the WAG fishery in 1992/93, which ran from November 1, 1992 to August 15, 1993 (i.e., July 1 - August 15, 1993 get assigned to the 1993/94 crab year).

b. Bycatch in groundfish fisheries

Bycatch of male GKC in groundfish fisheries was estimated for trawl and fixed gear fisheries from observer data for 1991 - present in the EAG and 1994 - present in the WAG. Analyses assume handling mortality of 80% for trawl fisheries and 50% for fixed gear fisheries.

c. Size composition

Retained and total catch size compositions of males in the directed fishery was estimated from retained catch sampling and on-board observer data. Retained catch size frequencies are available from 1985 - present and observer size frequencies are available from 1990 - present.

Previous assessments removed various uncommon or non-target species gear types by recommendation from the fleet (M. Siddeek, ADF&G personal communication, 2023). Those include: Dungeness crab pots, pyramid pots, conical pots, hair crab pots, snail pots, cods, dome shaped pots, ADF&G research pots with stretch mesh instead of escape rings, and rectangular pots measuring 9'x 9', 8 1/2' x 8 1/2', 9 1/2' x 9 1/2', 8' x 9', 8' x 10', 9' x 10', 7' x 8', or with unknown dimension. In 1993, nearly all WAG observer (162 / 174) pots belonged to one of those categories, mostly unknown sized rectangular pots (160). Including all rectangular pots has little impact on the size composition in other years in either subdistrict, so the total size composition time series was revised to include all rectangular pots (Jackson 2024b).

d. Catch per unit effort (CPUE)

Directed fishery catch per unit effort (CPUE) was estimated as the number of crab per pot lift from 1985 - present. Nominal CPUE data were standardized for model 23.1c using generalized additive models in three eras: 1) fish ticket CPUE 1985 - 1998, and 2) observer CPUE from 1995 - 2005 and 3) 2005 - present (Appendix A). Model 26.0, 26.0a, and 26.1 used a spatiotemporal generalized linear mixed model to standardize observer CPUE data from 1995 - present as a single index (Appendix A). Models fit the standardized index with two catchability time blocks corresponding to crab rationalization, as in model 23.1c.

e. Incomplete directed fishery

In the event that the most recent directed fishery is not complete by the time data must be prepared for the final assessment, terminal year data are estimated with the following assumptions:

- Retained catch equals the total allowable catch (TAC);
- Total catch is estimated as usual, though using the observer CPUE ($U_{obs,group}$, crab per pot lift) to-date and total directed effort (N) as

$$N = \frac{\text{TAC}}{wU_{ft}} \tag{1}$$

  where w is the average calculated weight of legal males in the fishery based on observer samples to-date, and U_{ft} is the retained legal male CPUE to date;
- Retained catch size composition is estimated based on dockside samples to-date;
- Total catch size composition is estimated based on observer samples to-date.

Models are re-run with completed data prior to determining the TAC for the upcoming season. At the time of preparing this document, the 2025/26 fishery was completed in both subdistricts.

3. Aggregated data

a. Tagging data

Tag release - recapture - time at liberty records from 1991, 1997, 2000, 2003, and 2006 male tag crab releases were aggregated by year at liberty to determine the molt increment and size transition matrix within GMACS.

b. Weight-at-length

Male length-weight relationship: $W = aL^b$ where $a = 1.445\text{e\^{}}{-4}$, $b = 3.28113$.

c. Natural mortality

Siddeek et al. (2022) used a tag recapture model to estimate a fixed natural mortality value of 0.22 yr^{-1}.

4. Available data excluded from the assessment

a. Triennial pot surveys

Data from triennial ADF&G pot surveys for Aleutian Islands golden king crab in a limited area in EAG (between 170° 21’ and 171° 33’ W longitude) that were performed during 1997 (Blau et al. 1998), 2000 (Watson and Gish 2002), 2003 (Watson 2004), and 2006 (Watson 2007) are available, but were not used as index in this assessment. It may be possible to explore the utility of these data as an index of abundance or informing selectivity in future model explorations. Tag release and recapture data from these surveys were used to estimate the model growth matrix.

b. Cooperative survey

The AIGKC cooperative pot survey was initiated in 2015 in the EAG and has continued every year since with the exception of 2020 and 2025. The survey was extended to WAG in 2018. The main purpose of the survey is to generate a cost effective data stream available to the stock assessment that is spatially representative and less susceptible to hyperstability than fishery CPUE. The survey has occurred during the beginning of each season, with participating vessels setting pots strings at pre-determined stations and later picking strings with ADF&G staff on board for collection of biological data. Survey data is available for 2015 - 2022 in the EAG and 2018 and 2019 in the WAG. A summary of analysis of cooperative survey data can be found in Appendix A of Jackson (2024). Models utilizing survey CPUE and size composition data were not recommended by the CPT and SSC for the 2026 final assessment.

E. Analytic Approach

1. History of modeling approaches for this stock

A size structured assessment model (hereafter referred to as the legacy model) based on only fisheries data for the EAG and WAG golden king crab stocks was accepted in 2016, and used to set OFL and ABC for the 2017/18 season (Siddeek et al. 2017). The CPT (January 2017) and SSC (February 2017) recommended using the Tier 3 F_{OFL} control rules to set the OFL and ABC. The legacy model was used from 2016 - 2022, and transitioned to the GMACS modelling framework. The CPT and SSC adopted a GMACS implementation of the assessment in May 2023. Progress of GMACS development has been documented on the GitHub development site (GMACS-project).

2. Model Description

a-f. See GMACS-project GitHub

g. Critical assumptions of the model

1. Directed fishery removals occur as a pulse at the mid-point of the season;
2. Natural mortality, M, was constant at 0.22 yr^{-1} based on analysis of tagging data (Siddeek et al. 2022);
3. Observer and fish ticket CPUE indices were assumed to be linearly related to exploitable abundance. The base model (23.1c) assumes three catchability and selectivity time blocks (fish ticket data 1985 - 1998, observer data 1995 - 2004 and 2005 - 2023). Selectivity is logistic;
4. Extra variance on standardized CPUE indices was estimated for each catchability period;
5. Male maturity was knife-edged, at 116 mm CL based on previous chela height analysis (Siddeek et al. 2018, 2022);
6. Discard handling mortality was 0.2 yr^{-1} in the directed fishery;
7. Bycatch mortality in groundfish fisheries was the weighted average of groundfish pot fishery mortality (0.5 yr^{-1}) and groundfish trawl fishery mortality (0.8 yr^{-1}). Groundfish fishery selectivity was set at full selection for all length classes (selectivity = 1.0);
8. Observation errors are log-normal for catch and index data and multinomial for length composition data.

h. Changes to the above since the previous assessment

None.

i. Model code had been checked and validated

GMACS code has been checked at various times by developers and independent reviewers. GMACS code and input files used in this report can be accessed here: ADF&G BSAI Crab Assessments GitHub.

3. Model Selection and Evaluation

a. Alternative model configurations

Four models were evaluated for the EAG and WAG:

- **23.1c**: The base model from the 2024 final assessment (23.1; Jackson 2024) with updated time series data and CPUE indices, and corrected recruitment bias correction from 1960 - 1980 (Jackson 2024b), accepted in 2025 and updated to GMACS version 2.20.34b. This model considers:

(i) Initial abundance by the equilibrium condition considering the mean number of recruits for 1987–2021: The equilibrium abundance was determined for 1960, projected forward with only M and annual recruits until 1980, then retained catch removed during 1981–1984 and projected to obtain the initial abundance in 1985;

(ii) Fish ticket CPUE index for 1985 - 1998, with index specific catchability and logistic selectivity;

(iii) Observer CPUE indices for 1995/96 - 2004/05 and 2005/06 - 2024/25, with index specific catchability and logistic selectivity;

(iv) Initial (Stage-1) weighting of effective sample sizes: number of vessel-days for retained and total catch size compositions; and (Stage-2) iterative re-weighting of effective sample sizes by the Francis method;

(v) Logistic directed fishery retention in a single time block;

(vi) Full selectivity (selectivity = 1.0) for groundfish fishery bycatch;

(vii) Knife-edge maturity size of 116 mm CL;

(viii) Natural mortality, $M = 0.22$ yr^{-1}, directed fishery handling mortality = 0.2 yr^{-1}, and weight groundfish bycatch mortality based on the annual proportion of trawl (0.8 yr^{-1}) and fixed-gear (0.5 yr^{-1}) bycatch;

(ix) Size transition matrix using tagging data estimated by the normal probability function with the logistic molt probability sub-model. The tag-recaptures were treated as Bernoulli trials (i.e., Stage-1 weighting);

(x) The period, 1987–2021, was used to determine the mean number of recruits for $\text{MMB}_{35\%}$ (a proxy for MMB_{MSY}) estimation under Tier 3.

- **26.0**: Model 23.1c, with spatiotemporal standardized CPUE index, catchability time-blocks 1995 - 2004 and 2005 - 2024;
- **26.0a**: Model 26.0, non-equilibrium initial conditions starting in 1981 and equal emphasis factors ($\lambda = 1$) on all likelihood components;
- **26.1**: Model 26.0a, with additional subdistrict specific time blocks on directed fishery selectivity (below).

In May 2025, the CPT recommended revisiting selectivity time blocks in response to unresolved poor fits to EAG index data. Process error associated with selectivity and catchability here are likely related to changing fleet dynamics. It is important to clarify that "selectivity" in this context refers to the combination of animal availability to fishing grounds and selectivity by the gear (Sampson 2014). During the pre-rationalized era there was a greater number and diversity of fishing vessels with more competitive, overlapping fishing grounds and less selective fishing behavior. Crab rationalization resulted in a drastic downsizing of the fleet in both subdistricts initially, and since then there has been further consolidation of vessels and vessel-specific fishing grounds (Figure 3 - 5). These changes in fleet dynamics are clearly evidenced by observer data, but unaccounted for in the post-rationalized era.

Model 26.1 used the multiple post-rationalization time blocks for selectivity, while maintaining a single post-rationalization block for catchability. Additional EAG time blocks included the the early post-rationalization fleet consolidation from 2005 - 2007, a period from 2008 - 2013 after further consolidation, a period from 2014 - 2021 corresponding to the swap of the *F/V Aleutian No. 1* and *F/V Patricia Lee*, and from 2022 to present after the departure of those vessels. WAG time blocks include 2005 - 2015 when the fishery was dominated by three vessels, 2016 - 2020 when the *F/V Early Dawn* was present and the *F/V Patricia Lee* was not, and from 2021 to present when most observed data were collected aboard the *F/V Alaska Trojan* and *F/V Aleutian No. 1* (Figure 3). Note that instances exist where vessels may have fulfilled observer coverage requirements in the broader AIGKC fishery, but may not be represented in the observer data at the subdistrict level (e.g., only one trip was made to the EAG and during an unobserved leg of the season). These circumstances were rare and likely not influential.

b. Progression of results

See the new results at the beginning of the report.

c. Evidence of search for balance between realistic and simpler models

Unlike annually surveyed stocks, Aleutian Islands golden king crab stock biomass is difficult to track, and several biological parameters are assumed based on knowledge from red king crab (e.g., handling mortality rate of 0.2 yr^{-1}) due to a lack of species/stock specific information. Several model parameters were fixed after initially running the model with free parameters to reduce the number of parameters to be estimated (e.g., groundfish bycatch selectivity parameters were fixed). In CPUE standardization, instead of using the traditional AIC, the Consistent Akaike Information Criteria (Bozdogan 1987) was used that considers number of parameters and data points used for fitting models when selecting the final model. The assessment models also considered different configuration of parameters to select parsimonious models. The detailed results of all models are provided in tables and figures.

d. Convergence status/criteria

ADMB default convergence criteria. A jittering analysis (described below) was performed to assess convergence to a global minimum.

e. Sample sizes for length composition data

The initial input sample sizes were estimated either as number of vessel-days for retained, or observer-days for total catch size compositions. Then effective sample sizes were iteratively re-weighted using the Francis (2011, 2017) mean length-based method (Table 6 - 7).

f. Credible parameter estimates

All estimated parameters seem to be credible and within bounds.

g. Model selection criteria

The likelihood values are used to select among alternatives that could be legitimately compared by that criterion. Only total negative log-likelihoods of models 26.0a and 26.1 are comparable due to differences in CPUE data and data weighting.

h. Residual analysis

Residual plots are illustrated in various figures for CPUE standardization. One step ahead (OSA) residuals were computed for size composition data using the R package *compResidual* (Trijoulet and Nielsen 2022). OSA residuals are preferred for diagnosis of multivariate models because they account for correlation among size bins and conform to a standard normal distribution for correctly specified models (Trijoulet et al. 2023).

i. Model evaluation

Provided under Results, below.

j. Retrospective analysis

Retrospective patterns were evaluated by iteratively re-running a model and 'peeling' (i.e. removing) the terminal year for each iteration. Mohn's ρ (Mohn 1999) was used to compare retrospective patterns in MMB between models:

$$\text{Mohn's } \rho = \frac{1}{n}\sum_{y=1}^{n}\frac{\text{MMB}_y - MMB}{MMB} \tag{2}$$

where MMB_y is the terminal year mature male biomass for each peel, MMB is the mature male biomass for the full model, and n is the number of peels.

k. Historical analysis

Abundance trajectories from previous assessment models were compared to examine the degree of historical bias in derived quantities. Since size at maturity has changed in previous assessments, legal male ($\geq$ 138 mm CL) abundance was plotted here.

k. Jittering

Initial starting values were 'jittered' and the model refit to examine the likelihood surface surrounding the putative maximum likelihood estimate (MLE). Jittered initial parameter values (θ_0) were computed as

$$\theta_0 = \begin{cases} \theta_{\text{init}} + \varepsilon \cdot (\theta_{\text{ub}} - \theta_{\text{init}}) \cdot \dfrac{\sigma_J}{4} & \text{if } \varepsilon > 0 \\ \theta_{\text{init}} + \varepsilon \cdot (\theta_{\text{init}} - \theta_{\text{lb}}) \cdot \dfrac{\sigma_J}{4} & \text{if } \varepsilon \leq 0 \end{cases} \tag{3}$$

where ε is a random draw from a standard normal distribution, σ_J was the jitter scale ($\sigma_J = 0.3$), and θ_{init}, θ_{lb}, and θ_{ub} are the parameters specified starting value and associated bounds. Each model was re-run in 100 iterations and the distributions of resulting objective functions and reference points were examined.

4. Results

a. Effective sample sizes and weighting factors

Weighting factors were used for catch biomass, recruitment deviation, pot fishery F, and groundfish fishery F. The retained catch biomass weight was set to an arbitrarily large value 500.0 (corresponding to a CV of 0.0316), because retained catch data are more reliable than any other data sets. The total catch biomass weight was scaled in accordance with the observer annual sample sizes (number of non-zero pots) with a maximum of 250.0 (corresponding to variable CV; Table 3). A small groundfish bycatch weight (0.5 corresponding to a CV of 1.3108) was chosen based on the September 2015 CPT suggestion. The CPUE weights were set to 1.0 for all models. A constant (model estimated) variance was included in addition to input CPUE variance for the CPUE fit. Estimates of additional variance tend to be larger for EAG models than WAG, and smallest for model 26.1, which estimated additional selectivity time blocks (Table 11 - 12). Input and re-weighted effective sample sizes for retained and total catch size compositions are in Tables 6 - 7.

b. Parameter estimates and tables

i Time series of retained and total catch in the directed fishery, bycatch in groundfish fisheries, and total fishing mortality is summarized in Tables 1 - 2;

ii Negative log-likelihood values and parameter estimates, excluding annual deviations, are summarized in Tables 9 - 12;

iii Estimated recruitment and MMB time series among models are in Tables 13 - 16.

c. Graphs of estimates

i Models 23.1c, 26.0, and 26.0a estimated similar selectivity in both subdistricts. Selectivity was considerably greater in the pre-rationalized period in comparison to the post-rationalized period, with selectivity in the EAG being slightly greater during pre-rationalization than in the WAG (Figure 18). Model 26.1 estimated three additional post-rationalization time blocks in the EAG and two additional post-rationalization time blocks in the WAG. The 2016 - 2020 and 2022 - 2025 EAG time blocks produced similar selectivity curves as did the 2005 - 2007 and 2008 - 2013 time blocks, suggesting a shift to increased selectivity at size during the later half of the post-rationalized period in the EAG (Figure 18). There was not much difference in post-rationalization selectivity curves estimated by model 26.1 in the WAG (Figure 18). All models assumed full selectivity for groundfish fishery bycatch. Retention probability was similar among models, characterized as a very steep curve, reaching full retention at approximately legal size (138 mm CL).

ii There was little difference in molt probability among models.

iii Recruitment trends were similar among models (Table 13 - 14; Figure 19). In the EAG model 26.1 estimated recruitment at slightly different scales from 2008 - 2010 and 2016 - 2018, and did not estimate a dip in recruitment in 2023 - 2024. In fact, EAG model 26.1 estimated an increase in recruitment in 2024 (Table 13; Figure 19).

iv Trajectories of mature male biomass (MMB) at mating (Feb 15) are shown in Table 15 - 16 and Figure 21. EAG model 26.1 estimated lower MMB in the early 2000s, slightly greater MMB during the 2010s, and again slightly lower MMB during the 2020s. All WAG models estimated very similar MMB trajectories (Figure 21).

v Fully selected fishing mortality (F) in the directed fishery and groundfish fisheries are shown in Figure 22. Directed fishing mortality was highest in the early-1990s, then decreased through the early-2000s. Fishing mortality in the EAG fishery steadily increased and peaked in 2019, before sharply decreasing from 2020-2022. WAG F underwent two cyclical peaks in 2012 and 2020. Groundfish fishery F is low throughout the timeseries, but has had the most prominent pulses in 2016 and 2020 in the EAG, and 2022 in the WAG (Figure 22). EAG model 26.1 deviated from other EAG models during the 2000s (higher) to mid 2010s (lower) (Figure 22).

Total F exceeded the F_{OFL} control rule throughout much of the 1990s. Since the 2000s MMB in the EAG has exceeded $\text{B}_{35\%}$ and F has been below $F_{35\%}$ (Figure 23). In the WAG, recent total F exceeded the F_{OFL} control rule, with MMB less than $\text{B}_{35\%}$, though 2024 and 2025 total F were within the control rule (Figure 23).

d. Evaluation of the fit to the data

i There was very little difference among model fits to catch data (Figure 7).

ii Fits to index data for models 23.1c, 26.0, 26.0a were similarly poor in the EAG (Figure 8 and 9). Model 26.1 estimated a "better" fit to EAG observer CPUE during the post rationalized period, but mostly averaged through the center of noisy data resulting in some residual patterns. There were only marginal differences in fit to index data among WAG models (Figure 9).

iii There was little difference in fits to size composition data (Figures 10 - 11 and 14 - 15). While all models appear to capture total size composition modes reasonably well, residual diagnostics highlighted clear patterns. Middle size bins (i.e., 130 - 150 mm CL) tended to be under predicted across all years, while smaller size bins were over predicted in the latter half of the time series (Figure 12 - 13 and 16 - 17).

e. Retrospective analysis

Retrospective analysis was performed by sequentially removing one year of data for ten model runs. EAG models continued to have considerable, positive retrospective patterns in MMB, though model 26.1 reduced retrospective patterns in the last 5 peels. Mohn's ρ ranged from $\rho = 0.264$ (EAG 26.1) to $\rho = 0.485$ (EAG 26.1) (Figure 24). EAG retrospective patterns likely arise from model misspecification that results in poor fit to index data, though the broader issue may be weak information on the scale and timing of recruitment, since signals of sublegal catch in fishery total size composition are very subtle (Figure 15). Retrospective pattern is less of a concern in the WAG ($\rho = 0.081$, 23.1c - $\rho = 0.19$, 26.1) (Figure 24). Several peels in WAG models 26.0, 26.0a, and 26.1 converged to the MLE outcome described in section E.4.g resulting in anomalous MMB estimates in the mid-1990s.

f. Historical analysis

Legal male abundance estimated from previous stock assessments were plotted to assess historical patterns in derived quantities. Legal male abundance is plotted here instead of MMB due to changes in size at maturity used in past assessments. Legal male trajectories in both areas indicated a downward historical pattern particularly in the terminal year, though the latest assessment estimated greater LMA in the WAG for 2025 than did the same model in the 2025 assessment (Figure 25).

g. Uncertainty and sensitivity analyses

i Estimated standard errors for estimated parameters are in Table 11 and 12. Uncertainty in estimated MMB and recruitment is detailed in Table 13 - 16.

ii Distribution of the subdistrict specific OFL is shown in Figure 29.

iii Distribution of terminal year MMB relative to $B_{35\%}$ estimated from MCMC draws is described in Figure 29.

iv Jitter analysis identified only one other minimum for EAG models 23.1c and 26.0a, which was not near the MLE. Jittering did not find an local minima for EAG models 26.0 and 26.1, though several of the jitter runs did not converge (Table 18). Jitter analysis of WAG models identified more local minima near the MLE (Table 18), though for WAG models 26.0, 26.0a, and 26.1, the MLE was not a viable outcome. The MLE runs in those models estimated an erroneously large fishing mortality rate (and subsequent catch) for groundfish fishery bycatch in 1996 (Figure 26 and 27). This was also observed during the 2024 final assessment, where the large spike in fishing mortality was attributed to an increased recruitment pulse in the early 1990s that allowed a slightly better fit to observer CPUE in 1995 and 1996. The extra crab were removed in the 1996 bycatch fishery since there are no associated index or size composition data to check erroneous catches (Jackson 2024). The CPT recommendation was to increase the smoothness penalty of F deviations, though doing so resulted in poorer fits to catch in years were observed groundfish fishery bycatch was high. Instead, the issue was resolved for the 2025 assessment by using a better starting value for mean F. At any rate, this issue remains unresolved and the "best" model was determined to be the runs with the second lowest NLL to the MLE. Overall, jittering provided a clearer view of the likelihood surface surrounding the MLE for WAG models than EAG models, though there is no reason to suggest that models used for setting harvest specifications were not at the lowest, viable NLL.

h. Comparison of alternative models

Model 23.1c is regarded as the base model and was the 2025 accepted model. Model 26.0 uses a spatiotemporal GLMM to standardize observer CPUE from 1995 - 2025, but still estimates fits to index data assuming two catchability time blocks corresponding to rationalization. Model 26.0a starts the model in 1981 in a non-equilibrium state, assumes equal likelihood weighting for catch data series, and uses the same observer CPUE index as model 26.0. Lastly, model 26.1 uses the same initial conditions and observer CPUE time series as model 26.0a, but considers additional time blocks for post-rationalization selectivity based on changes in vessel dynamics.

The spatiotemporal GLMM resulted in a slightly different CPUE index than the GAM index used in 23.1c, but as expected, an alternative standardization approach did not result in better fits to index data in the EAG (Figure 8 - 9). Otherwise there was little difference between models 23.1c and 26.0. Still, the spatiotemporal model better resolved spatial variability in observer CPUE data (Appendix A) and leverages the full time series to estimate catchability covariates.

Estimated equilibrium numbers at size were greater than at the start of the catch data time series, leading to a decreasing ramp in MMB (Figure 21). Non-equilibrium starting conditions resulted in lower numbers at larger sizes at the start of the model, but greater recruitment. Small differences in scale of recruitment since 2019 in the EAG led to subtle differences in MMB. It is unclear why initial conditions lead to different recruitment scales in recent years, but note that this pattern was also present in model 25.0, which weighted catch data similar to model 23.1c (Jackson 2024). Reducing the likelihood emphasis on retained and total catch to $\lambda = 1$ had negligible impact on fits to catch data in either subdistrict (Figure 7). Assuming non-equilibrium initial conditions is likely most appropriate since golden king crab were historically taken as incidental harvest during red king crab fisheries in Adak during the 1970s. The model start year used (1981) here does not necessarily reflect the full history of exploitation, rather the beginning of directed fishing (Leon et al. 2017). Despite relying solely on catch data from 1981 - 1985, early size composition data (1985 onward) seem adequate to estimate selectivity and initial numbers at length, resulting in nearly identical dynamic B_0 and depletion trajectories after 1985 (Figure 28).

Model 26.1 slightly improved fits to the observer CPUE index and reduced the estimated additional observation error (Table 11 - 12; Figure 9). Despite differences in selectivity, there was little impact on fits to size composition data. Following better fit to CPUE data in the EAG, the retrospective pattern in MMB was also improved in recent years (Figure 24). Adding post-rationalization time blocks to selectivity in the WAG resulted in only minor differences in model performance. Assigning process variability erroneously has been shown to have adverse consequences to management advice (Fisch et al., 2023; Szuwalski et al., 2018). Specifically, risk is most associated with mischaracterization of which process is time varying. Others have demonstrated that there is less downside if process variability is modeled in the correct process, but over-parameterized (Cronin-Fine and Punt 2021; Stewart and Monnahan 2017). Index data used here is solely fishery dependent, and fishers are incentivized to optimize high CPUE with reduced sorting by varying soak times and fishing locations. Furthermore, fleet consolidation has likely increased the influence of the highest performing vessels and fishing behaviors, prompting concerns of hyperstability. Given the history of fleet consolidation and variation in fishing behavior, it is highly plausible that time varying selectivity is applicable to the post-rationalization era for AIGKC, yet identifying appropriate time blocks remains a fairly subjective endeavor. More work should be done to better understand fleet dynamics and the effects of consolidation before a model incorporating additional selectivity time blocks is used to inform management. Specifically, research models could be developed that consider vessels in the post-rationalized period as different catch fleets, or vessels used in catch and index standardization could be reduced to reflect the catchability of vessels still operating.

The author recommended model is 26.0a for both subdistricts. Model 26.0a isn't a large improvement, but makes adjustments to model structure and input CPUE data that are a more manageable base from which to further explore a combined area model and time varying selectivity.

F. Calculation of the OFL and ABC

1. Aleutian Islands GKC is currently placed in Tier 3a (NPFMC 2007).
2. For Tier 3 stocks, estimated biological reference points include $B_{35\%}$ and $F_{35\%}$. Estimated model parameters are used to conduct mature male biomass-per-recruit analysis.
3. Specification of the overfishing limit (OFL):

The Tier 3 OFL is calculated using the F_{OFL} control rule

$$F_{\text{OFL}} = \begin{cases} 0 & \frac{B_{prj}}{B_{35\%}} \leq \beta \\ F_{35\%}\frac{(\frac{B_{prj}}{B_{35\%}} - aa)}{1-aa} & \beta < \frac{B_{prj}}{B_{35\%}} \leq 1 \\ F_{35\%} & B_{prj} > B_{35\%} \end{cases} \tag{4}$$

where

B_{prj} = the measure of the productive capacity of the stock, in this case mature male biomass (MMB), projected to time of mating (Feb 15); $F_{35\%}$ = a proxy for F_{MSY}, which is a full selection instantaneous F that will produce MSY at the MSY producing biomass; $B_{35\%}$ = a proxy for B_{MSY}, which is the value of biomass (MMB) at the MSY producing level; β = a parameter with restriction that $0 \leq \beta < 1$. A default value of 0.25 is used; aa = a parameter with restriction that $0 \leq aa \leq \beta$. A default value of 0.1 is used.

Average recruitment during a period of 1987-2022 was used to estimate $B_{35\%}$. The reference period for average recruitment is based on the time period for which uncertainty in estimated recruitment is below a reasonable threshold. In January 2024, the CPT recommended a 'terminal year minus four' approach to setting the upper bound of the reference period. Because B_{prj} depends on the intervening retained and discard catch (i.e., B_{prj} is estimated after the fishery), an iterative procedure was applied with predicted retained and discard catch, whereby the F_{OFL} and OFL were estimated using MCMC in GMACS.

The control rule is used for stock status determination. If total catch exceeds OFL estimated at B (B_{prj}), then "overfishing" occurs. If B equals or declines below 50% B_{MSY} (i.e., MSST), the stock is "overfished." If B/B_{MSY} or B/B_{MSY} proxy equals or declines below β, then the stock productivity is severely depleted, and the directed fishery is closed. In December 2025, the SSC recommended a stock status determination that considers both subdistricts combined. That is, current MMB and $B_{35\%}$ are summed, so that $B/B_{35\%}$ is representative of the whole stock. The control rule is then used to compute a shared F_{OFL} and subdistrict specific OFLs are summed. Since EAG and WAG are currently modeled separately, OFL was computed outside of GMACS as

$$\text{OFL} = \sum_i \sum_j N_j w_j \frac{\phi_i F_{\text{OFL}} S^c_{i,j}(S^r_{i,j} + 0.2(1 - S^r_{i,j}))(1 - e^{-Z_{i,j}})}{Z_{i,j}} \tag{5}$$

$$Z_{i,j} = M\tau + \phi_i F_{\text{OFL}} S^c_{i,j}(S^r_{i,j} + 0.2(1 - S^r_{i,j})) \tag{6}$$

where

N_j is the number of crab at length j; w_j is the weight in metric tonnes at length j; ϕ_i is the ratio of average total fishing mortality from 2012 - present corresponding to fleet i; $S^c_{i,j}$ is the average length-based capture selectivity of fleet i during the most recent time block; $S^r_{i,j}$ is the average length-based retention selectivity of fleet i during the most recent block; h_i is the discard mortality rate of fleet i, which is 20% for the directed fishery and average discard mortality from 2012 - present for combined trawl and fixed gear bycatch fisheries;

M is natural mortality (0.22 yr^{-1}); τ is the proportion of time elapsed from the beginning of year to the fishery in the last year of the model.

Biological reference points for all models evaluated in this assessment are detailed in Table 17.

MCMC runs with 100,000 replicates and 100 draws for model 26.0a were performed to estimate the distribution of $B_{35\%}$ and OFL. GMACS does not currently write draws of all parameter values or derived quantities needed for computing a combined OFL (i.e., N matrix) to a report file, so distribution of the OFL represented here refers to the subdistrict specific OFL. The distribution of the combined projected MMB (Feb 15, 2027) to $B_{35\%}$ suggests that probability of the stock being overfished is approximately zero (Figure 29).

The CPT and SSC recommended the 2025/26 acceptable biological catch (ABC) be set at ABC = (1 - 0.25) × OFL citing continued concerns about poor fits to index data and retrospective patterns in the EAG model. The CPT (November 2025) highlighted the risk of misappropriating subdistrict specific biomass surplus when subdistrict specific statuses relative to $B_{35\%}$ are not equal. The SSC (December 2025) recommended that subdistrict specific concerns in be address in the ABC buffer rather than the OFL computation. The combined OFL is about ∼ 5-7% larger than it would be using subdistrict specific stock statuses, but the resulting total allowable catch (TAC) by subdistrict set by ADF&G will remain unaffected since the harvest strategy is applied to the EAG and WAG separately (see Section C.6). Therefore, the CPT did not recommend an increased ABC buffer to account for uncertainty in combined stock status. The current assessment did not resolve poor index data fits or the associated retrospective pattern and continues to be solely informed by fishery dependent data, so the author recommendation is to continue with a 25% ABC buffer.

The OFL and ABC values for 2026/27 in the tables below are values estimated by the author-recommended model (26.0a) for consideration.

1,000 t

Year	MSST	Biomass (MMB_{mating})	TAC	Retained Catch	Total Catch	OFL	ABC
2022/23	5.832	13.600	2.291	2.369	2.612	3.761	2.821
2023/24	5.772	12.716	2.508	2.578	2.765	4.182	3.137
2024/25	5.632	11.087	2.214	2.287	2.426	3.725	2.794
2025/26	5.579	10.858	1.901	1.943	2.341	3.166	2.374
2026/27		10.670				3.493	2.620

Million lb

Year	MSST	Biomass (MMB_{mating})	TAC	Retained Catch	Total Catch	OFL	ABC
2022/23	12.857	29.983	5.051	5.223	5.758	8.292	6.219
2023/24	12.725	28.034	5.530	5.684	6.096	9.220	6.916
2024/25	12.417	24.443	4.881	5.042	5.348	8.212	6.159
2025/26	12.300	23.938	4.191	4.284	5.161	6.980	5.234
2026/27		23.523				7.701	5.776

2022/23 refence points were estimated before the WAG fishery was completed.
2023/24 refence points were estimated before EAG and WAG fisheries were completed.
2025/26 refence points were estimated before the EAG fishery was completed.

G. Rebuilding Analysis

N/A, not applicable for this stock.

H. Data Gaps and Research Priorities

1. List of variables related to scientific uncertainty

a) Models rely solely on fishery data;

b) Observer and fisheries CPUE indices played a major role in the assessment model;

c) Fixed bycatch mortality rates were used in each fishery (crab fishery and the groundfish fishery) that discarded golden king crab;

d) Discarded catch and bycatch mortality for each fishery in which bycatch occurred during 1981/82 - 1989/90 were not available;

e) Growth (i.e., tagging) data are only based on the EAG.

2. Research priorities

a) Resolve data conflict in EAG models;

b) Reallocate cooperative survey effort to small-mesh pot sampling;

c) Construct a combined EAG/WAG model;

d) Male size at maturity;

e) Area specific growth;

f) Connectivity between EAG and WAG.

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Tables

Table 1: Total allowable catch (TAC; t), number of vessels, retained catch, pot lifts, CPUE (crab per pot), directed fishery total catch (t), bycatch in groundfish fisheries (t), and sum of fishing mortality in all fisheries (t) in the EAG from 1985 - present. CF indicates confidential information.

			Retained Catch				Directed	GF	Total
Year	TAC	Vessels	(t)	(N)	Pots	CPUE	Total Catch	Bycatch	Mortality
1985		20	2,955	1,387,430	112,851	12.3	NA		NA
1986		31	2,686	1,374,943	156,521	8.8	NA		NA
1987		35	2,010	968,614	135,707	7.1	NA		NA
1988		38	2,335	1,156,046	157,382	7.3	NA		NA
1989		24	2,666	1,423,561	166,384	8.6	NA		NA
1990		18	1,688	888,332	101,110	8.8	3,521		NA
1991		15	2,035	1,083,243	126,501	8.6	4,017	0.1	2,432
1992		14	2,112	1,127,291	131,477	8.6	5,118	0.2	2,713
1993		10	1,439	767,918	95,273	8.1	2,212	5.2	1,597
1994		19	2,044	1,088,614	190,503	5.7	3,974	1.8	2,432
1995		19	2,259	1,150,168	184,470	6.2	4,658	1.6	2,740
1996	1,451	14	1,738	854,502	146,630	5.8	3,208	0.5	2,032
1997	1,451	13	1,588	780,610	106,403	7.3	2,897	0.2	1,850
1998	1,361	14	1,473	740,011	83,378	8.9	2,951	1.7	1,770
1999	1,361	15	1,392	709,332	79,129	9	2,541	6.0	1,625
2000	1,361	15	1,422	704,702	71,551	9.8	2,592	3.3	1,657
2001	1,361	19	1,442	730,030	62,639	11.7	2,154	0.6	1,584
2002	1,361	19	1,280	643,886	52,042	12.4	1,871	42.8	1,420
2003	1,361	18	1,350	643,074	58,883	10.9	1,854	39.9	1,471
2004	1,361	19	1,309	637,536	34,848	18.3	1,670	1.4	1,382
2005	1,361	7	1,300	623,966	24,569	25.4	1,620	1.4	1,365
2006	1,361	6	1,357	650,588	26,195	24.8	1,617	42.2	1,430
2007	1,361	4	1,356	633,253	22,653	28	1,755	132.0	1,502
2008	1,429	3	1,426	666,947	24,466	27.3	1,796	56.9	1,529
2009	1,429	3	1,429	679,886	26,298	25.9	1,814	30.7	1,523
2010	1,429	3	1,428	670,981	25,851	26	1,709	92.1	1,534
2011	1,429	3	1,429	668,828	17,915	37.3	1,805	46.2	1,530
2012	1,501	3	1,504	687,666	20,827	33	1,950	12.4	1,602
2013	1,501	3	1,546	720,220	21,388	33.7	1,854	6.6	1,613
2014	1,501	3	1,554	719,064	17,002	42.3	1,948	14.2	1,642
2015	1,501	3	1,590	763,604	19,376	39.4	2,210	43.4	1,736
2016	1,501	4	1,578	793,983	24,470	32.4	2,221	189.4	1,802
2017	1,501	4	1,571	802,610	25,516	31.5	2,350	89.2	1,773
2018	1,751	3	1,830	940,336	25,553	36.8	2,783	44.8	2,044
2019	1,955	3	2,031	1,057,464	30,998	34.1	3,044	30.9	2,250
2020	1,656	3	1,733	902,121	30,072	30	2,605	248.3	2,034
2021	1,637	3	1,706	863,269	30,948	27.9	2,408	32.5	1,863
2022	1,506	3	1,585	811,282	21,600	37.6	2,091	15.0	1,695
2023	1,687	3	1,758	900,225	23,593	38.2	2,316	15.4	1,878
2024	1,706	2	CF	CF	CF	CF	CF	8.3	CF
2025	1,506	2	1,549	772,348	23,889	32.3	1,736	5.4	1,591

Table 2: Total allowable catch (TAC; t), number of vessels, retained catch, pot lifts, CPUE (crab per pot), directed fishery total catch (t), bycatch in groundfish fisheries (t), and sum of fishing mortality in all fisheries (t) in the WAG from 1985 - present. CF indicates confidential information.

			Retained Catch				Directed	GF	Total
Year	TAC	Vessels	(t)	(N)	Pots	CPUE	Total Catch	Bycatch	Mortality
1985		40	2,821	1,112,529	92,354	12	NA		NA
1986		48	3,999	2,052,652	252,015	8.1	NA		NA
1987		49	2,189	1,248,732	176,295	7.1	NA		NA
1988		60	2,485	1,285,914	164,208	7.8	NA		NA
1989		58	3,024	1,610,281	202,580	7.9	NA		NA
1990		15	1,615	889,017	118,056	7.5	2,695		NA
1991		14	1,397	747,852	102,316	7.3	1,705		NA
1992		18	1,025	543,541	92,743	5.9	1,201		NA
1993		20	686	352,339	76,966	4.6	1,887	0.5	927
1994		29	1,540	845,058	198,761	4.3	5,197	0.2	2,271
1995		22	1,203	619,636	142,480	4.3	3,171	1.0	1,598
1996	1,225	20	1,259	652,801	114,121	5.7	2,291	5.8	1,470
1997	1,225	10	1,083	558,446	87,445	6.4	1,856	0.6	1,238
1998	1,225	6	955	505,407	50,885	9.9	1,590	0.8	1,083
1999	1,225	15	1,222	658,377	104,223	6.3	2,079	1.0	1,394
2000	1,225	12	1,342	723,794	104,056	7	2,314	0.7	1,537
2001	1,225	9	1,243	686,738	105,512	6.5	2,176	0.4	1,430
2002	1,225	6	1,198	664,823	78,979	8.4	1,889	1.4	1,337
2003	1,225	6	1,220	676,633	66,236	10.2	1,782	4.9	1,335
2004	1,225	6	1,219	685,465	56,846	12.1	1,839	1.0	1,344
2005	1,225	3	1,204	639,370	30,116	21.2	1,646	1.5	1,293
2006	1,225	4	1,030	527,737	26,110	20.2	1,400	1.8	1,105
2007	1,225	3	1,142	600,595	29,950	20.1	1,593	5.9	1,236
2008	1,286	3	1,150	587,661	26,200	22.4	1,762	9.5	1,280
2009	1,286	3	1,253	628,332	26,489	23.7	1,721	6.8	1,351
2010	1,286	3	1,279	626,246	29,944	20.9	1,618	4.4	1,350
2011	1,286	3	1,276	616,118	26,326	23.4	1,547	6.1	1,335
2012	1,352	4	1,339	672,916	32,716	20.6	1,785	8.8	1,435
2013	1,352	3	1,347	686,883	41,835	16.4	1,913	8.7	1,467
2014	1,352	2	1,217	635,312	41,548	15.3	1,618	6.8	1,302
2015	1,352	2	1,139	615,355	41,108	15	1,534	3.1	1,221
2016	1,014	3	1,015	543,796	38,118	14.3	1,506	5.1	1,117
2017	1,014	3	1,014	519,051	30,885	16.8	1,420	3.0	1,097
2018	1,134	3	1,135	578,221	29,156	19.8	1,643	4.7	1,240
2019	1,302	3	1,288	649,610	42,924	15.1	1,618	9.3	1,360
2020	1,343	3	1,267	682,107	46,701	14.6	1,817	10.8	1,383
2021	1,052	3	993	538,064	46,161	11.7	1,569	1.7	1,110
2022	785	3	784	427,696	32,786	13	1,130	43.8	876
2023	821	3	820	449,624	34,850	12.9	1,136	6.1	887
2024	508	2	CF	CF	CF	CF	CF	2.9	CF
2025	395	2	394	205,958	11,633	17.7	514	4.3	421

Table 3: Number of non-zero observer pots and observed CV for total catch in the directed fishery for the EAG and WAG.

	EAG		WAG	
Year	Pots_{nz}	CV	Pots_{nz}	CV
1990	130	0.28	220	0.22
1991	144	0.27	620	0.13
1992	137	0.28	533	0.14
1993			123	0.30
1994	41	0.53	1,080	0.10
1995	4,184	0.05	3,338	0.06
1996	5,052	0.04	5,297	0.04
1997	3,573	0.05	3,312	0.06
1998	2,976	0.06	1,747	0.08
1999	2,917	0.06	3,906	0.05
2000	4,432	0.05	4,038	0.05
2001	4,018	0.05	3,765	0.05
2002	3,491	0.05	2,181	0.07
2003	3,534	0.05	3,035	0.06
2004	1,961	0.07	2,374	0.07
2005	1,154	0.09	1,243	0.09
2006	1,073	0.10	1,116	0.10
2007	976	0.10	1,040	0.10
2008	606	0.13	950	0.11
2009	402	0.16	863	0.11
2010	425	0.15	816	0.11
2011	358	0.17	794	0.12
2012	437	0.15	1,070	0.10
2013	515	0.14	1,145	0.10
2014	370	0.17	1,030	0.10
2015	509	0.14	1,193	0.09
2016	660	0.12	968	0.10
2017	636	0.13	760	0.12
2018	513	0.14	688	0.12
2019	585	0.13	922	0.11
2020	567	0.13	1,137	0.10
2021	477	0.15	858	0.11
2022	336	0.17	804	0.12
2023	366	0.17	719	0.12
2024	451	0.15	357	0.17
2025	366	0.17	208	0.23

Table 4: Standardized observer CPUE index and associated CV based on rationalization time blocks (GAM) and the full time series (ST GLMM) for the EAG and WAG.

	EAG				WAG			
	GAM		ST GLMM		GAM		ST GLMM	
Year	Index	CV	Index	CV	Index	CV	Index	CV
1995	0.930	0.03	0.405	0.01	1.214	0.02	0.876	0.01
1996	0.899	0.02	0.356	0.01	1.040	0.02	0.753	0.01
1997	0.910	0.02	0.519	0.01	1.014	0.02	0.732	0.01
1998	1.056	0.02	0.633	0.01	1.068	0.02	0.768	0.01
1999	0.970	0.02	0.549	0.01	0.864	0.02	0.699	0.01
2000	0.854	0.02	0.596	0.00	0.884	0.02	0.730	0.01
2001	0.989	0.02	0.682	0.00	0.759	0.02	0.680	0.01
2002	1.102	0.02	0.756	0.00	0.901	0.02	0.765	0.01
2003	0.913	0.02	0.657	0.01	1.125	0.02	0.984	0.01
2004	1.509	0.01	1.119	0.01	1.244	0.02	0.944	0.01
2005	1.025	0.03	1.155	0.01	1.184	0.03	1.273	0.01
2006	0.759	0.03	0.953	0.01	1.199	0.03	1.362	0.01
2007	0.862	0.02	1.090	0.01	1.192	0.03	1.300	0.01
2008	0.886	0.03	1.074	0.01	1.336	0.02	1.456	0.01
2009	0.736	0.05	0.998	0.01	1.430	0.02	1.551	0.01
2010	0.724	0.05	0.979	0.01	1.191	0.03	1.237	0.01
2011	1.050	0.03	1.396	0.01	1.253	0.03	1.312	0.01
2012	1.004	0.03	1.430	0.01	1.280	0.02	1.312	0.01
2013	0.994	0.03	1.396	0.01	0.903	0.03	0.984	0.01
2014	1.265	0.02	1.720	0.01	0.866	0.04	0.960	0.01
2015	1.295	0.02	1.654	0.01	0.825	0.03	0.942	0.01
2016	1.043	0.02	1.402	0.01	0.920	0.03	1.074	0.01
2017	1.006	0.03	1.196	0.01	0.984	0.04	1.300	0.01
2018	1.194	0.02	1.546	0.01	1.213	0.03	1.616	0.01
2019	1.121	0.02	1.439	0.01	0.966	0.03	1.099	0.01
2020	1.017	0.03	1.226	0.01	0.906	0.03	0.930	0.01
2021	0.921	0.03	1.197	0.01	0.712	0.05	0.810	0.01
2022	1.226	0.03	1.391	0.01	0.679	0.06	0.805	0.01
2023	1.232	0.03	1.464	0.01	0.761	0.05	0.837	0.01
2024	1.083	0.03	1.371	0.01	0.599	0.10	0.721	0.01
2025	0.855	0.04	1.119	0.01	1.184	0.03	1.252	0.01

Table 5: Standardized fish ticket CPUE index and associated CV from 1985 - 1998 in the EAG and WAG.

	EAG		WAG	
Year	Index	CV	Index	CV
1985	1.524	0.09	3.248	0.04
1986	0.892	0.18	1.342	0.09
1987	0.827	0.10	1.094	0.07
1988	0.965	0.06	1.317	0.04
1989	1.109	0.04	1.152	0.04
1990	0.936	0.06	0.801	0.06
1991	0.923	0.06	0.755	0.08
1992	0.906	0.07	0.684	0.08
1993	0.929	0.06	0.761	0.08
1994	0.800	0.07	0.769	0.06
1995	0.856	0.07	0.939	0.05
1996	0.964	0.06	0.807	0.05
1997	1.408	0.04	0.726	0.05
1998	1.231	0.05	1.039	0.04

Table 6: Input and re-reweighted effective sample size for retained catch size composition (number of vessel days) for models 23.1c, 26.0, 26.0a, and 26.1.

	EAG					WAG				
Year	N_{obs}	23.1c	26.0	26.0a	26.1	N_{obs}	23.1c	26.0	26.0a	26.1
1985	366	73	74	83	81	346	35	37	36	38
1986	221	44	45	50	49	348	35	38	36	38
1987	276	55	56	62	61	359	36	39	37	40
1988	498	100	101	113	110	368	37	40	38	41
1989	606	121	123	137	134	755	77	82	79	84
1990	213	42	43	48	47	342	35	37	36	38
1991	149	29	30	33	33	166	16	18	17	18
1992	104	20	21	23	23	104	10	11	10	11
1993	369	74	75	83	81	415	42	45	43	46
1994	777	156	158	176	172	734	75	80	77	82
1995	1,046	210	213	237	232	734	75	80	77	82
1996	615	123	125	139	136	957	97	104	100	106
1997	800	160	163	181	177	968	99	106	102	108
1998	605	121	123	137	134	525	53	57	55	58
1999	624	125	127	141	138	1,140	116	125	120	127
2000	545	109	111	123	121	1,099	112	120	115	122
2001	550	110	112	125	122	923	94	101	97	103
2002	497	99	101	112	110	695	71	76	73	77
2003	457	91	93	103	101	645	66	70	68	72
2004	333	66	67	75	73	453	46	49	47	50
2005	395	79	80	89	87	452	46	49	47	50
2006	297	59	60	67	65	312	31	34	32	34
2007	352	70	71	80	78	367	37	40	38	41
2008	310	62	63	70	68	391	40	42	41	43
2009	257	51	52	58	57	330	33	36	34	36
2010	272	54	55	61	60	305	31	33	32	34
2011	249	50	50	56	55	351	35	38	37	39
2012	277	55	56	62	61	406	41	44	42	45
2013	289	58	58	65	64	471	48	51	49	52
2014	200	40	40	45	44	531	54	58	56	59
2015	204	41	41	46	45	514	52	56	54	57
2016	271	54	55	61	60	459	47	50	48	51
2017	252	50	51	57	55	370	37	40	39	41
2018	255	51	51	57	56	361	36	39	38	40
2019	260	52	52	59	57	462	47	50	48	51
2020	286	57	58	65	63	502	51	55	52	56
2021	281	56	57	63	62	479	49	52	50	53
2022	238	47	48	54	52	341	34	37	35	38
2023	278	55	56	63	61	407	41	44	42	45
2024	247	49	50	56	54	188	19	20	19	21
2025	258	51	52	58	57	122	12	13	12	13

Table 7: Input and re-reweighted effective sample size for total catch size composition (number of vessel days) for models 23.1c, 26.0, 26.0a, and 26.1.

	EAG					WAG				
Year	N_{obs}	23.1c	26.0	26.0a	26.1	N_{obs}	23.1c	26.0	26.0a	26.1
1990	67	40	41	40	38	239	85	100	100	93
1991	44	26	26	26	25	106	37	44	44	41
1992	44	26	26	26	25	85	30	35	35	33
1993	5	3	3	3	2	51	18	21	21	19
1994	121	72	74	73	70	237	84	99	99	92
1995	1,013	607	619	617	586	700	250	293	293	272
1996	615	369	376	374	355	957	342	401	400	372
1997	800	480	489	487	463	968	346	406	405	377
1998	605	363	370	368	350	525	187	220	219	204
1999	624	374	381	380	361	1,140	408	478	477	444
2000	545	327	333	332	315	1,099	393	461	460	428
2001	550	330	336	335	318	923	330	387	386	359
2002	497	298	304	302	287	695	248	291	291	270
2003	457	274	279	278	264	645	230	270	270	251
2004	333	199	203	202	192	453	162	190	189	176
2005	210	126	128	127	121	352	125	147	147	137
2006	194	116	118	118	112	250	89	104	104	97
2007	189	113	115	115	109	232	83	97	97	90
2008	148	88	90	90	85	242	86	101	101	94
2009	141	84	86	85	81	225	80	94	94	87
2010	172	103	105	104	99	211	75	88	88	82
2011	157	94	96	95	90	285	102	119	119	111
2012	143	85	87	87	82	322	115	135	134	125
2013	166	99	101	101	96	333	119	139	139	129
2014	108	64	66	65	62	353	126	148	147	137
2015	126	75	77	76	72	323	115	135	135	125
2016	176	105	107	107	101	280	100	117	117	109
2017	164	98	100	99	94	215	76	90	90	83
2018	141	84	86	85	81	237	84	99	99	92
2019	152	91	93	92	87	244	87	102	102	95
2020	158	94	96	96	91	305	109	127	127	118
2021	138	82	84	84	79	247	88	103	103	96
2022	90	54	55	54	52	226	80	94	94	88
2023	139	83	85	84	80	220	78	92	92	85
2024	116	69	70	70	67	91	32	38	38	35
2025	151	90	92	92	87	92	32	38	38	35

Table 8: Comparison of likelihood components for GMACS version 2.20.31 and 2.20.34b based on model 23.1c.

	EAG		WAG	
Component	v2.20.31	v2.20.34b	v2.20.31	v2.20.34b
Catch	-488.770	-488.770	-467.100	-467.100
Index	-45.632	-45.632	-68.475	-68.475
Size Composition	864.840	864.840	1,053.017	1,053.017
Recruitment	19.319	19.319	23.813	23.813
Tagging	2,698.016	2,698.016	2,697.195	2,697.195
N Parameters	167.000	167.000	165.000	165.000
Total	3,074.719	3,071.105	3,265.318	3,261.705

Table 9: Likelihood components and number of parameters for EAG models.

Component	23.1c	26.0	26.0a	26.1
Retained Catch	-454.120	-453.992	-453.929	-453.878
Total Catch	-66.834	-66.608	-66.207	-66.466
Groundfish Bycatch	32.184	32.190	32.194	32.196
Obs CPUE 1995 - 2004	-9.928	-12.698	-12.688	-12.689
Obs CPUE 2005 - 2025	-21.365	-21.150	-21.043	-33.387
FT CPUE 1985 - 1998	-14.339	-14.137	-14.167	-13.679
Retained Size Composition	493.705	490.396	462.746	469.061
Total Size Composition	371.135	366.264	368.142	380.344
Recruitment	19.319	19.289	12.786	12.792
Tagging	2,698.016	2,697.920	2,698.189	2,698.484
Penalties	0.152	0.152	0.152	0.150
Priors	23.180	23.873	69.499	91.437
Initial Conditions	0.000	0.000	0.597	0.588
N Parameters	167.000	166.000	162.000	168.000
Total NLL	3,071.105	3,061.499	3,076.269	3,104.952

Table 10: Likelihood components and number of parameters for WAG models.

Component	23.1c	26.0	26.0a	26.1
Retained Catch	-452.328	-451.822	-451.853	-451.924
Total Catch	-45.103	-39.012	-39.490	-40.466
Groundfish Bycatch	30.331	30.330	30.330	30.330
Obs CPUE 1995 - 2004	-9.603	-13.296	-13.307	-13.205
Obs CPUE 2005 - 2025	-41.941	-35.095	-35.172	-36.920
FT CPUE 1985 - 1998	-16.931	-17.247	-17.265	-17.232
Retained Size Composition	620.118	601.857	612.730	597.053
Total Size Composition	432.900	393.166	393.516	409.922
Recruitment	23.813	23.757	18.306	18.456
Tagging	2,697.195	2,698.110	2,697.922	2,697.822
Penalties	0.075	0.075	0.075	0.076
Priors	23.180	23.873	69.499	84.124
Initial Conditions	0.000	0.000	0.540	0.564
N Parameters	165.000	164.000	160.000	164.000
Total NLL	3,261.705	3,214.694	3,265.832	3,278.601

Table 11: Parameter estimates (standard error) among EAG models, except annual deviations and initial numbers at size.

Parameter	23.1c	26.0	26.0a	26.1
ln R_0	7.77 (0.072)	7.78 (0.072)		
ln R_{ini}			9.08 (0.119)	9.07 (0.12)
ln $\bar{R}$			7.98 (0.082)	7.98 (0.081)
Rec Dist Scale	0.53 (0.071)	0.53 (0.07)	0.53 (0.07)	0.53 (0.071)
Growth α	23.45 (1.467)	23.45 (1.466)	23.5 (1.466)	23.24 (1.472)
Growth β	0.08 (0.011)	0.08 (0.011)	0.08 (0.011)	0.07 (0.011)
Growth σ	3.65 (0.096)	3.65 (0.096)	3.65 (0.096)	3.66 (0.097)
Molt probability μ	141.5 (0.62)	141.42 (0.618)	141.56 (0.63)	141.52 (0.635)
Molt probability cv	0.08 (0.004)	0.08 (0.004)	0.09 (0.004)	0.09 (0.004)
Sel ln S_{50} 1981-2004	4.73 (0.03)	4.74 (0.031)	4.75 (0.031)	4.76 (0.034)
Sel ln S_{Δ} 1981-2004	2.86 (0.135)	2.87 (0.133)	2.87 (0.131)	2.91 (0.134)
Sel ln S_{50} 2005-2025	4.9 (0.01)	4.9 (0.01)	4.9 (0.01)	
Sel ln S_{Δ} 2005-2025	2.08 (0.057)	2.08 (0.057)	2.07 (0.057)	
Sel ln S_{50} 2005-2007				4.93 (0.019)
Sel ln S_{Δ} 2005-2007				2.21 (0.124)
Sel ln S_{50} 2008-2013				4.94 (0.017)
Sel ln S_{Δ} 2008-2013				2.28 (0.099)
Sel ln S_{50} 2014-2021				4.88 (0.013)
Sel ln S_{Δ} 2014-2021				2.04 (0.086)
Sel ln S_{50} 2022-2025				4.88 (0.013)
Sel ln S_{Δ} 2022-2025				1.74 (0.123)
Ret ln R_{50}	4.91 (0.002)	4.91 (0.002)	4.91 (0.001)	4.91 (0.001)
Ret ln R_{Δ}	0.65 (0.058)	0.65 (0.058)	0.66 (0.055)	0.66 (0.056)
ln $\bar{F}$ Directed Fishery	-9.99e-01 (3.334)	-1.01e+00 (3.334)	-9.96e-01 (3.334)	-9.48e-01 (3.334)
ln $\bar{F}$ Groundfish Fisheries	-6.96e+00 (3.784)	-6.97e+00 (3.784)	-6.97e+00 (3.784)	-6.94e+00 (3.784)
Obs CPUE q 1995-2004	4.73e-04 (5.27e-05)	2.85e-04 (3.08e-05)	2.88e-04 (3.12e-05)	3.09e-04 (3.04e-05)
Obs CPUE q 2005-2025	4.77e-04 (5.29e-05)	5.91e-04 (6.34e-05)	5.86e-04 (6.34e-05)	6.18e-04 (6.41e-05)
FT CPUE q 1985-1998	5.79e-04 (5.38e-05)	5.88e-04 (5.52e-05)	5.94e-04 (5.56e-05)	6.13e-04 (5.97e-05)
ln extra cv Obs CPUE 1995-2004	-1.48e+00 (0.246)			
ln extra cv Obs CPUE 2005-2025	-1.52e+00 (0.203)			
ln extra cv Obs CPUE 1995-2025		-1.58e+00 (0.158)	-1.58e+00 (0.157)	-1.98e+00 (0.159)
ln extra cv FT CPUE 1985-1998	-1.61e+00 (0.26)	-1.59e+00 (0.26)	-1.59e+00 (0.256)	-1.55e+00 (0.253)

Table 12: Parameter estimates (standard error) among WAG models, except annual deviations and initial numbers at size.

Parameter	23.1c	26.0	26.0a	26.1
ln R_0	7.54 (0.072)	7.53 (0.072)		
ln R_{ini}			9.3 (0.149)	9.3 (0.15)
ln $\bar{R}$			7.63 (0.08)	7.63 (0.08)
Rec Dist Scale	0.48 (0.07)	0.49 (0.066)	0.49 (0.067)	0.49 (0.069)
Growth α	22.51 (1.493)	22.57 (1.482)	22.6 (1.482)	22.53 (1.487)
Growth β	0.07 (0.011)	0.07 (0.011)	0.07 (0.011)	0.07 (0.011)
Growth σ	3.67 (0.098)	3.67 (0.098)	3.67 (0.098)	3.67 (0.098)
Molt probability μ	141.36 (0.69)	141.39 (0.702)	141.4 (0.702)	141.42 (0.699)
Molt probability cv	0.09 (0.005)	0.09 (0.005)	0.09 (0.005)	0.09 (0.005)
Sel ln S_{50} 1981-2004	4.83 (0.022)	4.83 (0.021)	4.83 (0.021)	4.83 (0.021)
Sel ln S_{Δ} 1981-2004	2.64 (0.083)	2.65 (0.078)	2.65 (0.079)	2.64 (0.08)
Sel ln S_{50} 2005-2025	4.89 (0.009)	4.9 (0.009)	4.9 (0.009)	
Sel ln S_{Δ} 2005-2025	2.02 (0.053)	2.03 (0.049)	2.03 (0.049)	
Sel ln S_{50} 2005-2015				4.91 (0.01)
Sel ln S_{Δ} 2005-2015				2.08 (0.065)
Sel ln S_{50} 2016-2020				4.89 (0.012)
Sel ln S_{Δ} 2016-2020				2.01 (0.093)
Sel ln S_{50} 2021-2025				4.89 (0.013)
Sel ln S_{Δ} 2021-2025				1.88 (0.107)
Ret ln R_{50}	4.91 (0.002)	4.91 (0.002)	4.91 (0.002)	4.91 (0.002)
Ret ln R_{Δ}	0.64 (0.066)	0.64 (0.064)	0.64 (0.065)	0.64 (0.063)
ln $\bar{F}$ Directed Fishery	-7.38e-01 (3.334)	-7.12e-01 (3.334)	-7.12e-01 (3.334)	-7.17e-01 (3.334)
ln $\bar{F}$ Groundfish Fisheries	-7.61e+00 (3.897)	-7.60e+00 (3.897)	-7.59e+00 (3.897)	-7.59e+00 (3.897)
Obs CPUE q 1995-2004	9.77e-04 (1.05e-04)	8.00e-04 (6.89e-05)	7.99e-04 (6.91e-05)	7.89e-04 (6.75e-05)
Obs CPUE q 2005-2025	9.11e-04 (7.62e-05)	1.04e-03 (8.79e-05)	1.04e-03 (8.85e-05)	1.05e-03 (9.01e-05)
FT CPUE q 1985-1998	9.16e-04 (8.02e-05)	9.29e-04 (7.90e-05)	9.29e-04 (7.94e-05)	9.17e-04 (7.83e-05)
ln extra cv Obs CPUE 1995-2004	-1.45e+00 (0.245)			
ln extra cv Obs CPUE 2005-2025	-2.74e+00 (0.305)			
ln extra cv Obs CPUE 1995-2025		-2.06e+00 (0.155)	-2.06e+00 (0.155)	-2.12e+00 (0.157)
ln extra cv FT CPUE 1985-1998	-1.78e+00 (0.273)	-1.80e+00 (0.277)	-1.81e+00 (0.279)	-1.80e+00 (0.276)

Table 13: Recruitment estimates and associated standard errors (in parentheses) for EAG models.

Year	23.1c	26.0	26.0a	26.1
1960	2,322 (1,159)	2,331 (1,163)		
1961	2,310 (1,149)	2,318 (1,153)		
1962	2,296 (1,138)	2,304 (1,142)		
1963	2,279 (1,125)	2,287 (1,129)		
1964	2,258 (1,110)	2,266 (1,113)		
1965	2,234 (1,091)	2,242 (1,095)		
1966	2,207 (1,070)	2,214 (1,073)		
1967	2,175 (1,046)	2,181 (1,049)		
1968	2,139 (1,020)	2,145 (1,022)		
1969	2,099 (990)	2,105 (992)		
1970	2,055 (958)	2,060 (960)		
1971	2,009 (924)	2,014 (926)		
1972	1,961 (890)	1,965 (891)		
1973	1,913 (856)	1,917 (856)		
1974	1,869 (823)	1,872 (824)		
1975	1,831 (794)	1,833 (794)		
1976	1,804 (771)	1,805 (771)		
1977	1,795 (758)	1,796 (757)		
1978	1,818 (760)	1,818 (759)		
1979	1,898 (792)	1,897 (790)		
1980	2,058 (859)	2,055 (857)		
1981	2,245 (919)	2,242 (916)	3,258 (1,282)	3,265 (1,291)
1982	2,307 (888)	2,310 (888)	2,249 (884)	2,259 (892)
1983	2,634 (980)	2,640 (979)	2,693 (965)	2,701 (974)
1984	2,731 (919)	2,721 (914)	2,772 (892)	2,760 (897)
1985	1,948 (725)	1,935 (718)	1,912 (685)	1,910 (687)
1986	3,137 (933)	3,116 (924)	3,101 (880)	3,077 (884)
1987	3,400 (1,054)	3,397 (1,048)	3,493 (1,014)	3,499 (1,025)
1988	2,755 (853)	2,758 (850)	2,748 (827)	2,749 (839)
1989	3,582 (708)	3,592 (705)	3,569 (691)	3,560 (704)
1990	2,480 (620)	2,466 (613)	2,484 (603)	2,484 (613)
1991	2,716 (593)	2,689 (584)	2,699 (571)	2,681 (577)
1992	2,843 (498)	2,789 (489)	2,754 (477)	2,697 (480)
1993	2,971 (310)	2,981 (307)	2,966 (303)	2,946 (305)
1994	2,976 (221)	2,992 (219)	2,986 (218)	2,958 (219)
1995	2,327 (214)	2,344 (214)	2,333 (213)	2,282 (211)
1996	2,937 (244)	2,960 (244)	2,954 (243)	2,865 (237)
1997	3,249 (290)	3,294 (290)	3,287 (290)	3,154 (278)
1998	2,965 (296)	3,009 (297)	3,002 (296)	2,873 (283)
1999	2,975 (306)	3,027 (309)	3,027 (308)	2,867 (291)
2000	2,256 (280)	2,303 (282)	2,313 (283)	2,180 (267)
2001	2,549 (305)	2,600 (309)	2,614 (309)	2,481 (293)
2002	1,891 (284)	1,913 (286)	1,929 (287)	1,828 (278)
2003	1,655 (314)	1,671 (315)	1,689 (316)	1,645 (314)
2004	3,179 (531)	3,159 (529)	3,154 (525)	3,217 (553)
2005	2,154 (536)	2,178 (539)	2,197 (534)	2,240 (562)
2006	2,069 (563)	2,110 (572)	2,123 (565)	2,171 (592)
2007	2,741 (640)	2,799 (652)	2,803 (642)	2,965 (694)
2008	2,470 (608)	2,529 (621)	2,519 (609)	2,839 (690)
2009	2,150 (539)	2,198 (550)	2,190 (539)	2,382 (608)

2010	2,154 (522)	2,180 (528)	2,174 (517)	2,399 (579)
2011	1,967 (504)	1,976 (506)	1,972 (496)	2,008 (529)
2012	2,055 (514)	2,060 (514)	2,050 (504)	1,948 (501)
2013	2,290 (565)	2,302 (565)	2,307 (556)	2,278 (554)
2014	2,894 (615)	2,883 (613)	2,887 (605)	2,806 (602)
2015	2,937 (638)	2,964 (638)	2,969 (630)	2,961 (627)
2016	3,227 (695)	3,220 (691)	3,232 (684)	3,104 (663)
2017	3,309 (727)	3,285 (720)	3,307 (714)	3,060 (670)
2018	2,772 (700)	2,770 (692)	2,784 (686)	2,559 (628)
2019	2,632 (682)	2,609 (672)	2,640 (669)	2,388 (605)
2020	2,312 (669)	2,337 (667)	2,383 (668)	2,248 (612)
2021	2,350 (692)	2,373 (689)	2,429 (696)	2,301 (630)
2022	2,410 (725)	2,405 (713)	2,487 (730)	2,184 (651)
2023	2,267 (777)	2,245 (761)	2,361 (795)	2,535 (920)
2024	2,141 (854)	2,135 (845)	2,275 (898)	3,015 (1,331)
2025	2,375 (1,200)	2,384 (1,204)	2,591 (1,312)	2,575 (1,304)

Table 14: Recruitment estimates and associated standard errors (in parentheses) for WAG models.

Year	23.1c	26.0	26.0a	26.1
1960	1,870 (943)	1,854 (934)		
1961	1,869 (942)	1,853 (933)		
1962	1,868 (941)	1,852 (932)		
1963	1,867 (940)	1,850 (931)		
1964	1,866 (938)	1,848 (929)		
1965	1,864 (937)	1,847 (927)		
1966	1,863 (935)	1,845 (925)		
1967	1,862 (934)	1,843 (923)		
1968	1,861 (932)	1,842 (921)		
1969	1,861 (931)	1,841 (920)		
1970	1,862 (931)	1,841 (918)		
1971	1,865 (931)	1,843 (918)		
1972	1,871 (933)	1,849 (919)		
1973	1,882 (937)	1,859 (923)		
1974	1,901 (946)	1,877 (931)		
1975	1,930 (961)	1,906 (946)		
1976	1,978 (987)	1,954 (973)		
1977	2,054 (1,032)	2,032 (1,019)		
1978	2,182 (1,113)	2,163 (1,103)		
1979	2,406 (1,272)	2,397 (1,271)		
1980	2,825 (1,601)	2,847 (1,633)		
1981	3,356 (1,894)	3,436 (1,958)	3,831 (2,121)	3,929 (2,168)
1982	2,863 (1,445)	2,869 (1,461)	2,605 (1,343)	2,624 (1,358)
1983	2,126 (972)	2,114 (967)	2,050 (937)	2,057 (937)
1984	2,428 (1,125)	2,412 (1,116)	2,378 (1,112)	2,377 (1,104)
1985	4,712 (1,537)	4,759 (1,521)	4,789 (1,540)	4,753 (1,517)
1986	2,671 (1,107)	2,633 (1,086)	2,627 (1,102)	2,629 (1,094)
1987	2,193 (780)	2,150 (759)	2,142 (765)	2,162 (771)
1988	2,380 (526)	2,417 (513)	2,417 (514)	2,410 (522)
1989	1,249 (289)	1,274 (284)	1,270 (284)	1,264 (288)
1990	1,098 (250)	1,136 (249)	1,132 (249)	1,122 (251)
1991	1,430 (320)	1,470 (316)	1,465 (317)	1,454 (320)
1992	2,982 (375)	2,952 (361)	2,957 (362)	3,006 (368)
1993	2,391 (290)	2,275 (273)	2,275 (273)	2,273 (280)
1994	1,986 (200)	1,997 (188)	1,995 (187)	1,991 (192)
1995	1,547 (170)	1,529 (159)	1,527 (158)	1,529 (163)
1996	1,915 (190)	1,888 (176)	1,885 (176)	1,886 (180)
1997	1,958 (203)	1,941 (188)	1,940 (188)	1,933 (192)
1998	2,123 (197)	2,091 (182)	2,087 (181)	2,086 (186)
1999	2,409 (213)	2,376 (197)	2,371 (197)	2,371 (202)
2000	2,058 (231)	2,038 (214)	2,033 (213)	2,039 (219)
2001	2,102 (252)	2,080 (236)	2,073 (235)	2,066 (241)
2002	1,565 (259)	1,534 (245)	1,528 (244)	1,546 (252)
2003	1,852 (308)	1,870 (302)	1,864 (302)	1,901 (313)
2004	2,049 (406)	2,161 (412)	2,156 (411)	2,137 (420)
2005	2,211 (465)	2,158 (467)	2,154 (467)	2,160 (476)
2006	2,149 (451)	2,182 (457)	2,183 (458)	2,166 (464)
2007	1,427 (393)	1,470 (393)	1,467 (394)	1,459 (398)
2008	1,840 (427)	1,678 (401)	1,678 (403)	1,680 (408)
2009	1,645 (369)	1,668 (373)	1,667 (374)	1,674 (381)

2010	1,143 (310)	1,284 (324)	1,282 (325)	1,284 (330)
2011	1,777 (322)	1,818 (340)	1,817 (340)	1,834 (349)
2012	1,671 (332)	1,743 (344)	1,737 (344)	1,778 (357)
2013	1,801 (336)	1,828 (343)	1,825 (343)	1,819 (356)
2014	1,840 (358)	1,802 (351)	1,803 (352)	1,760 (356)
2015	1,775 (362)	1,562 (330)	1,564 (331)	1,570 (336)
2016	1,206 (306)	1,165 (290)	1,162 (290)	1,156 (291)
2017	1,326 (283)	1,274 (276)	1,272 (276)	1,232 (271)
2018	1,178 (263)	1,285 (269)	1,282 (269)	1,206 (263)
2019	1,400 (271)	1,452 (278)	1,448 (278)	1,410 (276)
2020	1,315 (276)	1,274 (276)	1,269 (275)	1,261 (277)
2021	1,109 (293)	1,100 (284)	1,092 (283)	1,067 (286)
2022	1,813 (435)	1,506 (403)	1,496 (401)	1,557 (423)
2023	1,387 (535)	1,291 (481)	1,272 (477)	1,350 (528)
2024	1,524 (671)	1,455 (628)	1,425 (617)	1,552 (700)
2025	1,875 (947)	1,860 (940)	1,813 (918)	1,816 (920)

Table 15: MMB estimates and associated standard errors (in parentheses) for EAG models.

Year	23.1c	26.0	26.0a	26.1
1960	16,995 (1,205)	17,040 (1,206)		
1961	16,984 (1,223)	17,029 (1,224)		
1962	16,943 (1,472)	16,988 (1,474)		
1963	16,888 (1,732)	16,932 (1,735)		
1964	16,822 (1,940)	16,865 (1,944)		
1965	16,745 (2,089)	16,788 (2,093)		
1966	16,657 (2,186)	16,699 (2,190)		
1967	16,556 (2,242)	16,598 (2,246)		
1968	16,441 (2,265)	16,481 (2,269)		
1969	16,308 (2,263)	16,347 (2,266)		
1970	16,157 (2,239)	16,195 (2,242)		
1971	15,985 (2,197)	16,021 (2,200)		
1972	15,792 (2,140)	15,827 (2,142)		
1973	15,578 (2,069)	15,610 (2,071)		
1974	15,344 (1,986)	15,374 (1,986)		
1975	15,093 (1,890)	15,120 (1,890)		
1976	14,830 (1,783)	14,855 (1,782)		
1977	14,564 (1,665)	14,586 (1,663)		
1978	14,306 (1,535)	14,325 (1,532)		
1979	14,076 (1,391)	14,091 (1,387)		
1980	13,903 (1,230)	13,914 (1,226)		
1981	13,349 (1,054)	13,355 (1,049)	11,860 (1,265)	11,798 (1,268)
1982	12,230 (873)	12,231 (868)	10,999 (1,018)	10,933 (1,020)
1983	11,116 (726)	11,114 (722)	10,546 (731)	10,487 (733)
1984	10,079 (619)	10,079 (616)	9,771 (595)	9,725 (597)
1985	8,377 (523)	8,380 (521)	8,217 (495)	8,183 (495)
1986	7,020 (434)	7,018 (431)	6,932 (407)	6,902 (407)
1987	6,433 (390)	6,422 (387)	6,354 (369)	6,324 (369)
1988	6,019 (398)	5,999 (395)	5,953 (381)	5,917 (380)
1989	5,269 (361)	5,250 (358)	5,245 (351)	5,214 (351)
1990	5,597 (323)	5,583 (321)	5,579 (314)	5,550 (314)
1991	5,715 (292)	5,706 (290)	5,698 (284)	5,667 (283)
1992	5,339 (260)	5,321 (257)	5,323 (252)	5,291 (250)
1993	5,698 (234)	5,659 (229)	5,663 (226)	5,614 (221)
1994	5,562 (229)	5,500 (224)	5,487 (221)	5,409 (213)
1995	5,259 (247)	5,202 (242)	5,180 (239)	5,084 (227)
1996	5,398 (274)	5,356 (270)	5,329 (267)	5,210 (250)
1997	5,533 (308)	5,510 (305)	5,477 (303)	5,319 (280)
1998	6,073 (356)	6,076 (355)	6,040 (353)	5,814 (323)
1999	6,850 (417)	6,889 (418)	6,851 (417)	6,532 (375)
2000	7,487 (473)	7,564 (475)	7,526 (475)	7,111 (421)
2001	7,949 (526)	8,065 (528)	8,034 (530)	7,519 (463)
2002	8,185 (564)	8,336 (565)	8,318 (569)	7,726 (490)
2003	8,251 (601)	8,428 (602)	8,428 (607)	7,776 (519)
2004	7,968 (618)	8,152 (619)	8,171 (623)	7,498 (536)
2005	7,719 (612)	7,893 (613)	7,924 (618)	7,296 (535)
2006	7,998 (616)	8,147 (619)	8,183 (623)	7,665 (552)
2007	7,861 (600)	8,007 (603)	8,055 (608)	7,651 (554)
2008	7,707 (580)	7,867 (584)	7,922 (588)	7,652 (557)
2009	7,844 (561)	8,032 (568)	8,087 (572)	8,030 (562)

2010	7,832 (529)	8,047 (542)	8,092 (545)	8,305 (565)
2011	7,654 (502)	7,886 (519)	7,921 (521)	8,345 (564)
2012	7,345 (481)	7,575 (499)	7,602 (500)	8,184 (559)
2013	6,931 (467)	7,144 (484)	7,164 (485)	7,757 (547)
2014	6,605 (469)	6,798 (483)	6,812 (484)	7,307 (535)
2015	6,521 (484)	6,694 (495)	6,708 (497)	7,096 (531)
2016	6,762 (504)	6,908 (510)	6,922 (512)	7,188 (529)
2017	7,201 (528)	7,337 (533)	7,356 (536)	7,521 (534)
2018	7,576 (567)	7,687 (568)	7,717 (574)	7,714 (551)
2019	7,728 (616)	7,809 (612)	7,854 (622)	7,624 (574)
2020	7,787 (647)	7,842 (637)	7,900 (650)	7,457 (572)
2021	7,760 (693)	7,795 (674)	7,877 (693)	7,246 (575)
2022	7,672 (760)	7,713 (733)	7,830 (759)	7,103 (595)
2023	7,373 (881)	7,418 (844)	7,581 (878)	6,761 (666)
2024	7,080 (1,070)	7,114 (1,020)	7,340 (1,064)	6,448 (840)
2025	6,958 (1,286)	6,972 (1,226)	7,283 (1,286)	6,671 (1,175)

Table 16: MMB estimates and associated standard errors (in parentheses) for WAG models.

Year	23.1c	26.0	26.0a	26.1
1960	13,366 (945)	13,272 (940)		
1961	13,365 (960)	13,271 (955)		
1962	13,361 (1,165)	13,266 (1,156)		
1963	13,356 (1,383)	13,260 (1,371)		
1964	13,350 (1,562)	13,252 (1,547)		
1965	13,344 (1,696)	13,244 (1,680)		
1966	13,337 (1,793)	13,235 (1,775)		
1967	13,329 (1,859)	13,226 (1,840)		
1968	13,321 (1,903)	13,215 (1,883)		
1969	13,313 (1,930)	13,205 (1,909)		
1970	13,306 (1,944)	13,194 (1,922)		
1971	13,299 (1,949)	13,184 (1,926)		
1972	13,295 (1,945)	13,176 (1,921)		
1973	13,294 (1,934)	13,171 (1,910)		
1974	13,299 (1,917)	13,173 (1,892)		
1975	13,315 (1,893)	13,184 (1,867)		
1976	13,347 (1,862)	13,212 (1,834)		
1977	13,405 (1,820)	13,265 (1,791)		
1978	13,503 (1,765)	13,361 (1,735)		
1979	13,667 (1,688)	13,523 (1,659)		
1980	13,940 (1,577)	13,800 (1,550)		
1981	14,317 (1,414)	14,191 (1,390)	15,067 (1,861)	14,974 (1,839)
1982	12,422 (1,203)	12,330 (1,182)	12,756 (1,529)	12,697 (1,512)
1983	10,689 (935)	10,649 (912)	10,953 (998)	10,962 (984)
1984	11,563 (691)	11,545 (673)	11,671 (722)	11,710 (712)
1985	9,489 (619)	9,475 (606)	9,506 (629)	9,555 (618)
1986	6,770 (546)	6,766 (534)	6,760 (544)	6,801 (536)
1987	6,970 (397)	6,977 (384)	6,975 (390)	6,997 (388)
1988	6,069 (278)	6,054 (267)	6,049 (269)	6,070 (271)
1989	4,233 (216)	4,204 (207)	4,196 (208)	4,223 (211)
1990	3,855 (175)	3,839 (170)	3,832 (170)	3,855 (172)
1991	3,232 (159)	3,237 (155)	3,228 (156)	3,245 (157)
1992	2,932 (144)	2,966 (142)	2,955 (142)	2,963 (143)
1993	3,415 (135)	3,469 (133)	3,458 (133)	3,467 (134)
1994	3,480 (145)	3,504 (139)	3,497 (139)	3,526 (141)
1995	3,732 (147)	3,702 (139)	3,696 (140)	3,727 (142)
1996	3,710 (154)	3,667 (145)	3,661 (146)	3,690 (148)
1997	3,709 (156)	3,651 (147)	3,644 (147)	3,672 (150)
1998	3,987 (162)	3,910 (152)	3,902 (153)	3,928 (155)
1999	4,030 (173)	3,937 (162)	3,930 (162)	3,950 (164)
2000	4,111 (188)	3,997 (177)	3,988 (176)	4,006 (178)
2001	4,414 (210)	4,279 (197)	4,268 (196)	4,285 (198)
2002	4,650 (228)	4,501 (215)	4,487 (215)	4,506 (216)
2003	4,770 (249)	4,607 (240)	4,590 (239)	4,608 (239)
2004	4,664 (262)	4,498 (258)	4,477 (257)	4,509 (257)
2005	4,678 (276)	4,552 (275)	4,528 (274)	4,576 (275)
2006	5,045 (298)	4,981 (297)	4,957 (296)	4,999 (296)
2007	5,376 (309)	5,316 (306)	5,292 (306)	5,332 (306)
2008	5,534 (311)	5,504 (300)	5,483 (300)	5,511 (300)
2009	5,277 (298)	5,250 (282)	5,231 (282)	5,251 (283)

2010	5,092 (264)	4,997 (259)	4,980 (259)	5,000 (260)
2011	4,752 (235)	4,684 (235)	4,669 (235)	4,692 (237)
2012	4,206 (222)	4,224 (222)	4,210 (221)	4,238 (225)
2013	3,925 (218)	3,999 (221)	3,985 (221)	4,029 (227)
2014	3,847 (222)	3,973 (224)	3,957 (224)	4,022 (234)
2015	3,958 (227)	4,095 (227)	4,080 (227)	4,137 (242)
2016	4,219 (226)	4,294 (221)	4,281 (221)	4,310 (233)
2017	4,339 (214)	4,285 (205)	4,274 (205)	4,292 (210)
2018	4,041 (193)	3,926 (185)	3,916 (185)	3,913 (188)
2019	3,563 (177)	3,432 (174)	3,422 (174)	3,376 (174)
2020	3,076 (174)	3,008 (179)	2,997 (178)	2,895 (179)
2021	2,987 (190)	2,955 (204)	2,942 (202)	2,814 (206)
2022	3,071 (213)	3,031 (238)	3,015 (236)	2,880 (247)
2023	3,149 (242)	3,051 (282)	3,030 (279)	2,903 (306)
2024	3,818 (313)	3,545 (373)	3,518 (370)	3,447 (420)
2025	4,447 (485)	4,088 (522)	4,047 (516)	4,059 (597)

Table 17: Comparison of biological reference points for models 23.1c, 26.0, 26.0a, and 26.1. Stock status, F_{OFL}, and OFL are computed using the combined approach detailed in Section F above.

Subdistrict	Model	MMB (t)	$B_{35\%}$ (t)	Status	$\bar{R}_{1987-2022}$	$F_{35\%}$	F_{OFL}	OFL (t)	Total OFL (t)
EAG	23.1c	6,406	6,630	0.96	2,648	0.522	0.501	2,146	3,534
WAG		4,279	4,488		1,799	0.516	0.496	1,388	
EAG	26.0	6,412	6,659	0.94	2,662	0.518	0.484	2,104	3,355
WAG		4,035	4,477		1,793	0.523	0.489	1,251	
EAG	26.0a	6,680	6,687	0.96	2,669	0.516	0.492	2,232	3,493
WAG		3,990	4,470		1,790	0.523	0.500	1,261	
EAG	26.1	6,774	6,590	0.98	2,631	0.481	0.472	2,044	3,343
WAG		4,075	4,462		1,787	0.512	0.504	1,299	

Subdistrict	Model	MMB (mil lb)	$B_{35\%}$ (mil lb)	Status	$\bar{R}_{1987-2017}$	$F_{35\%}$	F_{OFL}	OFL (mil lb)	Total OFL (mil lb)
EAG	23.1c	14.12	14.62	0.96	2,648	0.522	0.501	4.73	7.79
WAG		9.43	9.89		1,799	0.516	0.496	3.06	
EAG	26.0	14.14	14.68	0.94	2,662	0.518	0.484	4.64	7.40
WAG		8.90	9.87		1,793	0.523	0.489	2.76	
EAG	26.0a	14.73	14.74	0.96	2,669	0.516	0.492	4.92	7.70
WAG		8.80	9.85		1,790	0.523	0.500	2.78	
EAG	26.1	14.93	14.53	0.98	2,631	0.481	0.472	4.51	7.37
WAG		8.98	9.84		1,787	0.512	0.504	2.86	

Table 18: Objective function, catch, index, and size likelihood components, key management quantities, and frequency of each outcome for 100 jitter runs with jitter scale ($\sigma_J = 0.3$) for each model. Blank rows indicate runs that did not converge.

	Model	Objective Function	Δ NLL	Catch	Index	Size	MMB_{proj}	$B_{35\%}$	Max. Gradient	N
EAG	23.1c	3,071.105	0.000	-488.770	-45.630	864.840	6,406	6,630	1.17e-04	72
		3,109.156	38.051	-472.580	-70.170	902.110	6,184	7,136	1.70e-04	7
									NA	21
EAG	26.0	3,061.499	0.000	-488.410	-47.990	856.660	6,412	6,659	8.88e-05	83
									NA	17
EAG	26.0a	3,076.269	0.000	-487.940	-47.900	830.890	6,680	6,687	9.72e-05	85
		3,211.518	135.249	-489.190	-46.820	966.880	6,561	6,592	1.95e-02	2
									NA	13
EAG	26.1	3,104.952	0.000	-488.150	-59.750	849.410	6,774	6,590	8.69e-05	89
									NA	11
WAG	23.1c	3,261.705	0.000	-467.100	-68.470	1,053.020	4,279	4,488	1.50e-05	52
		3,264.779	3.074	-449.520	-76.710	1,043.570	4,420	4,921	1.45e-04	18
		3,269.614	7.909	-465.410	-73.900	1,060.620	4,277	4,436	1.64e-04	6
									NA	24
WAG	26.0	3,213.291	0.000	-445.160	-78.400	987.880	4,157	4,863	9.11e-05	23
		3,214.694	1.404	-460.500	-65.640	995.020	4,035	4,477	1.41e-05	57
									NA	20
WAG	26.0a	3,264.626	0.000	-445.540	-78.610	998.890	4,126	4,852	8.91e-05	40
		3,265.831	1.205	-461.010	-65.740	1,006.250	3,990	4,470	6.58e-05	45
		3,346.922	82.296	-445.710	-78.280	1,081.330	4,040	4,801	6.65e-02	1
		3,348.546	83.920	-461.280	-64.040	1,088.090	3,905	4,410	2.87e-02	1
		3,609.860	345.234	-374.070	-60.590	1,259.990	3,738	4,255	6.38e-04	2
									NA	11
WAG	26.1	3,276.748	0.000	-446.720	-81.330	999.980	4,171	4,840	2.39e-04	21
		3,278.601	1.853	-462.060	-67.360	1,006.980	4,075	4,462	1.17e-04	65
		3,363.736	86.988	-446.680	-81.110	1,086.940	4,063	4,786	8.22e-04	2
		3,366.019	89.271	-462.140	-65.640	1,093.300	3,973	4,401	1.23e-02	1
		3,634.549	357.801	-374.930	-61.970	1,272.350	3,878	4,251	1.28e-03	2
									NA	9

Figures

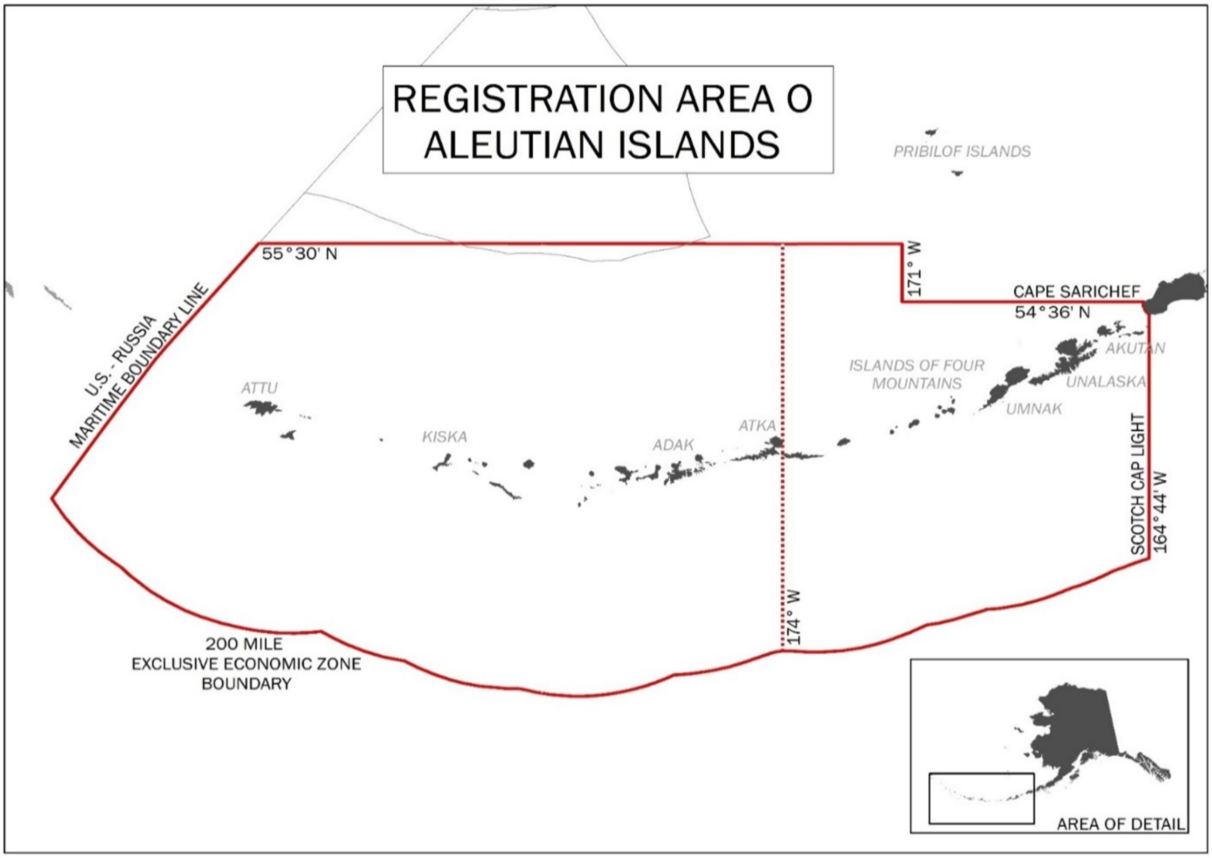

Figure 1: Map of the Aleutian Islands Registration Area (O), divided in to WAG and EAG subdistricts at 174° west longitude.

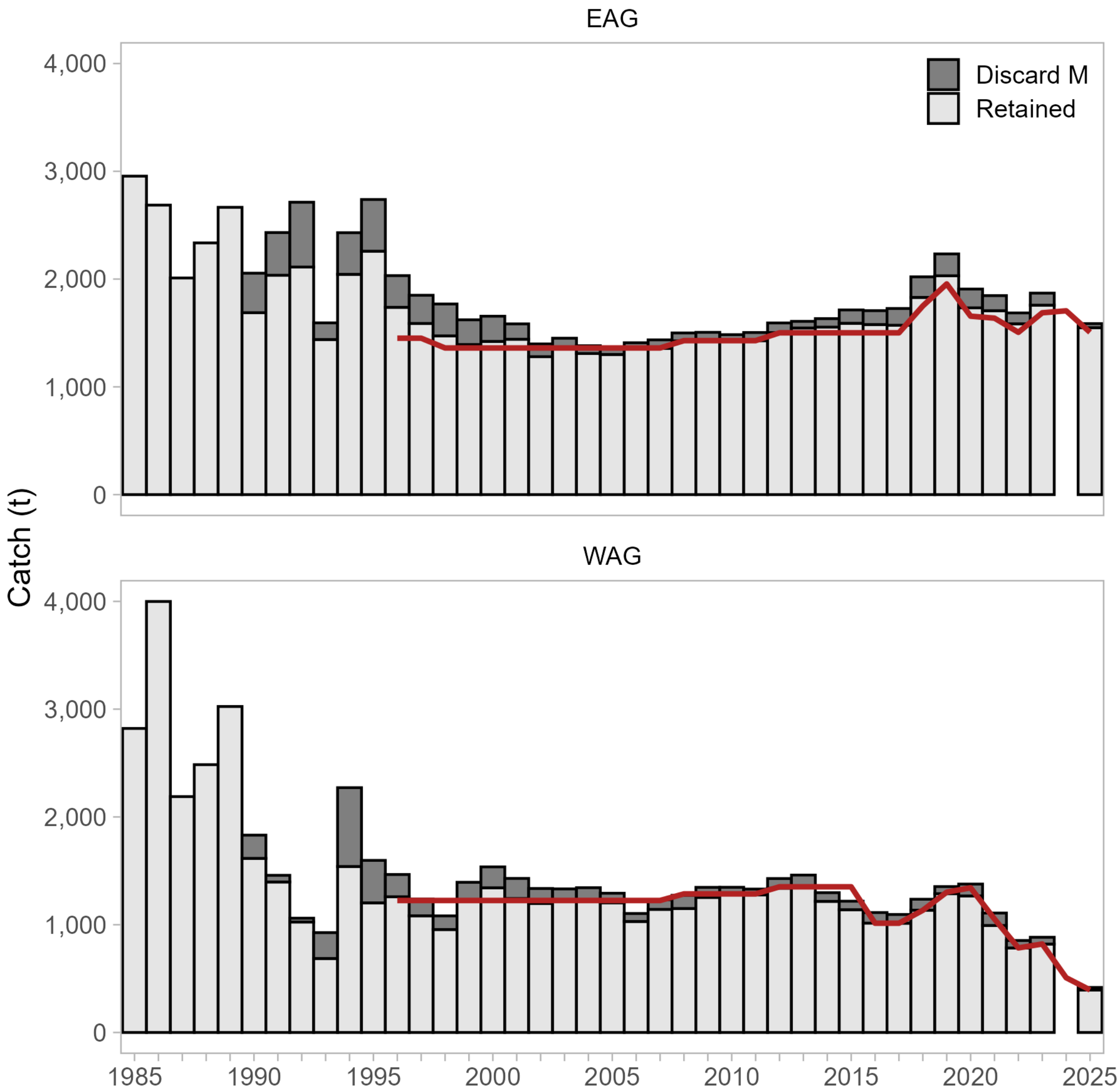

Figure 2: Time series of retained catch (t), directed fishery discard mortality (t), and the total allowable catch (t; red line) in the EAG and WAG. Catch in 2024/25 was removed due to confidentiality.

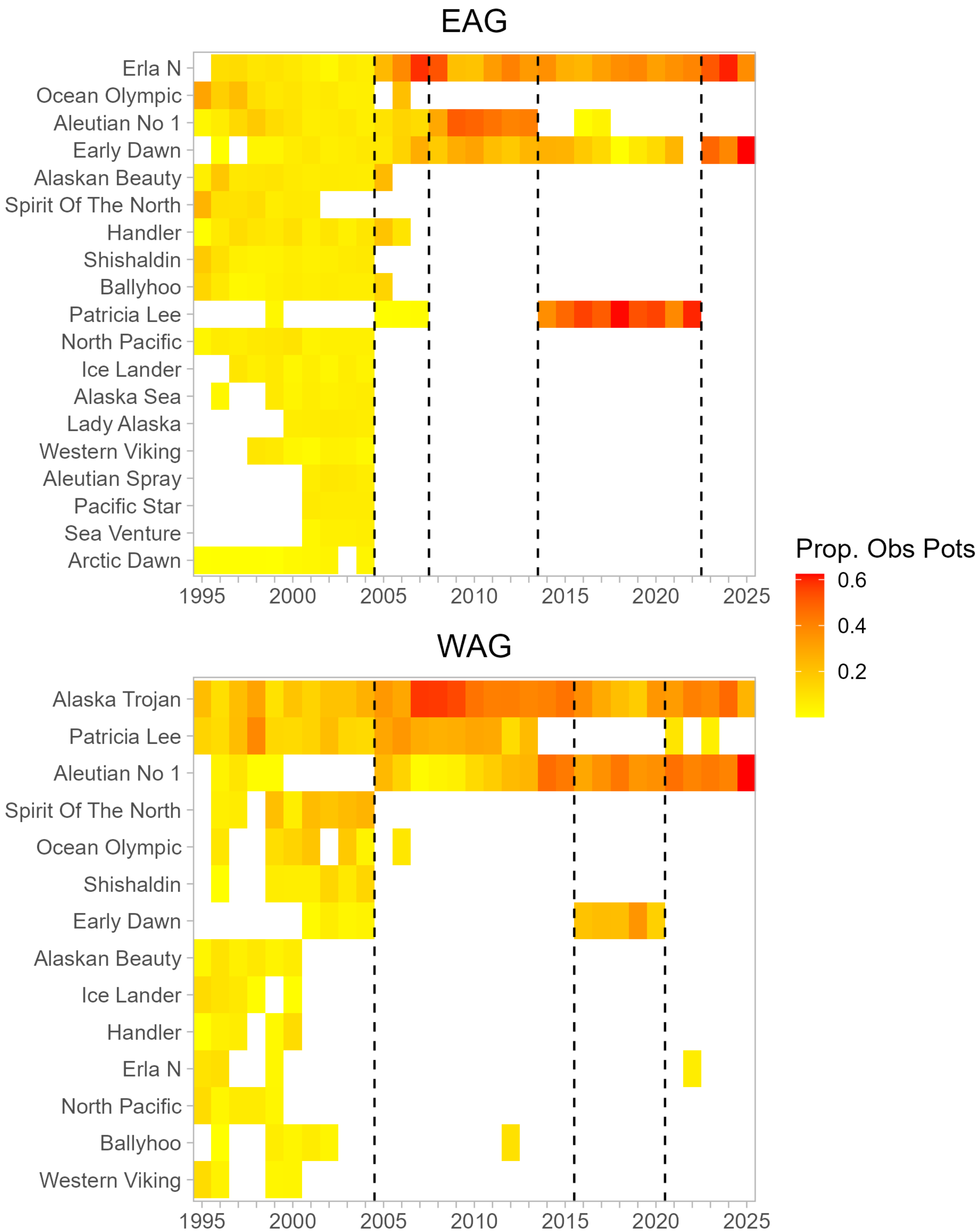

Figure 3: Proportion of observer pots by vessel and year in the EAG and WAG.

Figure 4: Vessels fishing the most observed pots within 10 km^2 cells in the EAG. Different vessels are denoted by color, and locations have been disorted while preserving clusters to protect data confidentiality.

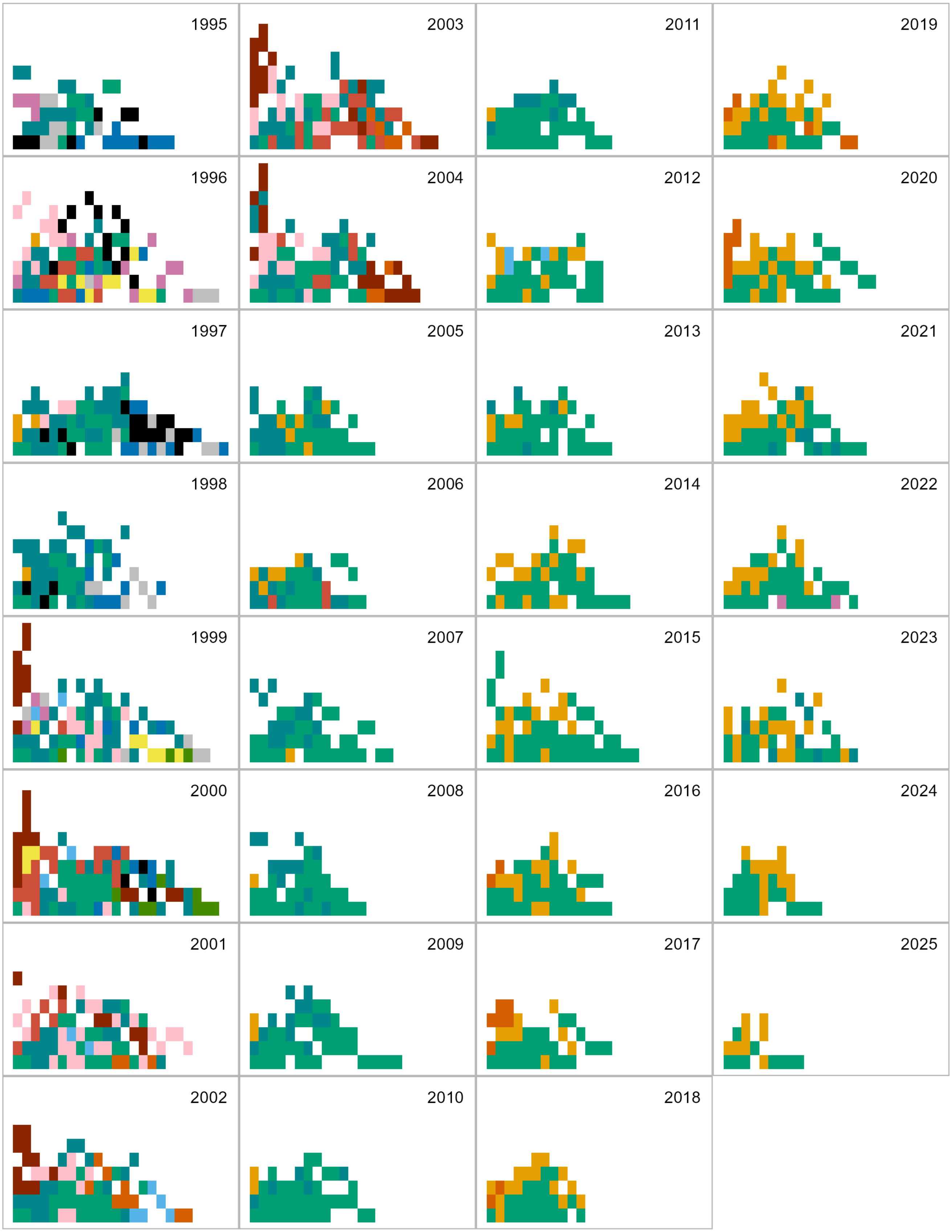

Figure 5: Vessels fishing the most observed pots within 10 km^2 cells in the WAG. Different vessels are denoted by color, and locations have been disorted while preserving clusters to protect data confidentiality.

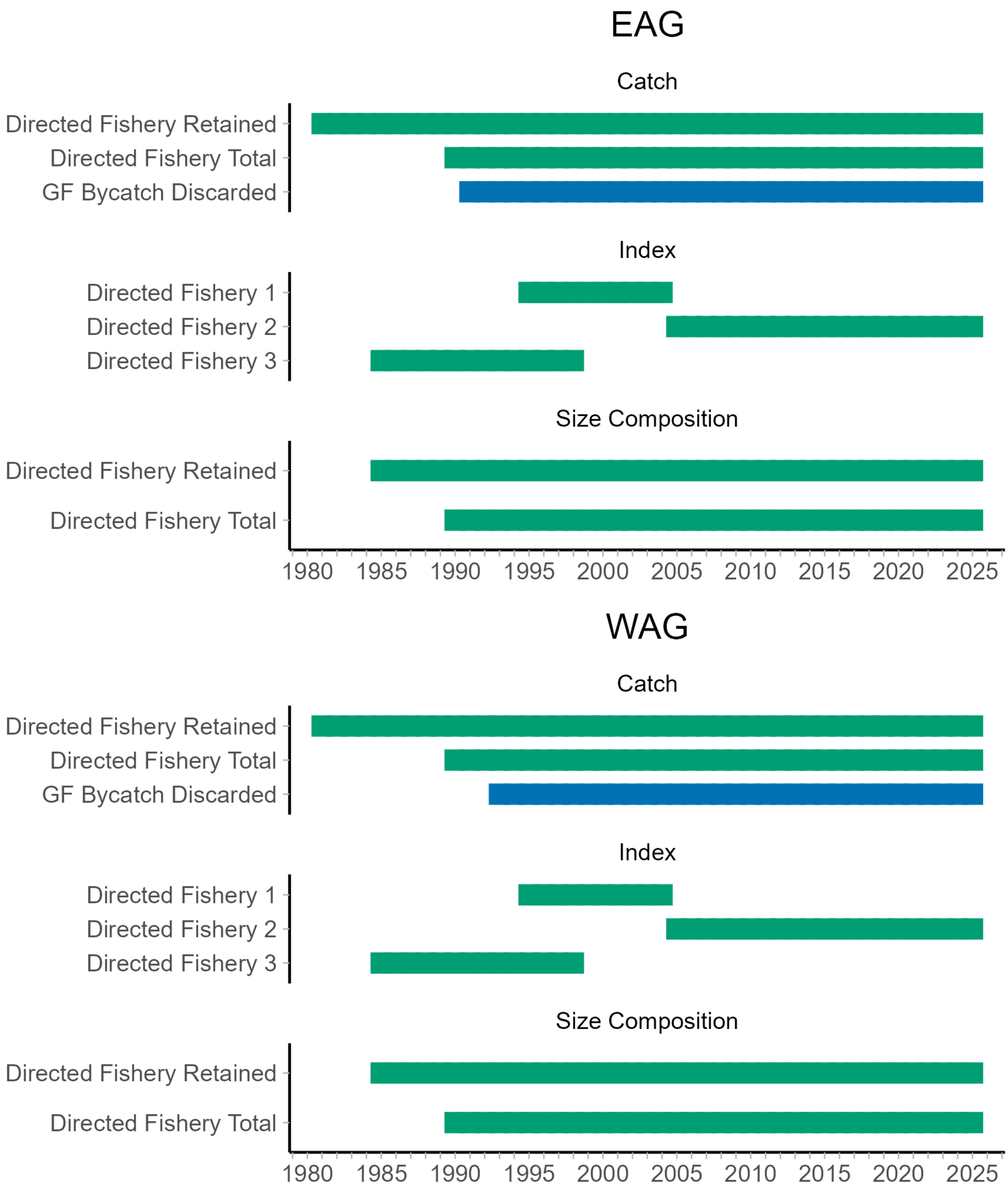

Figure 6: Data range by fleet for EAG and WAG models.

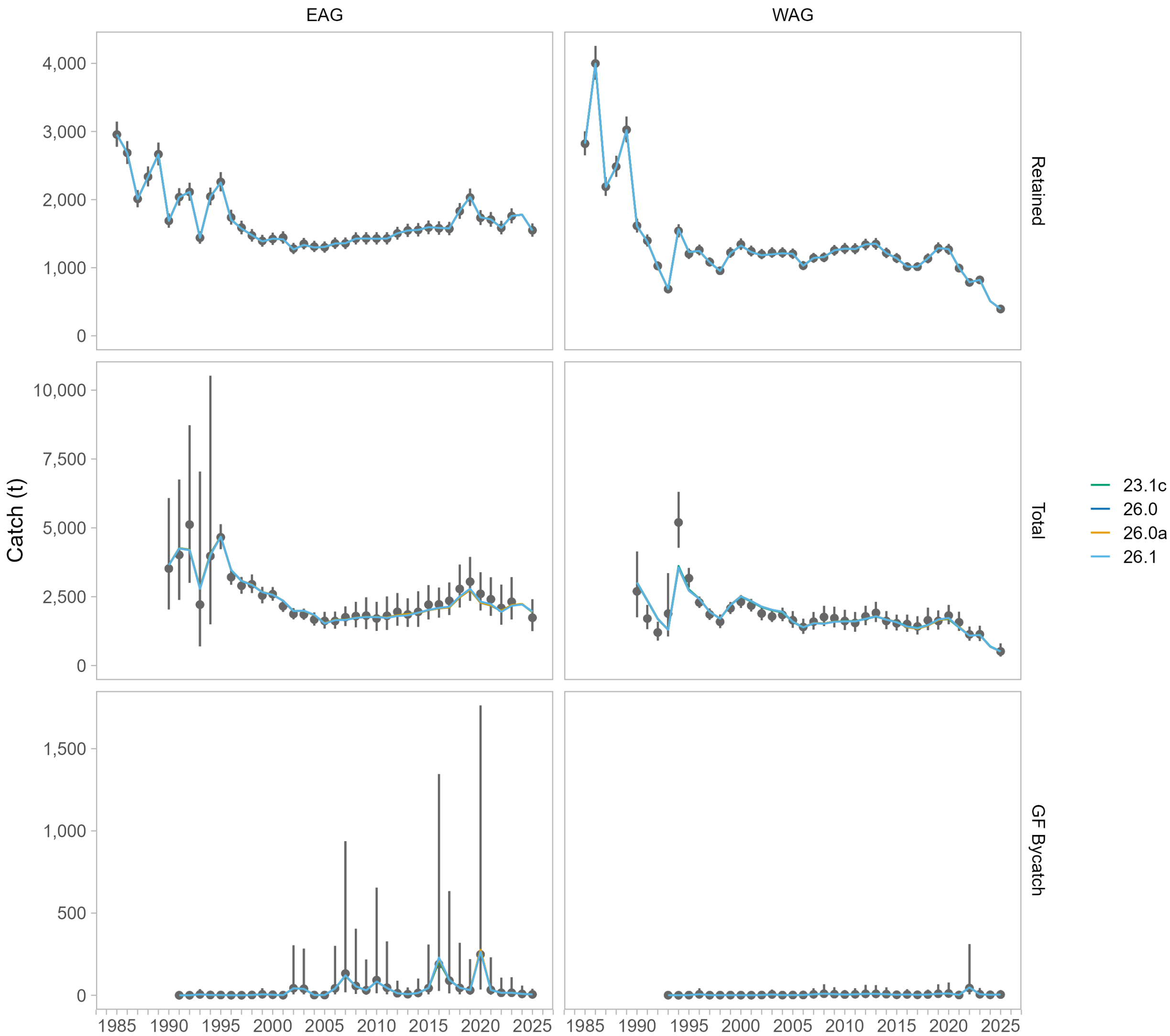

Figure 7: Comparison of model fit to retained catch, total catch, and groundfish bycatch. Error bars on observed values represent 95% confidence intervals. Observed catch for 2024 was removed due to confidentiality

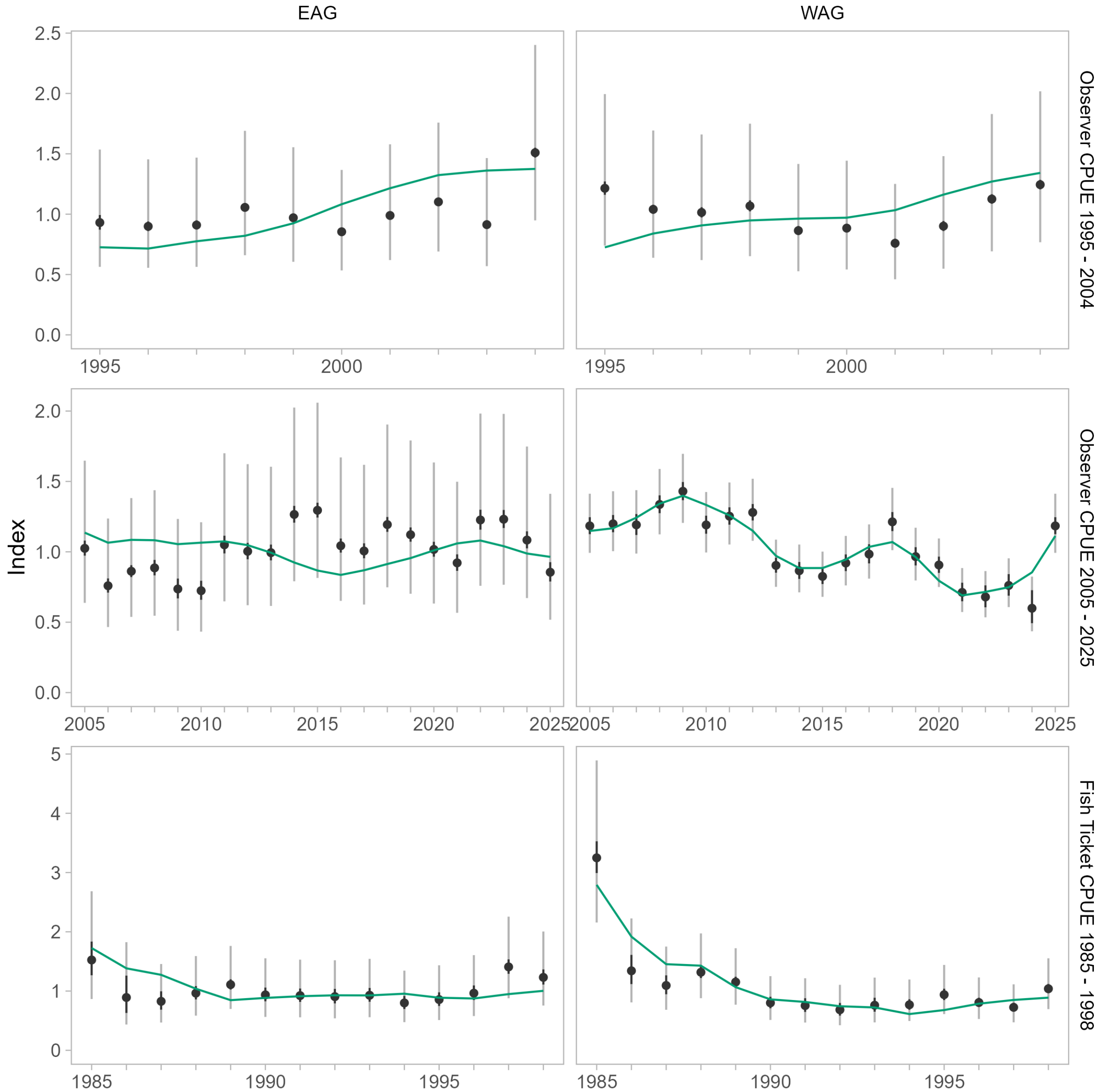

Figure 8: Fit to CPUE indices for model 23.1c. Error bars on observed values represent 95% confidence intervals (black) and estimated additional error (grey).

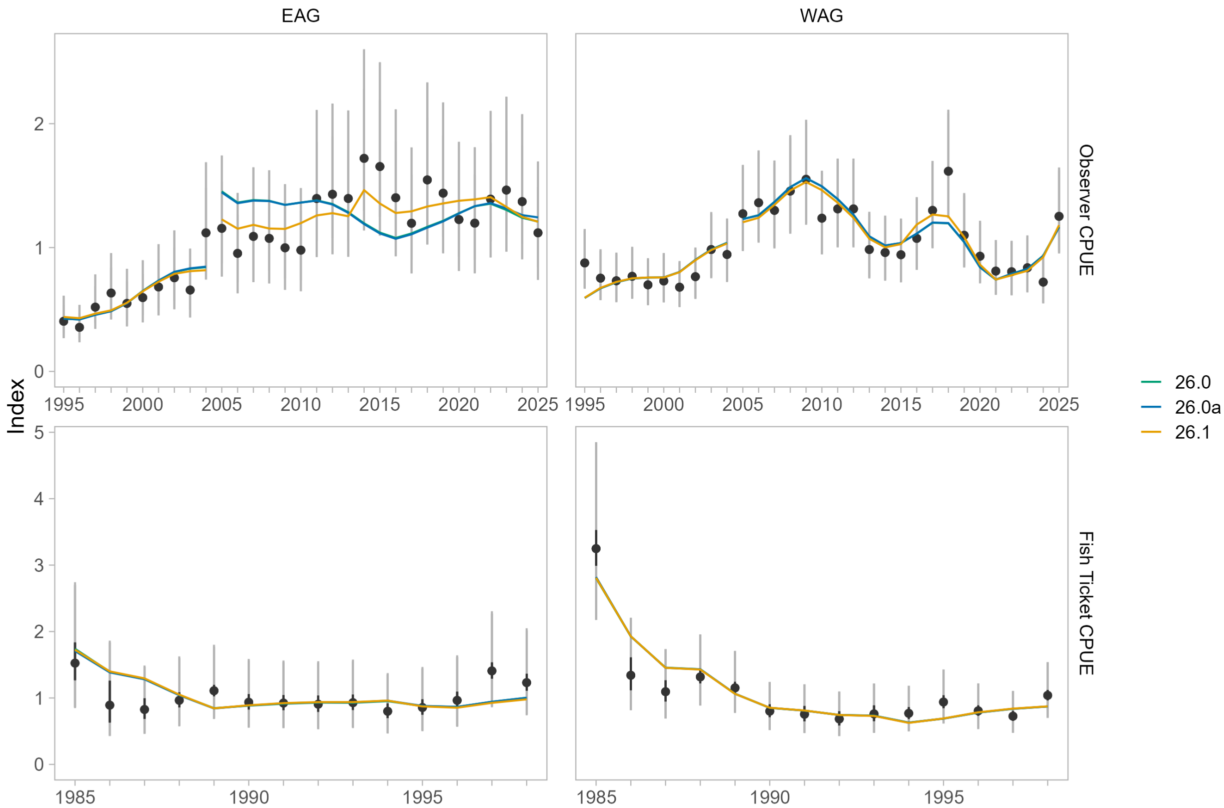

Figure 9: Comparison of fit to CPUE indices for models 26.0, 26.0a, and 26.1. Error bars on observed values represent 95% confidence intervals (black) and estimated additional error (grey).

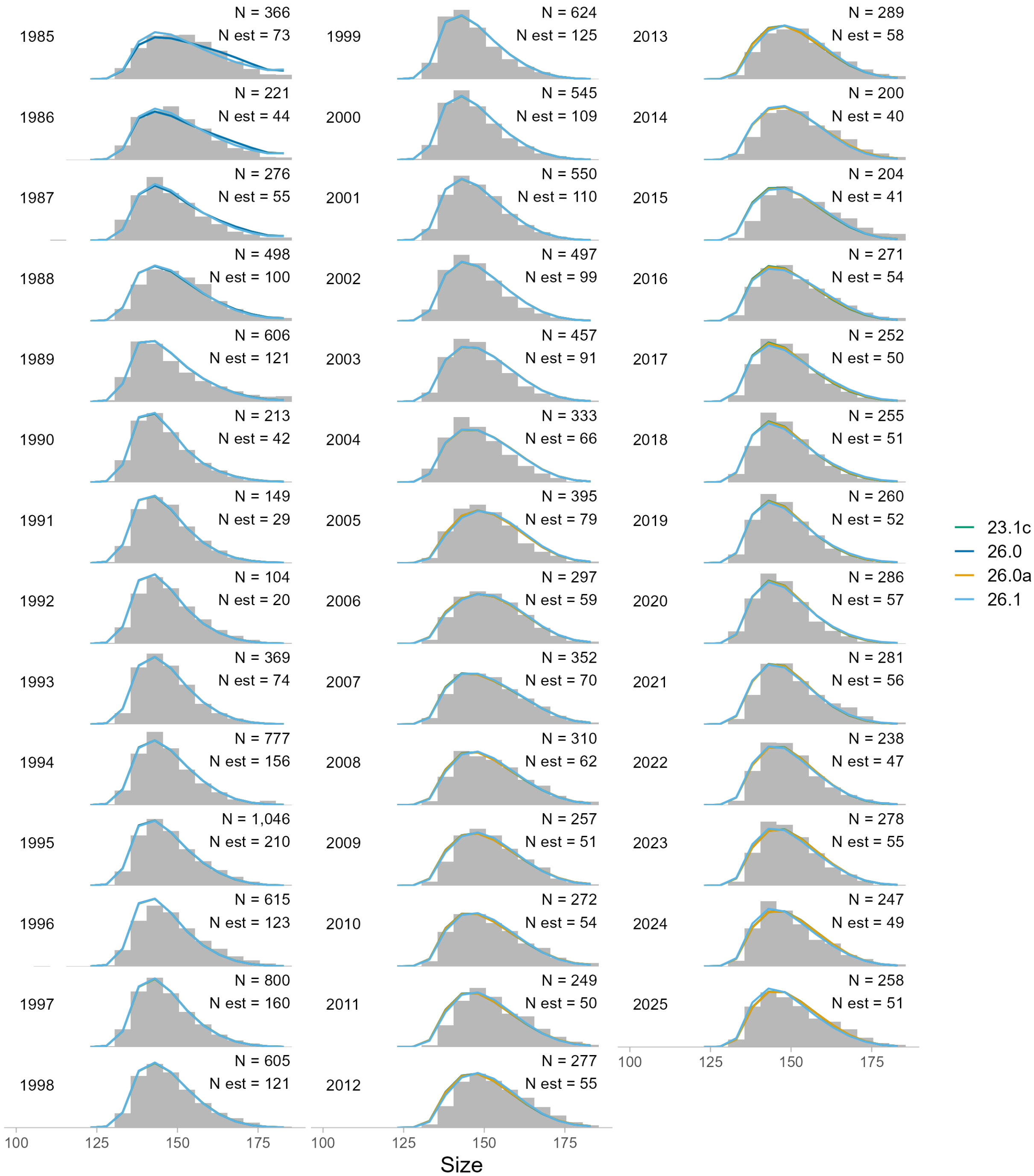

Figure 10: Comparison of model fit to retained catch size composition in the EAG.

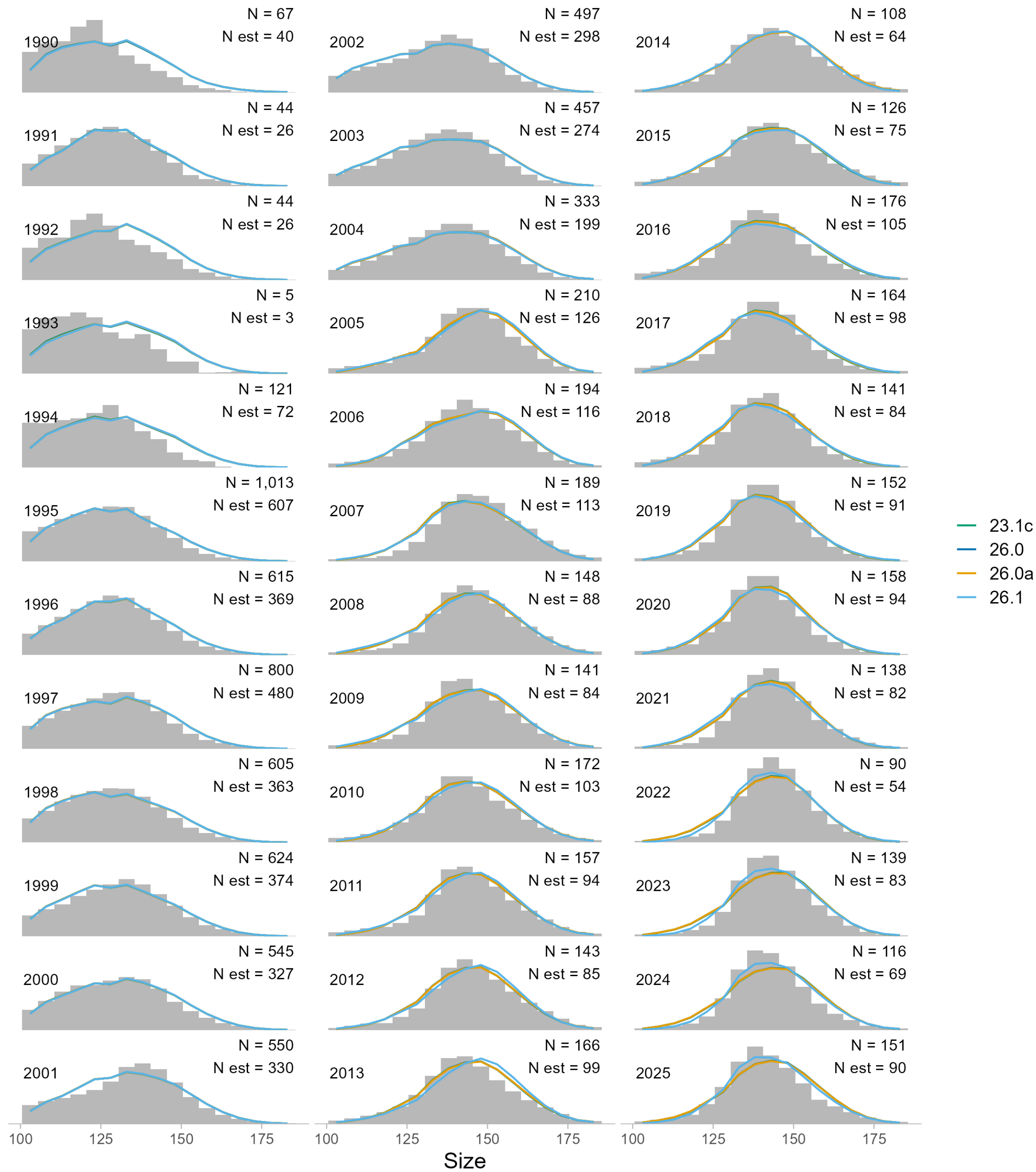

Figure 11: Comparison of model fit to total catch size composition in the EAG.

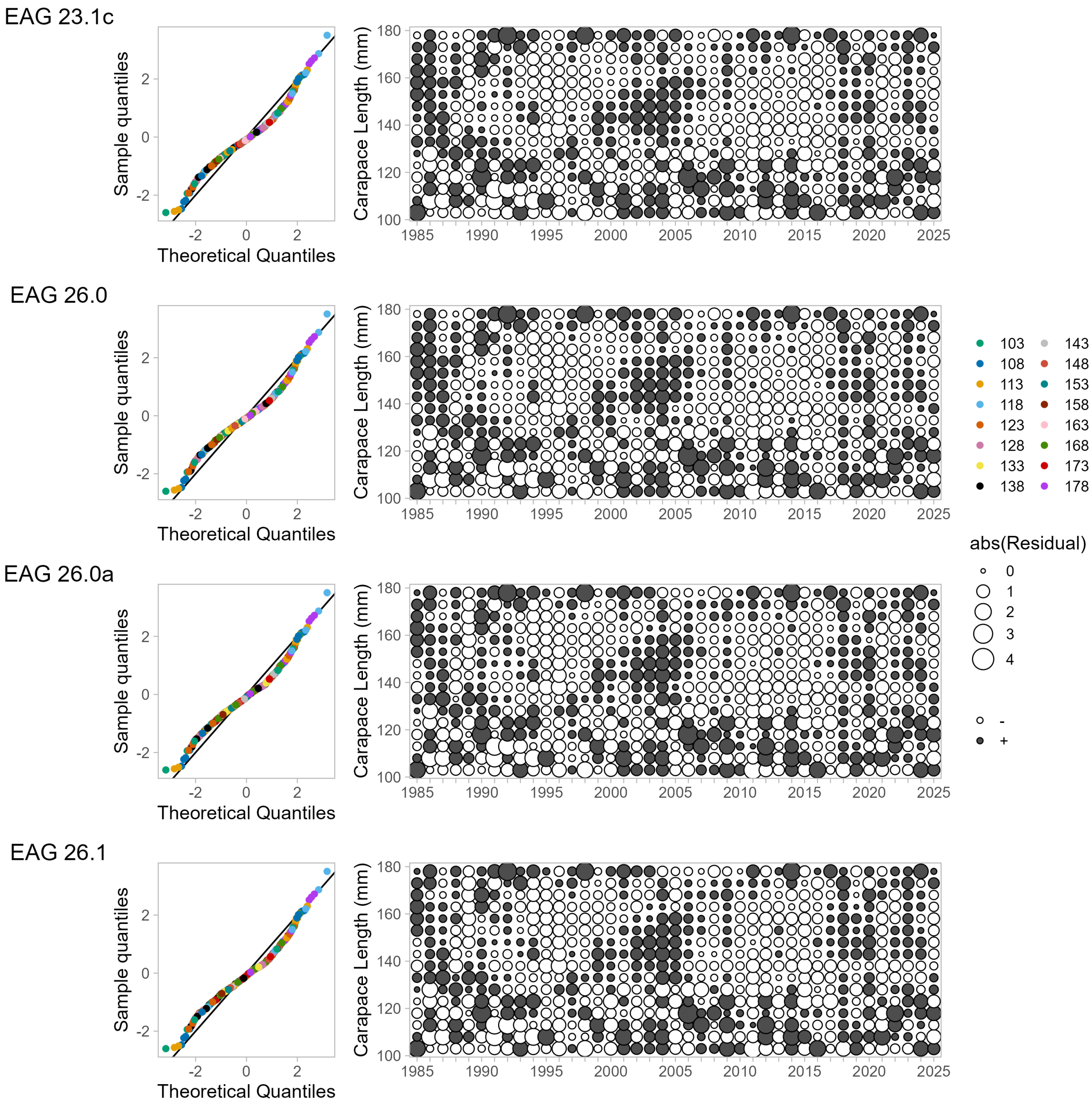

Figure 12: QQ plots and bubble plots for one step ahead residuals for fits to retained size composition data among EAG models

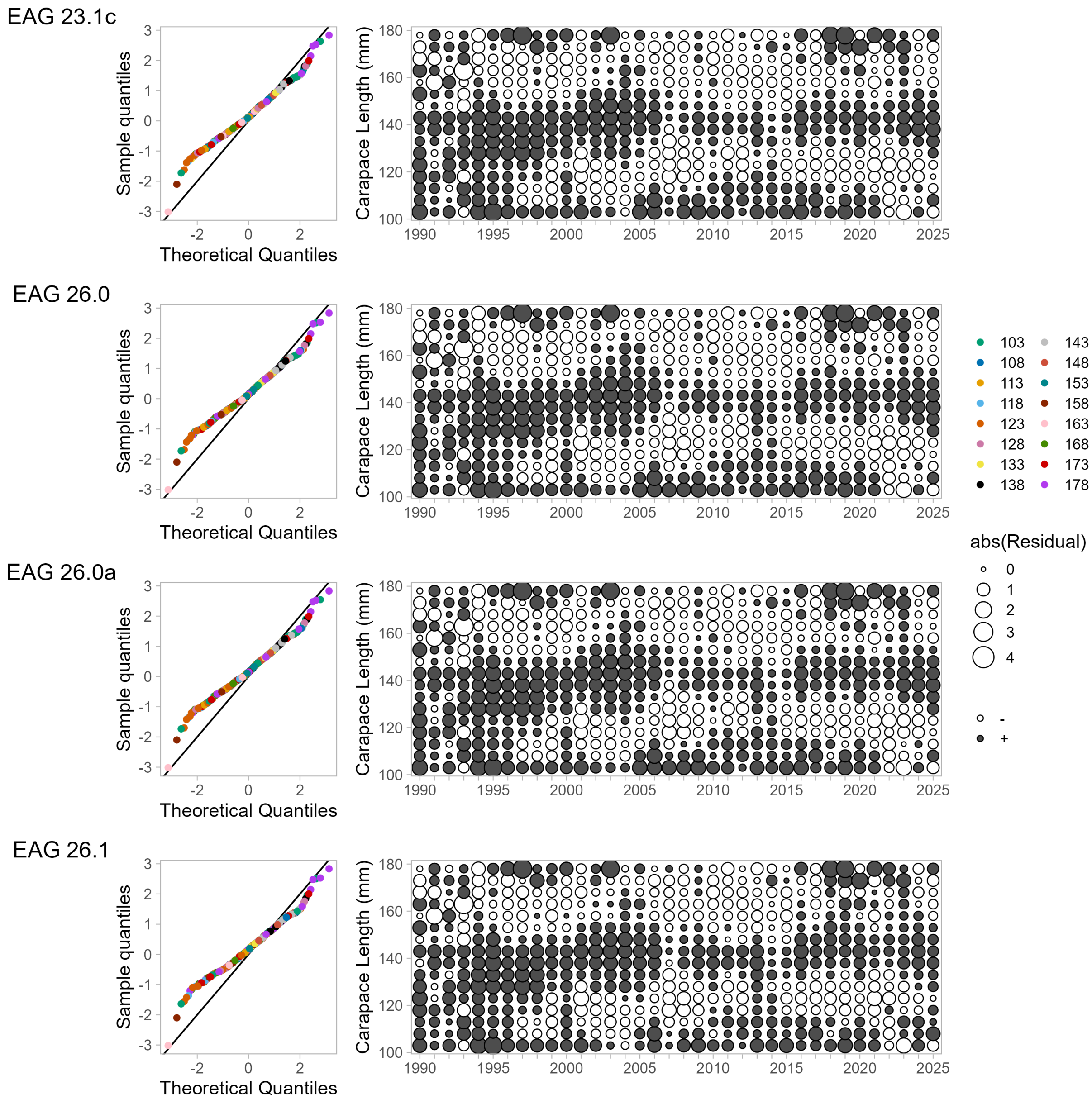

Figure 13: QQ plots and bubble plots for one step ahead residuals for fits to total size composition data among EAG models

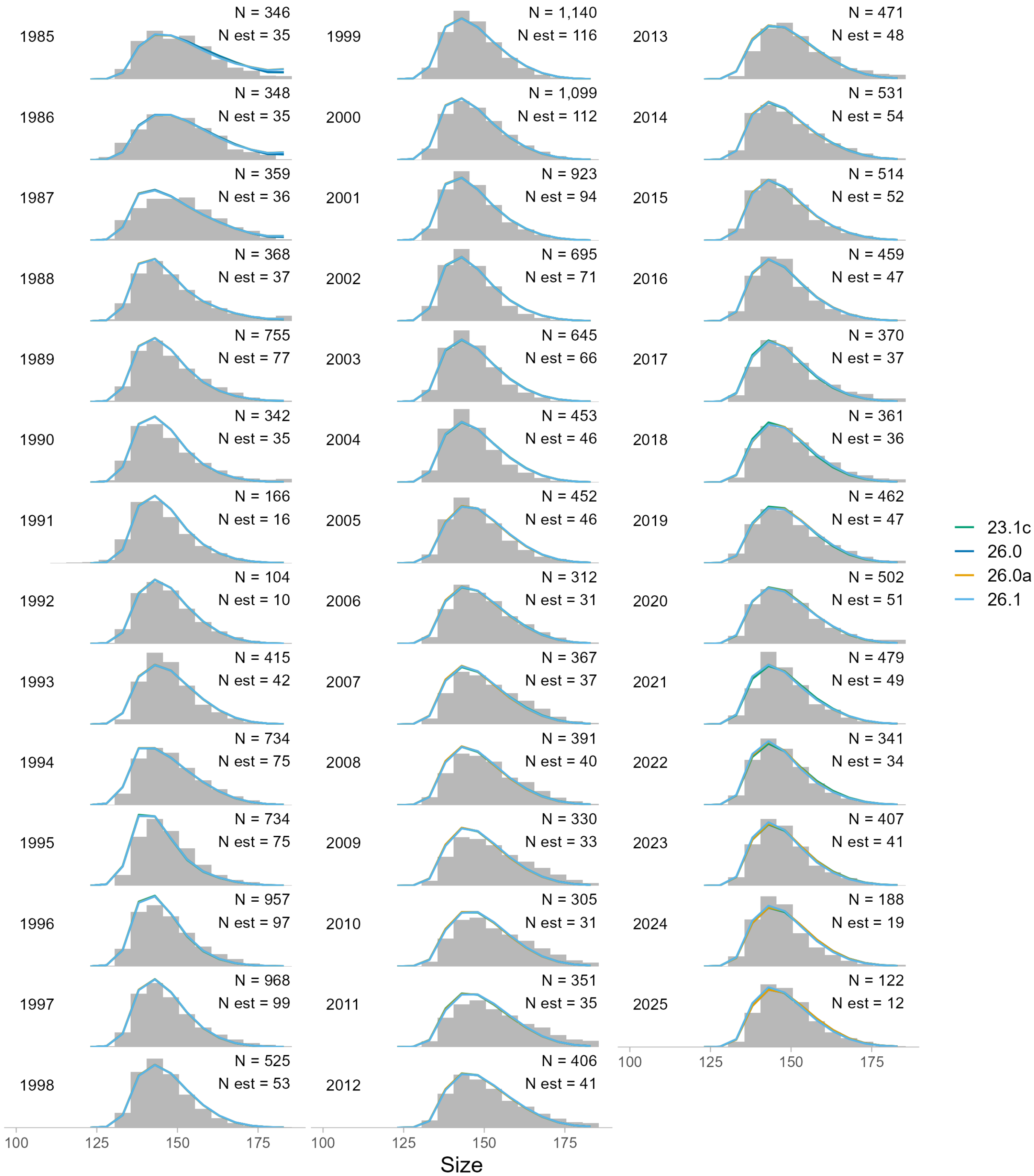

Figure 14: Comparison of model fit to retained catch size composition in the WAG.

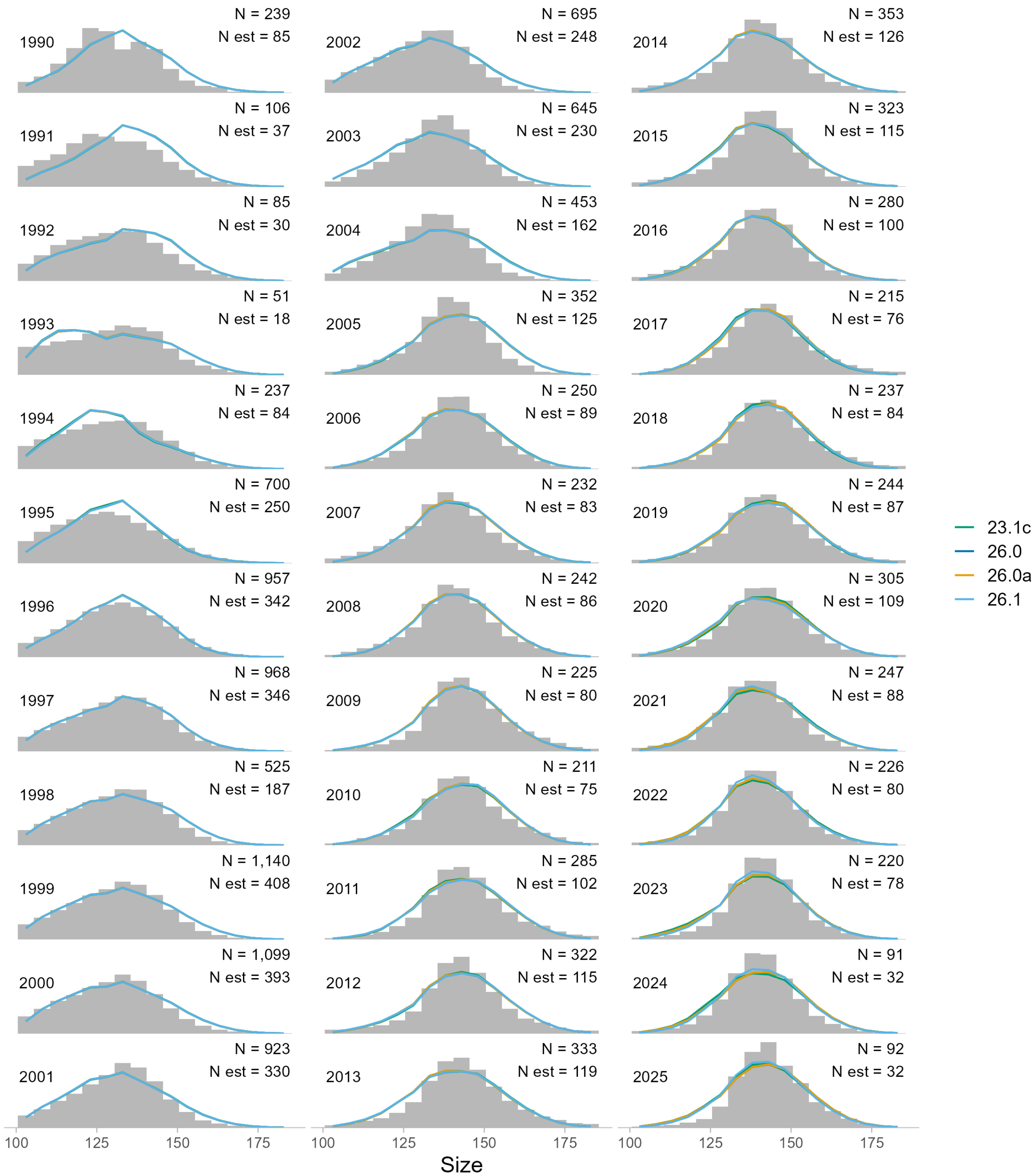

Figure 15: Comparison of model fit to total catch size composition in the WAG.

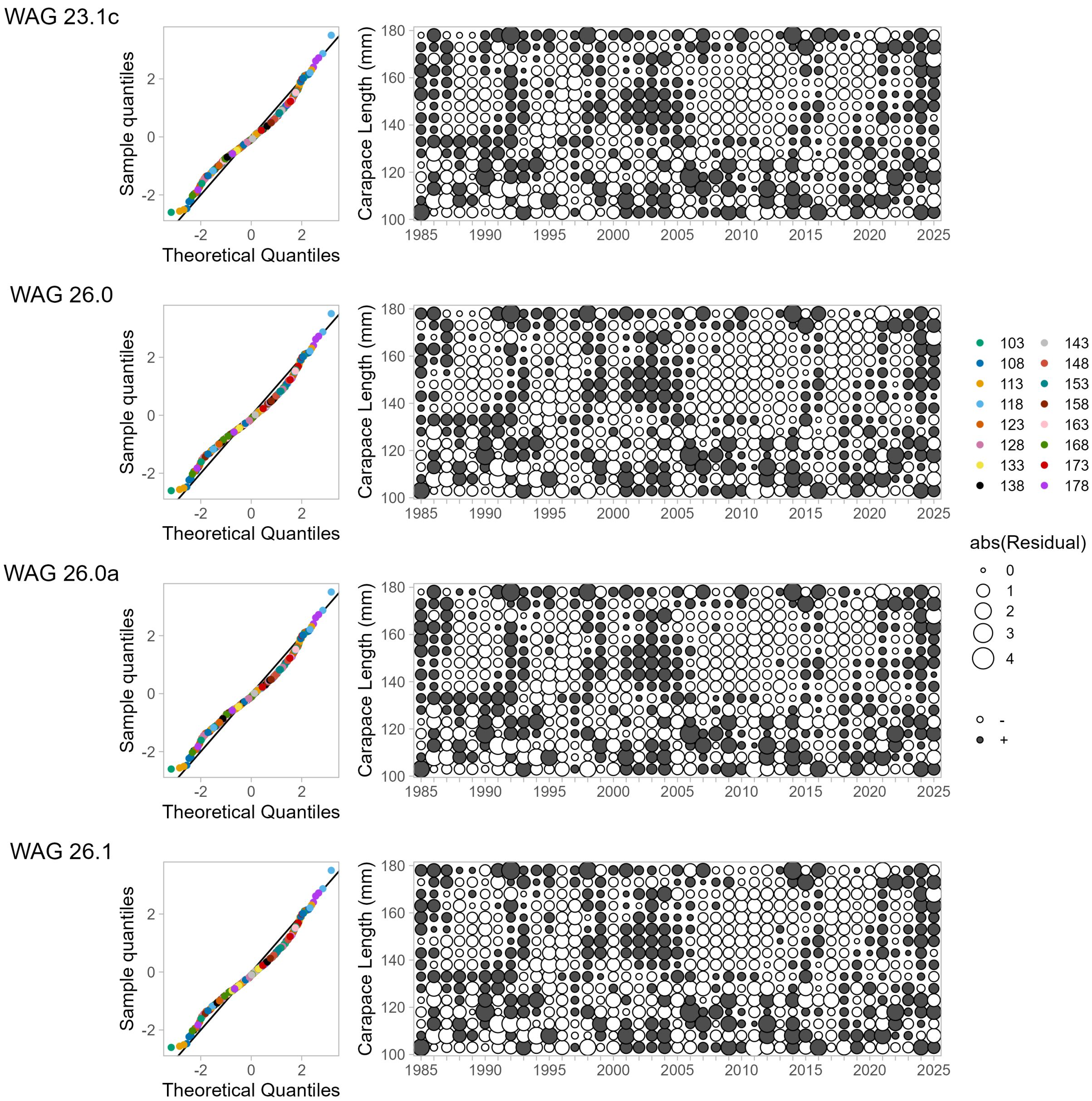

Figure 16: QQ plots and bubble plots for one step ahead residuals for fits to retained size composition data among WAG models

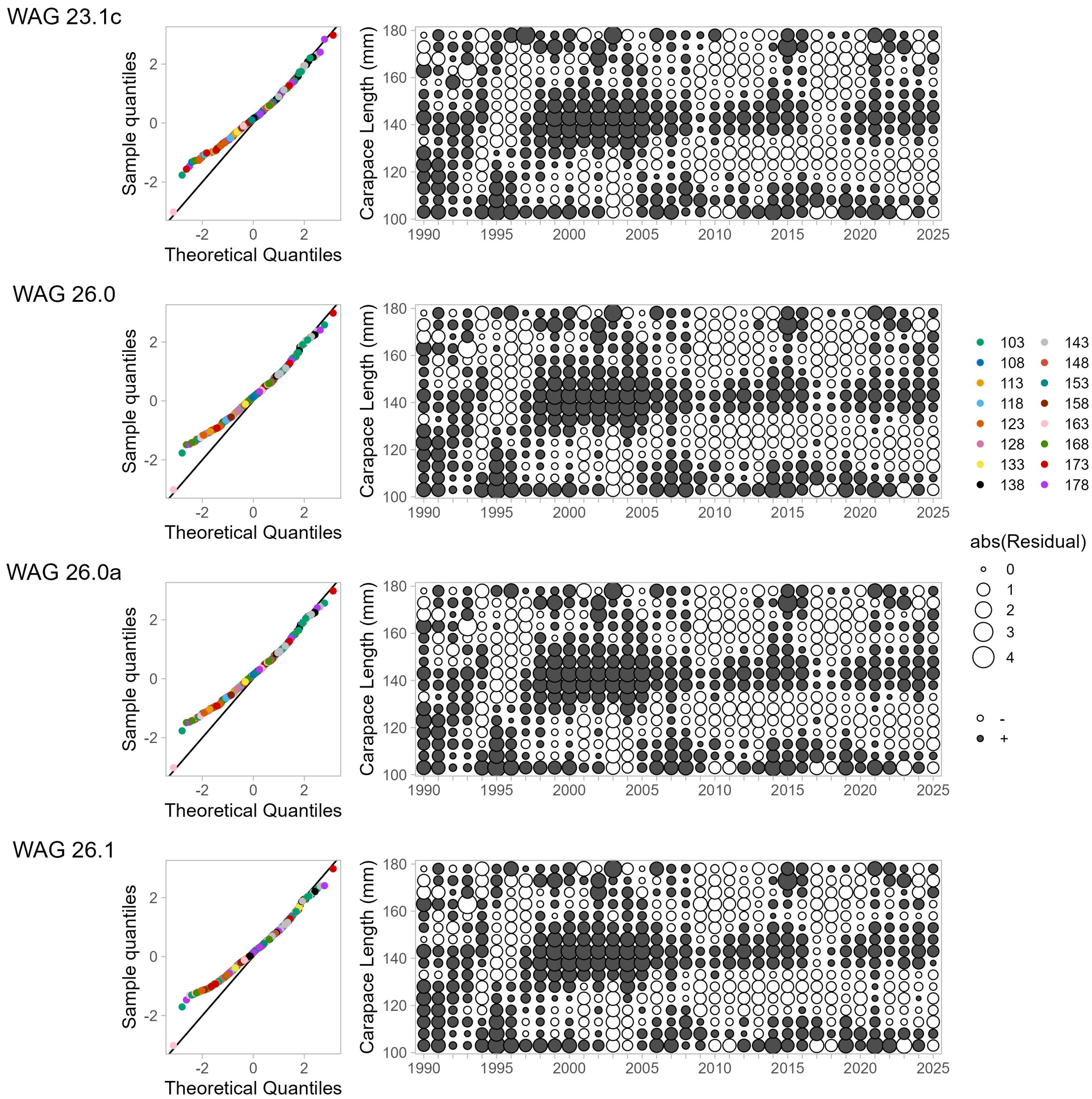

Figure 17: QQ plots and bubble plots for one step ahead residuals for fits to total size composition data among WAG models

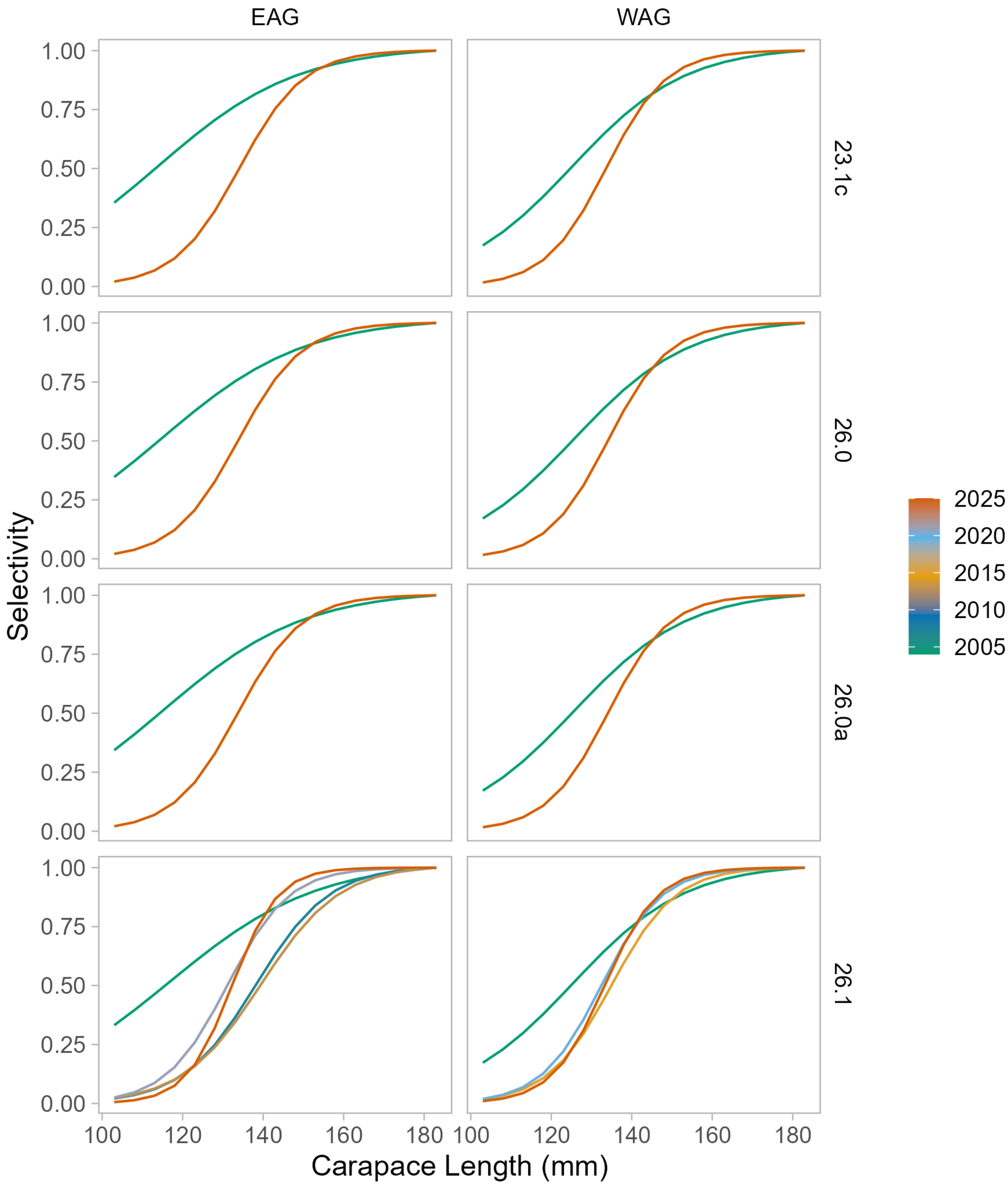

Figure 18: Comparison of estimated directed fishery selectivity time blocks for models 23.1c, 26.0, 26.0a, and 26.1.

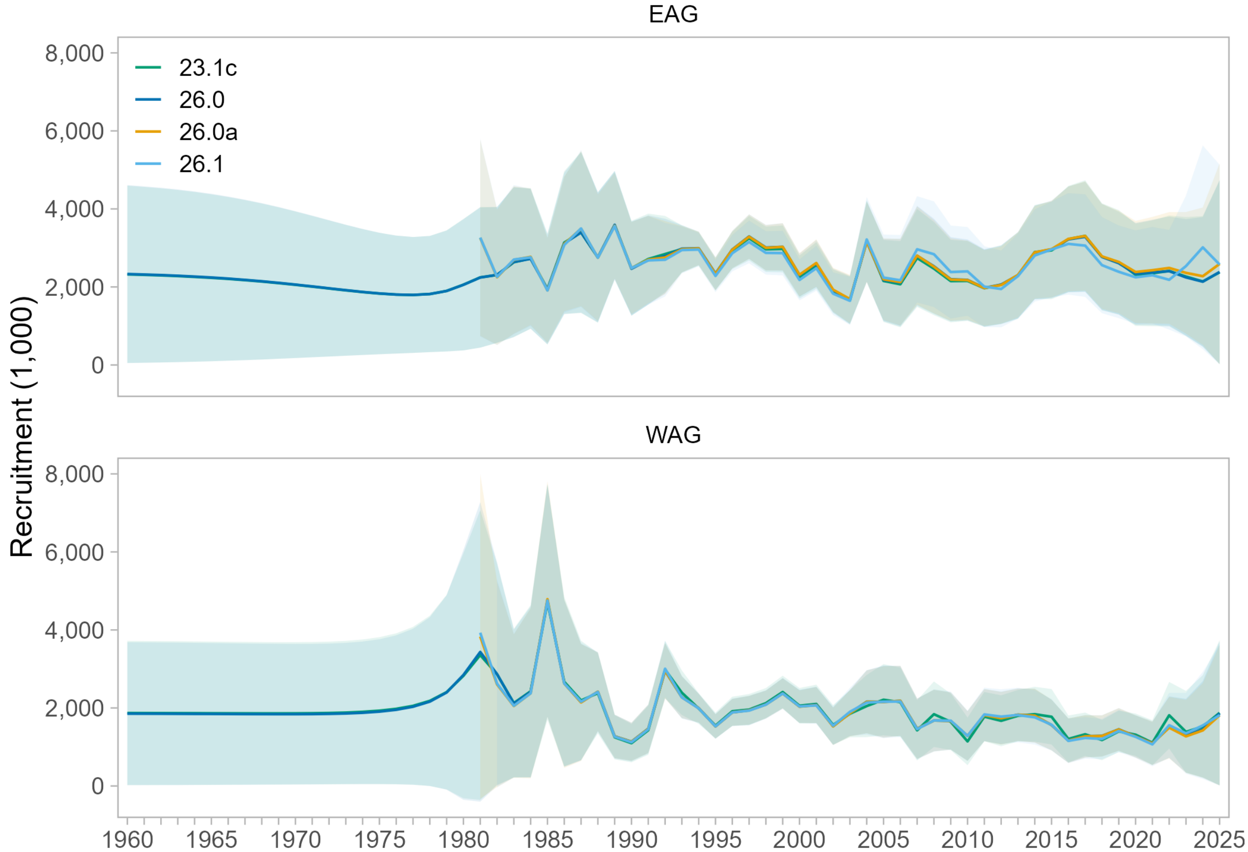

Figure 19: Comparison of model estimated recruitment and associated 95% CI for models 23.1c, 26.0, 26.0a, and 26.1.

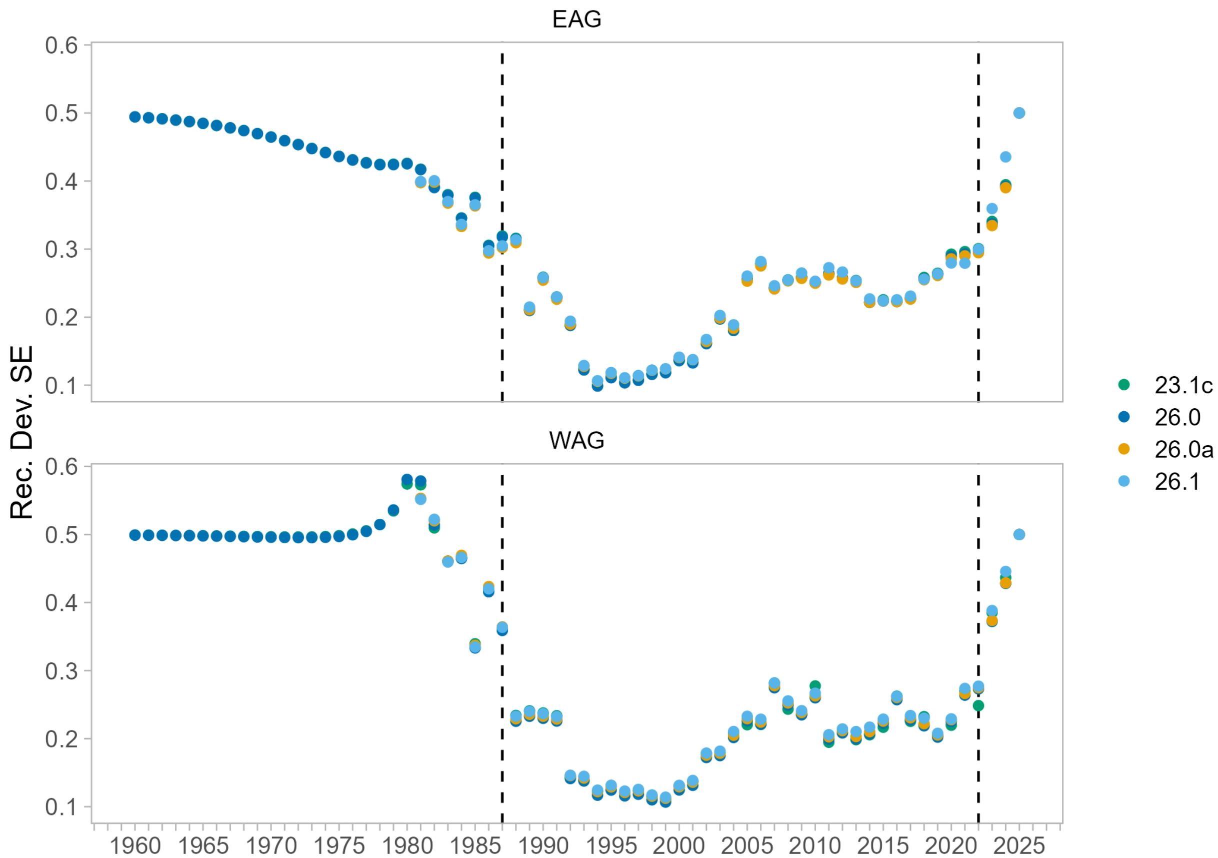

Figure 20: Standard errors of recruitment deviations for models 23.1c, 26.0, 26.0a, and 26.1. Dotted lines indicate the reference time series for mean recruitment used in reference point calculation, 1987 - 2022.

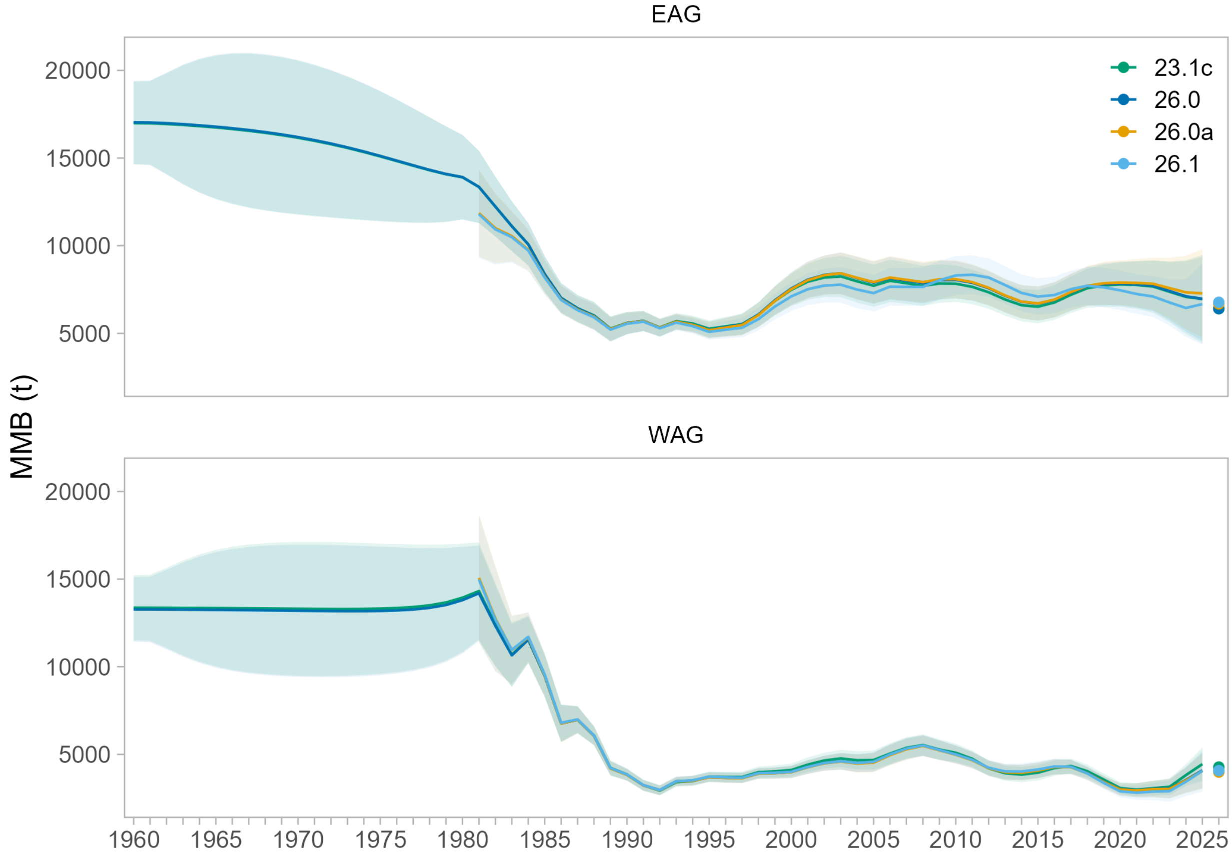

Figure 21: Comparison of model estimated MMB and associated 95% CI for models 23.1c, 26.0, 26.0a, and 26.1. Points indicate projected MMB for Feb 15, 2027.

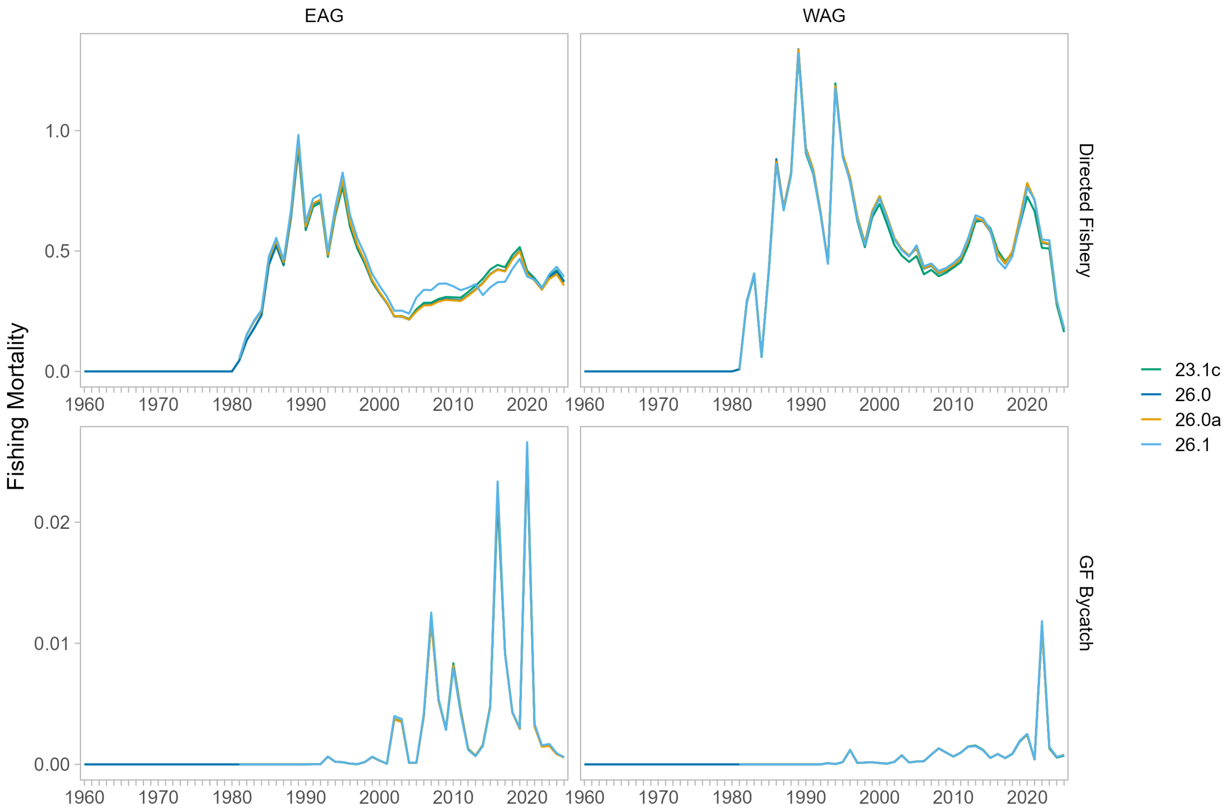

Figure 22: Comparison of model estimated fully selected fishing mortality for models 23.1c, 26.0, 26.0a, and 26.1 by fleet.

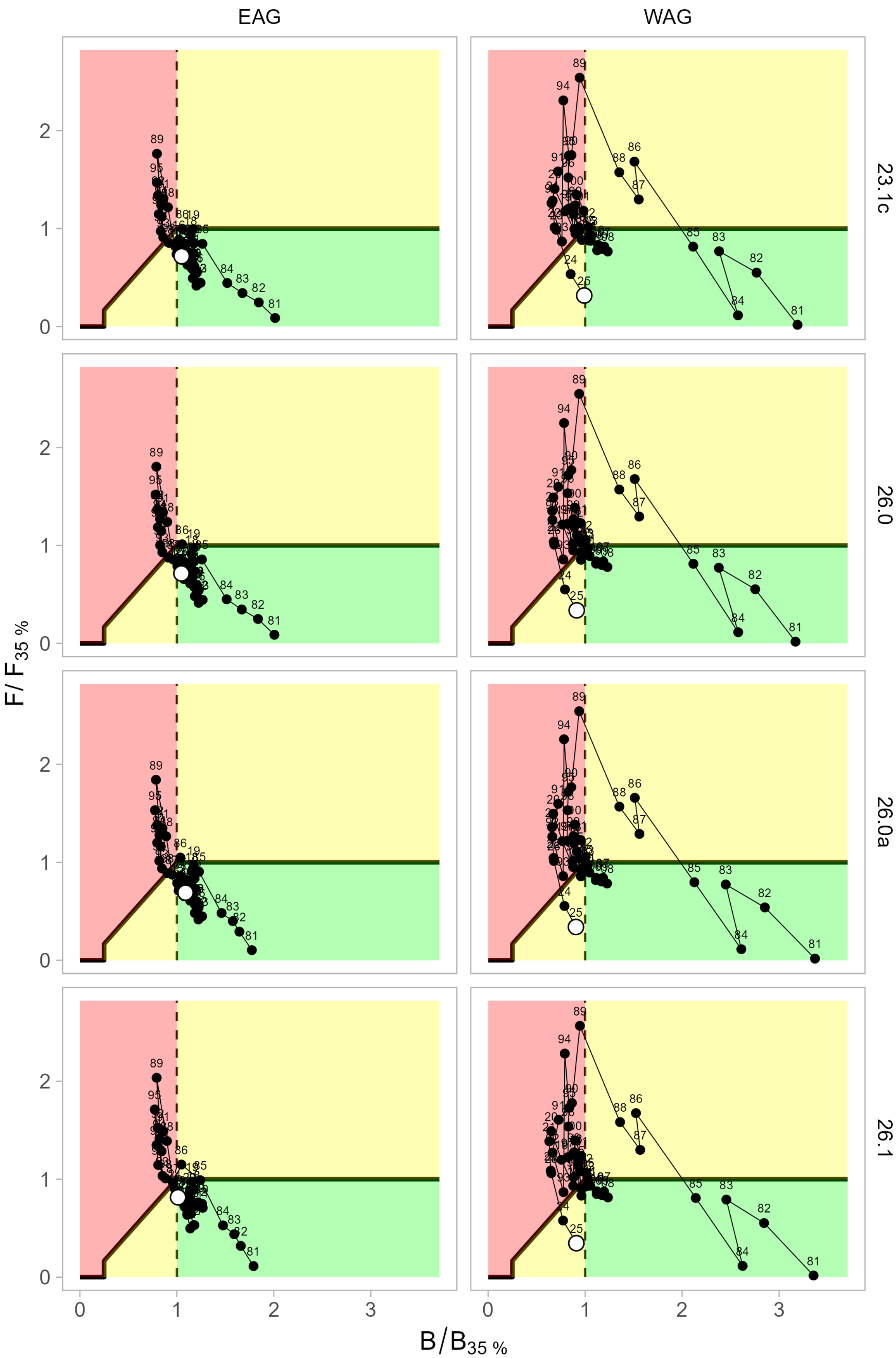

Figure 23: Kobe plots for models 23.1c, 26.0, 26.0a, and 26.1. Bolded line indicates the tier 3 F_{OFL} control rule.

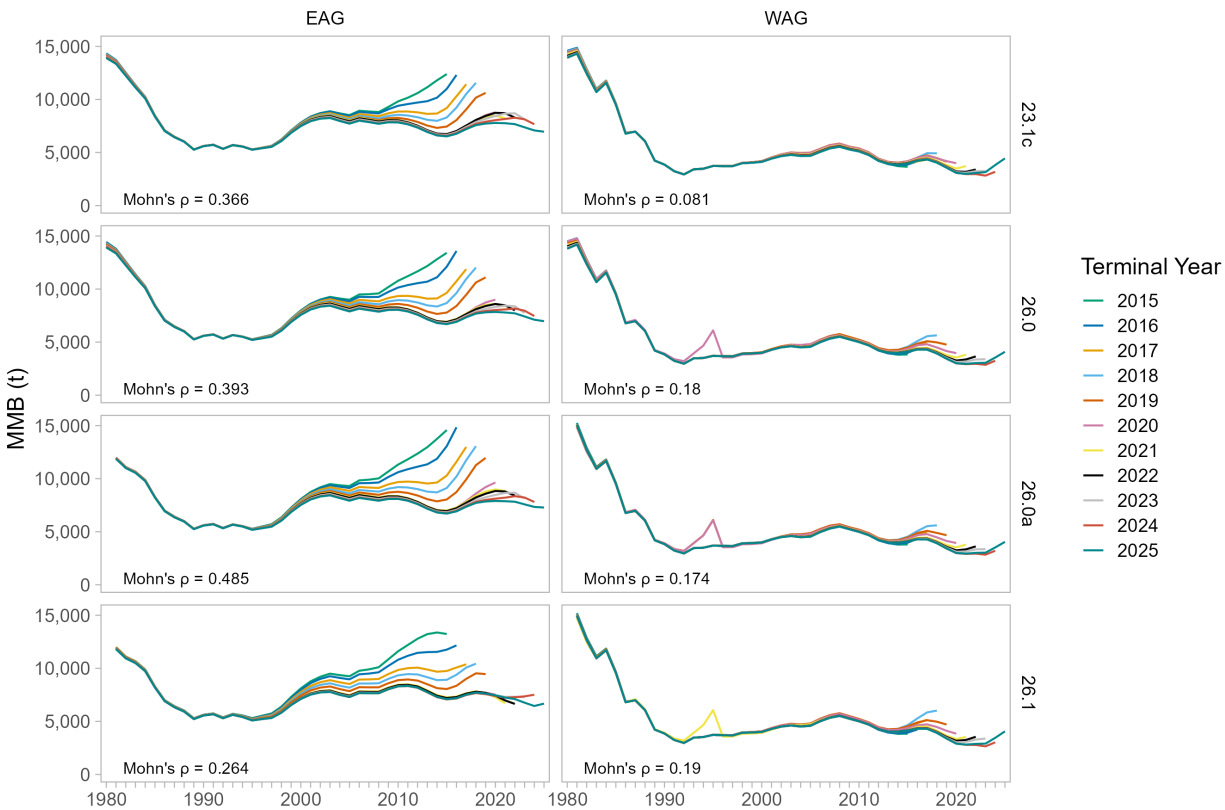

Figure 24: Estimated MMB and associtated Mohn's ρ from retrospective analyses by model.

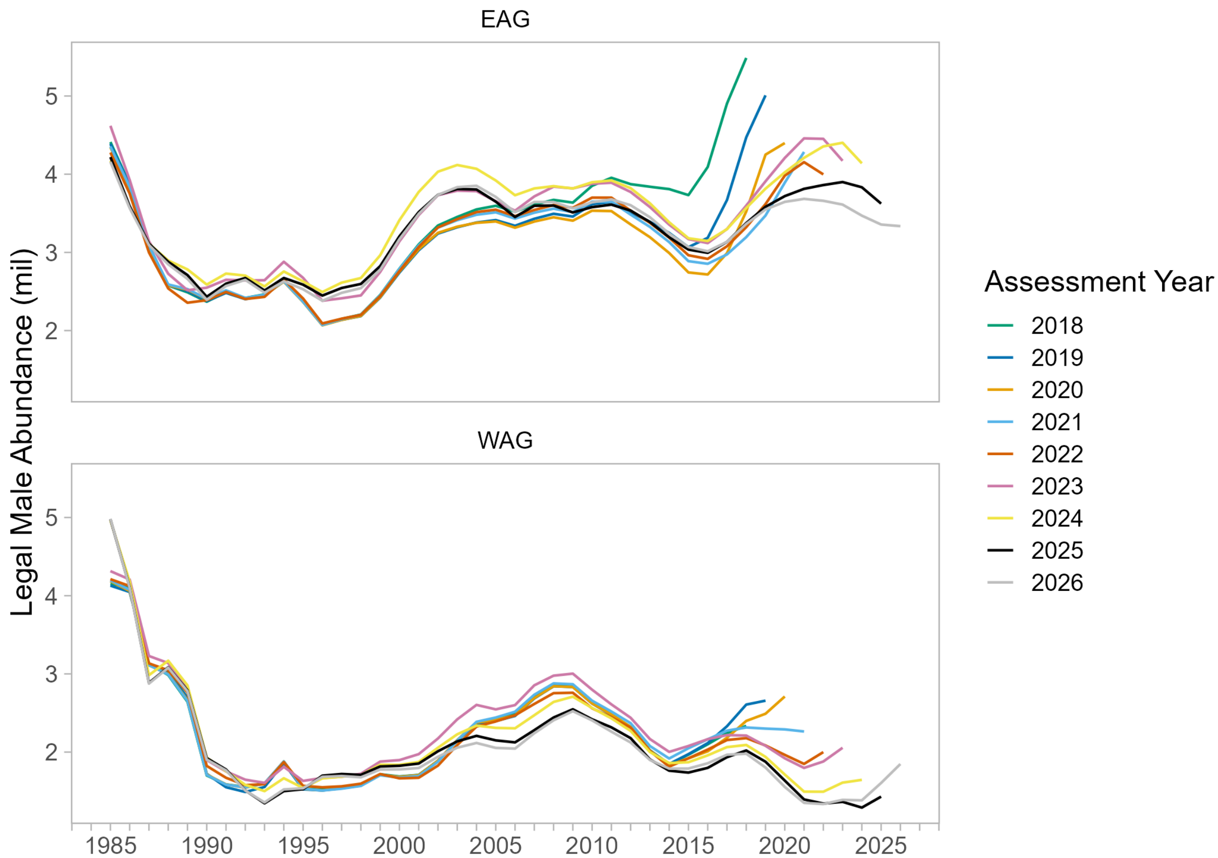

Figure 25: Estimated legal male abundance from 1985 - present by assessment year going back to 2018/19.

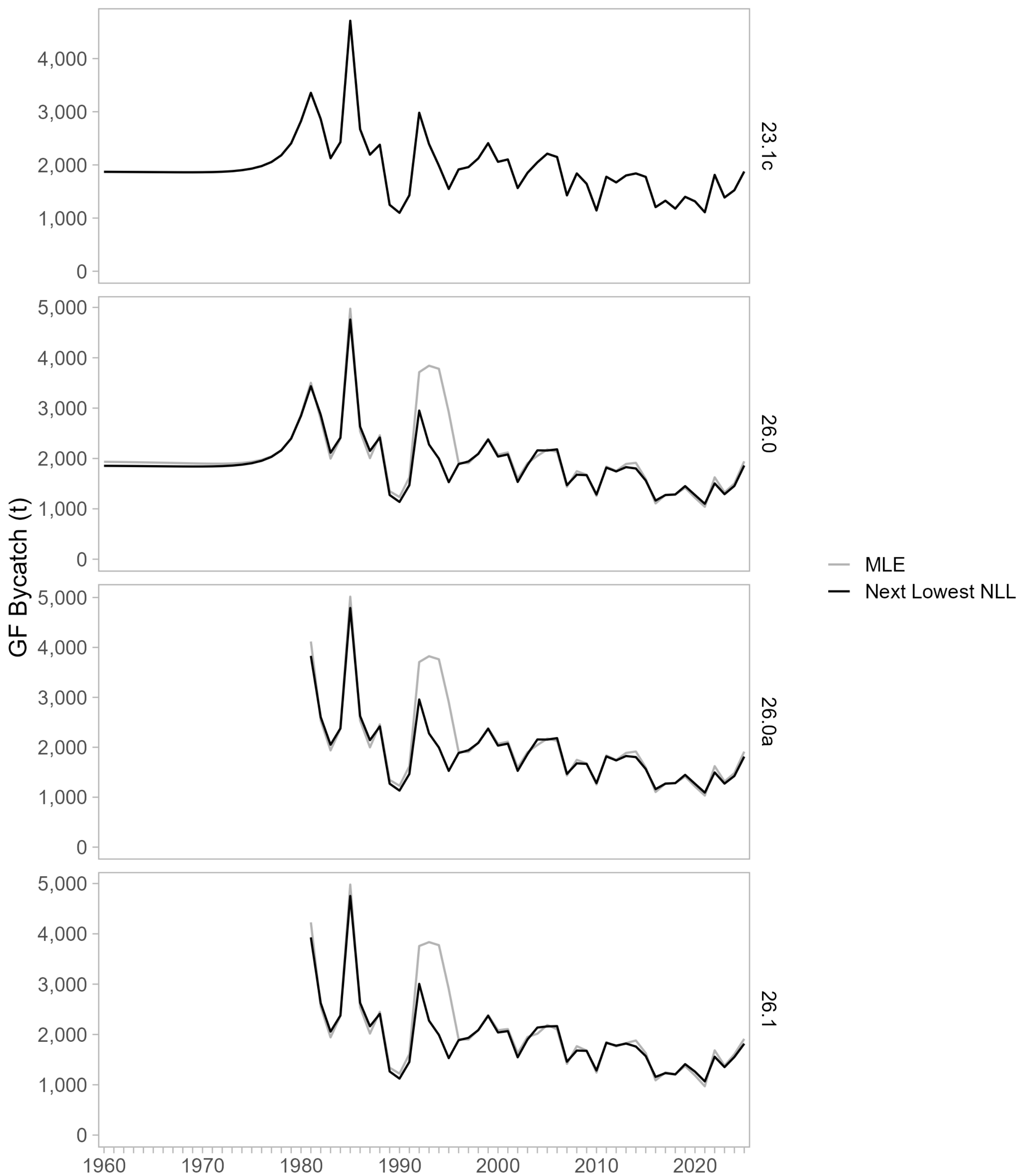

Figure 26: Recruitment trajectories from selected jitter runs for WAG models showing the larger early 1990s recruitment pulse of the MLE runs in comparison to the runs with the next lowest NLL.

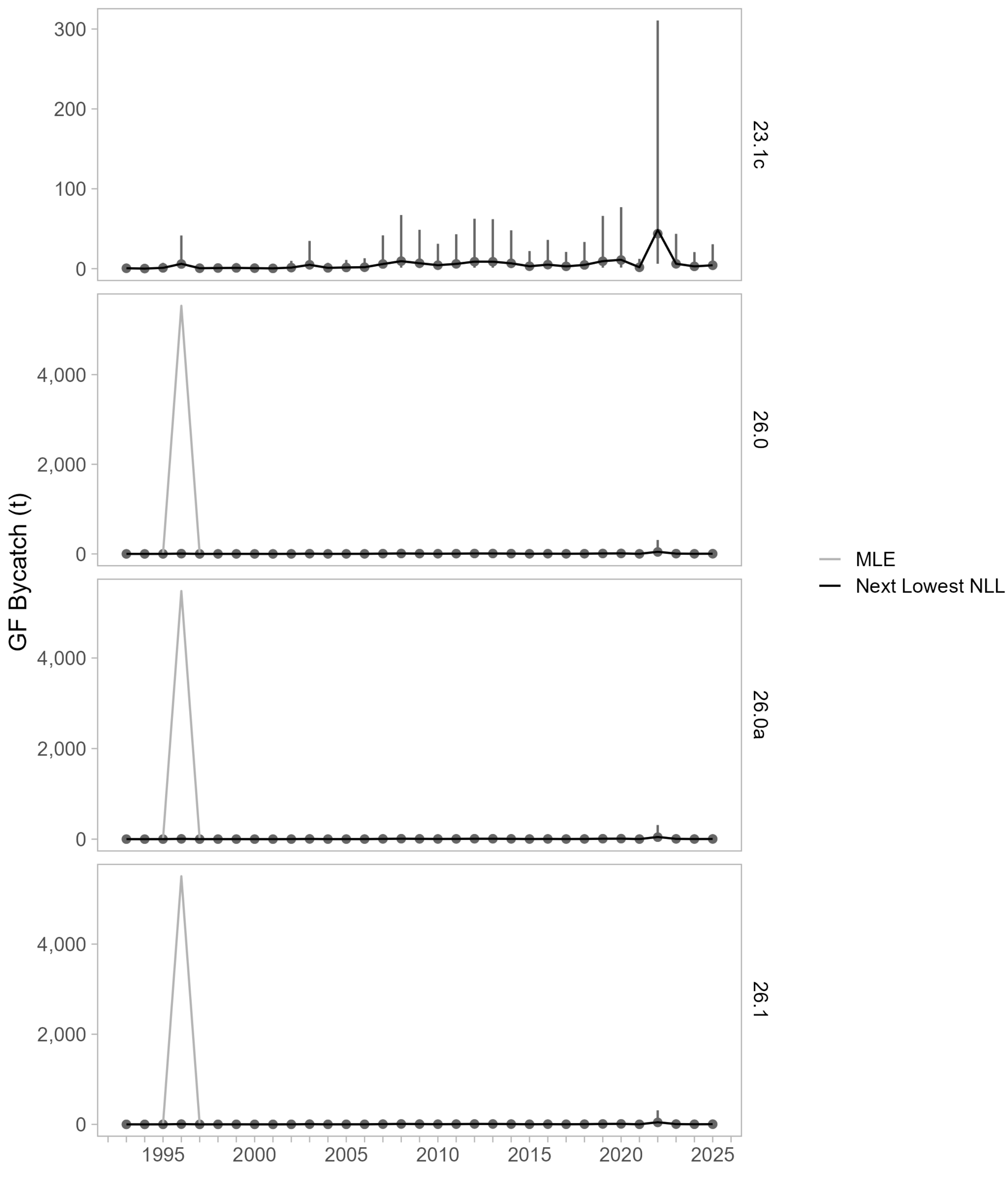

Figure 27: Fit to groundfish fishery bycatch from selected jitter runs for WAG models showing the erroneously large predicted catch in 1996 of the MLE runs in comparison to the runs with the next lowest NLL.

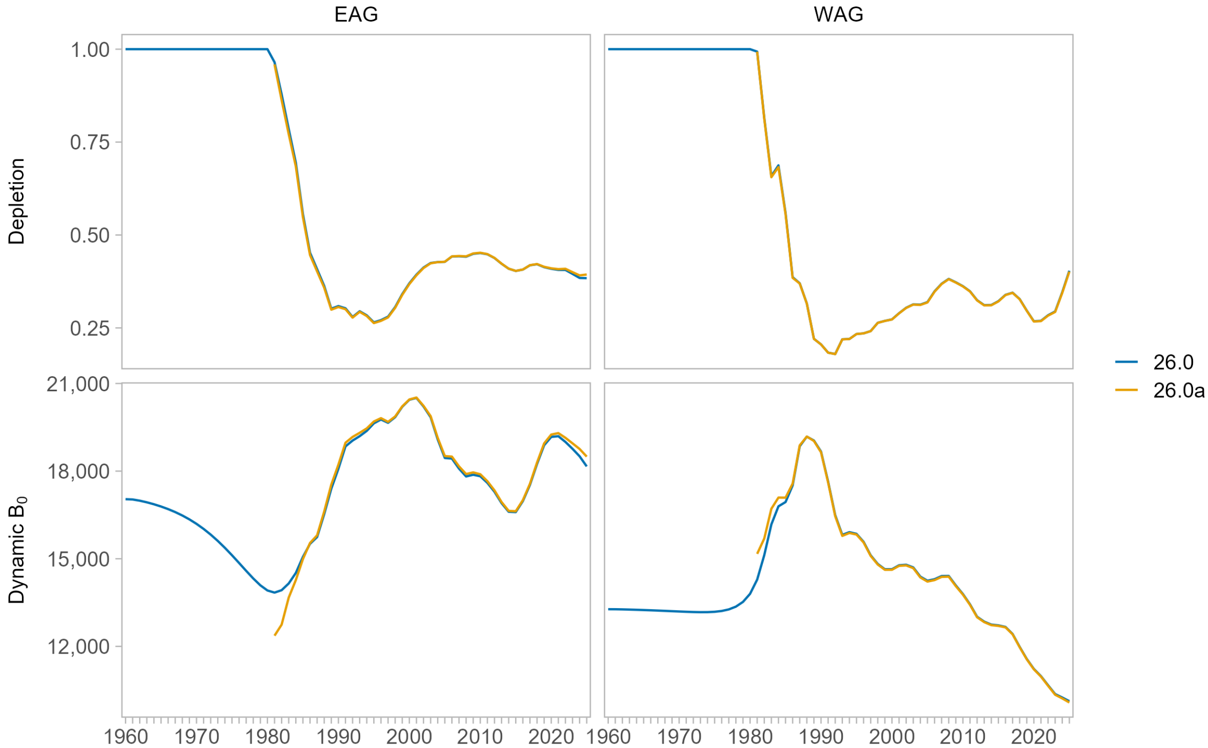

Figure 28: Dynamic B_0 and depletion from models with equilibrium (26.0) and fished (26.0a) initial conditions.

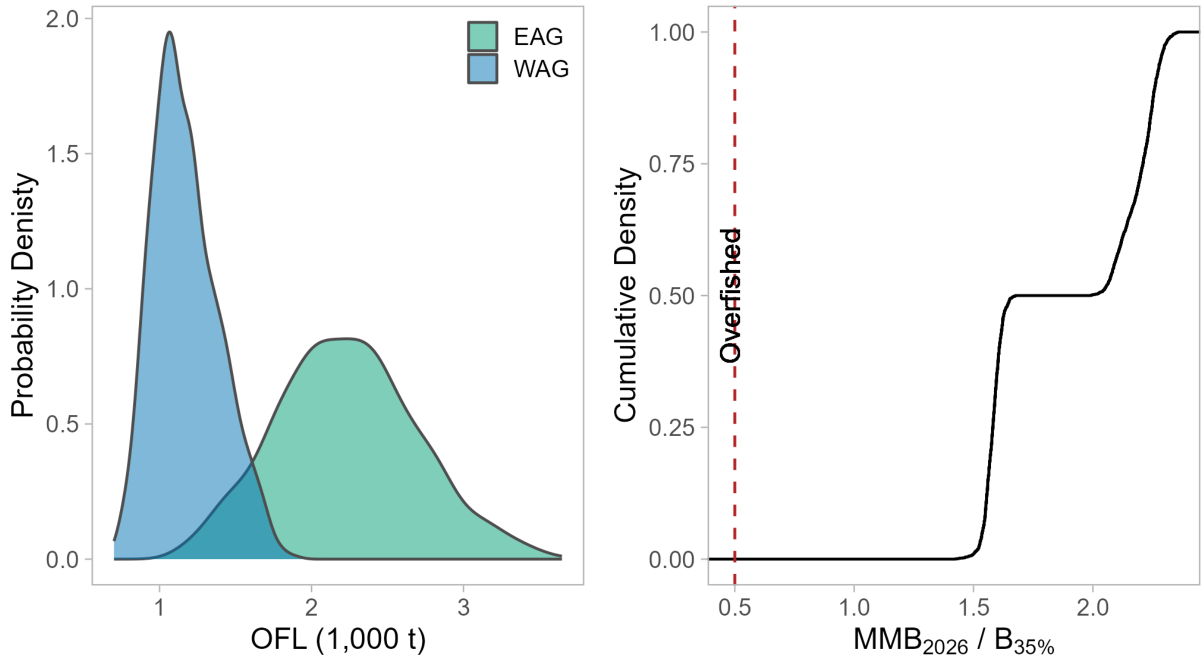

Figure 29: Distrubition of OFL (1,000 t) and cumulative density function of MMB projected to Feb 15, 2027 relative to $B_{35\%}$ from MCMC draws on model 26.0a.

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