Bristol Bay red king crab (BBRKC) proposed models May 2026

Katie Palof[1],
[1]Alaska Department of Fish and Game, katie.palof@alaska.gov

May 2026

Summary

This document details model explorations for BBRKC that include some of those suggested by the crab plan team (CPT) and Scientific and Statistical Committee (SSC), and also version updates to the GMACS modeling framework (GMACS version 2.20.34a. 2026-01-15). All GMACS updates were tested to ensure model fit (likelihood values, output, etc.) matched the last accepted base model from September 2025 (version 2.20.20, 2025-01-30). Model explorations in this document focuses on extended size bins in the base model to account for potential shifts in growth over time. The work presented here is a preliminary exploration of work this topic, and involves some assumptions about size increments and molting probability in these new size bins.

The results of these model explorations are presented in this document in section C. Background on the Bristol Bay red king crab modeling approach, modeling framework (GMACS), and history of the stock and fisheries can be found in the last full SAFE and will not be repeated here (**BBRKC 2025 SAFE**).

B. Responses to SSC and CPT

CPT and SSC Comments on Assessments in General

Response to SSC Comments (June 2025, Oct 2025):

"The SSC notes that a historical retrospective is different from a within model retrospective and requests that crab assessments include a plot comparing the model-estimated time series of mature male biomass from the current assessment with the time series from the ten previous assessments."

Response: This figure was provided in the 2025 SAFE document and will continue to be provided moving forward.

"The SSC recommended that the CPT provide GMACS version updates in each CPT report with information on changes between versions and that authors clearly identify which GMACS versions were used and a brief summary of the effects on the assessment."

Response: The GMACS version used is clearly defined in "Assessment Methodology" in the full SAFE document, and updates to GMACS versions can be explored in more detail on the **GMACS GitHub repo**. Additionally, starting in May 2026, the CPT will include a "GMACS updates" section in the CPT minutes.

"The SSC recommends that each crab SAFE chapter include a clear description of the buffers used in harvest specification over the most recent five years, as a basis for comparing the current year's buffer recommendations."

Response: Historical considerations for buffers are described in Appendix E of the 2025 SAFE document, and will be included as an appendix in the 2026 SAFE.

"The SSC recommends continued progress towards making SAFE documents as consistent in structure and content as practicable."

Response: CPT is currently working on standardized SAFE formatting.

Response to SSC Comments (June 2024, Oct 2024):

"The SSC suggests … guidance for constructing and interpreting jitter analyses… "

Response: The CPT discussed jittering guidance in May 2025 and continues to improve the interpretation and graphical representation of jitter results; these will be shown in the Sept 2026 SAFE.

"The SSC would like to see additional residual diagnostics other than raw residuals for length composition data from GMACS models. The SSC encourages crab authors to collaborate with ground fish assessment authors regarding the use of One-Step-Ahead and Pearson residuals."

Response: One-Step-Ahead residuals were incorporated into GMACS output figures for use in assessment output, and are presenting here for the base model, 24.0c.2, and model 26.0.

"The SSC requests that the CPT consider whether distinguishing between full and update assessments, …, would be useful for crab assessments."

Response: CPT determined that it utilizes assessment frequency to address prioritization in workload and does not see a need for different assessment types at this time (refer to May and Sept 2025 CPT minutes).

"The SSC suggests the CPT live link assessments and other documents in their report to facilitate review."

Response: This has be taken into consideration in spring reports and full SAFEs.

"The SSC reiterates the request for the CPT to develop a process to ensure the authors have provided responses to all previous SSC recommendations."

Response: The CPT has developed a Google sheet to track requests; further action maybe discussed at the May 2026 meeting.

"The SSC requests the authors and CPT consider coordinating the approach to analyzing the Bering Sea Fisheries Research Foundation (BSFRF) data for two Chionoecetes crab and Bristol Bay red king crab (BBRKC) stocks, and specifically consider developing the results as a prior on selectivity for use in the models (also reiterated in Oct 2025 SSC minutes)."

Response: There was discussion among authors at the Jan 2026 modeling workshop, with reference to Buck Stockhausen's work on this topic. The CPT has not developed a coordinated approach yet to this topic, and both the tanner and snow crab assessments have higher priority items this develoment cycle. The 2026 modeling workshop results illustrated that relationships between the NMFS trawl survey data and the BSFRF data are different for BBRKC than for the two Chionoecetes stocks, and therefore a similar approach may not be appropriate for BBRKC. Exploratory work on this topic was started in model runs in May of 2024 and 2025 but the author chose to postpone future work until the following year to allow more time for consistency in approaches if applicable.

Response to SSC Comments (June 2023, Oct 2023):

"The SSC recommends that a"fallback" Tier 4 alternative be provided, as recommended by the Simpler Modeling workshop. When doing so the SSC asks the authors to provide plots to compare OFLs with the status quo Tier 3 models for previous years, justification for the time series used for status determination and a recommended ABC buffer."

Response: A Tier 4 fallback based on survey data and the REMA model was provided in fall of 2024 and 2025, and will be provided this Sept.

"For the inclusion of trawl survey data, the SSC suggests crab assessment authors and the CPT be more explicit about best practices for which standard years are included for bottom trawl survey data."

Response: This was addressed by the CPT at our Jan 2024 meeting. See meeting minutes for agreed upon "best practices".

"The SSC recommends the crab stocks begin using the established risk table format from groundfish for assessing uncertainty around buffer considerations"

Response: After viewing draft risk tables in Sept. 2024 the CPT decided to pick up a risk table format for crab stock discussion at the May 2025 meeting. Draft risk tables were presented for all annual stocks at the Sept 2025 meeting, where the CPT determined that work was still needed to come to a "crab centric" framework for risk tables. They will be discussed again at the May 2026 CPT meeting and presented with full assessments in Sept. 2026.

"The SSC recommends that uncertainty intervals be included when showing time series of biomass/abundance estimated by models.

Response: These are provided in this document.

CPT and SSC Comments on BBRKC assessment

Responses to SSC Comments (June 2025/Oct 2025):

Look at spatial aggregation of the directed fishery and spatial comparison of NMFS survey metrics (such as CPUE, average size, sex ratio) relative to fleet metrics to the extent possible to see what might be influencing increasing CPUE trends in the fishery.

Response: The author plans to examine this in more detail for the Sept 2026 CPT meeting to include the most recent crab season (crab year 2025/26). Currently, CPUE from the directed fishery is not included as a model input therefore while differences in directed fishery CPUE and survey results are interesting they are not creating any assessment model conflict.

"Developing additional size bins for the larger females across the entire time series."

Response: Model 26.0 in this document explores an increased size bin range for both males and females. This document details this model run with results discussed in the Results and Discussion sections of this document.

"Continued evaluation of the Northern District data in the stock assessment."

Response: The author will continue to provide comparisons of sex and maturity groupings from both BB and the Northern Unstratified Area in the final SAFE document. Additionally, the author has preliminary work on a sdmTMB model (below) that incorporates all red king crab caught in the NMFS trawl survey but only predicts abundance within the Bristol Bay (BB) area in an attempt to determine potential influence of movement in / out of Bristol Bay on the biomass and abundance estimates used in the stock assessment. This is preliminary work and still needs more rigorous testing before incorporating into a model run, since this would involve both using model based indices and utilizing data outside of the Bristol Bay boundary. The author plans to collaborate with others to refine this process before incorporating into model runs.

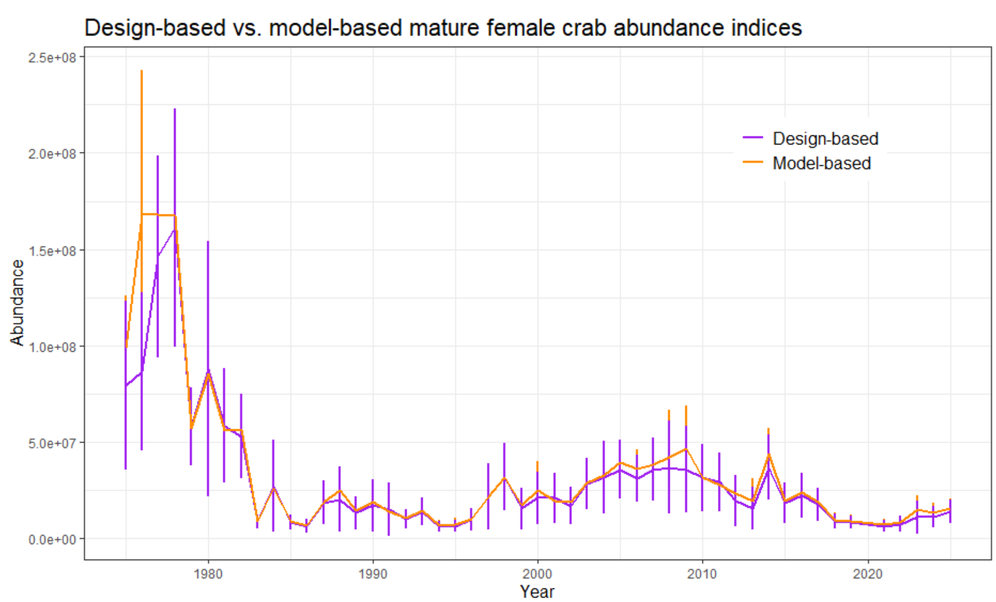

Figure 1: Abundance of mature female red king crab using design based (NMFS trawl survey CPUE data) and model based estimation (sdmTMB).

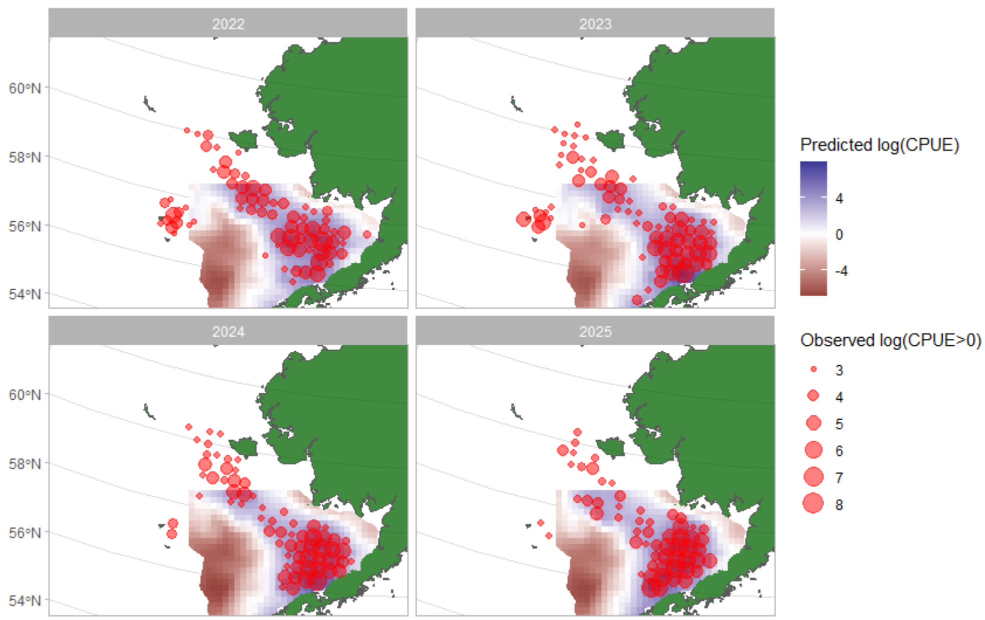

Figure 2: Map of observed (NMFS trawl survey all EBS) vs predicted (model based prediction in Bristol Bay) abundance of mature female red king crab for the last 4 survey years.

"Consideration of Bristol Bay and Pribilof Islands genetics and movement studies and the incorporation of directed crab fisheries data from the State of Alaska observer program to inform the upcoming EFH 5-year review"

Response: Additional genetic work is currently underway as a research project funded by disaster relief research for BBRKC; the author is a collaborator on that project. The ADFG observer program is currently working with the EFH group to incorporate directed fishery crab data; this is being lead by the ADFG Kodiak regional office.

Responses to SSC Comments (June 2024/Oct 2024):

"The SSC recommends that the author bring forward a model that adds the BSFRF prior on selectivity for the 2025 assessment."

Response: The May 2025 model exploration document presented Models 25.1a, 25.1b, and 25.1b2 which all use the BSFRF data as a prior on selectivity. The author determined that these models do not improve model fit and rely on assumptions between the BSFRF and NMFS survey data that may not be valid for BBRKC; further work is planned on this topic for 2027.

"The SSC agrees with the additional considerations by the CPT in their minutes prioritizing; 1) considerations of selectivity time periods based on gear types and 2) considerations of time-varying selectivity in the fishery data relative to the survey data."

Response: The selectivity models presented in the May 2025 document do retain the two time blocks for survey selectivity for the NMFS time series. However, the author has not yet explored time-varying selectivity in the fishery data relative to the survey data and hopes to have some discussion with the CPT on what this exploration could look like.

"The SSC reiterates its request to evaluate whether crab biomass and fishing mortality in the northern district should be included."

Response: Since 2022 the SAFE document has tracked Northern RKC data from the NMFS trawl survey. Overall, the proportions of different size/sex groups of the Northern RKC during recent years are higher than in the past and do not trend higher except for mature females in 2021. The high survey mature female abundance in the Northern area in 2021 was primarily from three tows and one of them is more than 50% of total mature females. The survey abundance of the Northern RKC will continue to be plotted in the SAFE report in the future. After migration patterns between BBRKC and the Northern RKC are fully understood, we will model them in the stock assessment. An assessment model that includes crab outside the Bristol Bay boundary would have to include updates to data inputs for all catch and survey time series, and also include conversations with managers on the implications of a larger spatial model. Explorations into model based indices for other Bering Sea stocks may provide an option for BBRKC to utilize the Northern district crab to design a model based index that only predicts over the traditional Bristol Bay grid. Work on this started this spring but still needs some development and discussion before incorporating a model-based index into models runs.

"The SSC recommends the author revisit previous CPT discussion and rationale on whether 50% handling mortality is appropriate for both pot and longline (fixed gear) gear and to provide additional information in the next assessment."

Response: The May 2025 document includes a model run, model 24.0c.1a, that has a reduced handling mortality (20%) for the fixed gear groundfish catch in place of the historical 50% level. No measurable changes to model results were observed, only small changes in management quantities that lie within the range of variability for those estimates. This is likely due to the small magnitude of fixed gear catch in the model compared to directed fishery catch. Ultimately a change in the handling mortality rate for fixed gear would have to be approved by the CPT. A review of the data available to inform handling mortality estimations occurred at the May 2022 CPT meeting (**HM May 2022**). At this time there are no direct research studies conducted on mortality of crab caught as bycatch in the longline or pot groundfish fisheries. Historically ranges of 30 to 50% have been use in various Council analyses and since 2008 a 50% rate has been applied when splitting bycatch between fixed and trawl gear.

Response to CPT Comments (from May 2024):

"Including BSFRF as a 'ghost fleet' as a check on model behavior."

Response: Further exploration of the BSFRF data and its use in the BBRKC model is needed and planned for in the future.

Split the selectivity into eras to reflect the change in survey gear, but still use the same priors, perhaps with larger CVs in the early era.

Response: Models explored in May 2025 (25.1a, 25.1b, and 25.1b2) all retain the time blocks for survey selectivity estimation and use the same priors for both periods. Model 25.1b2 has larger CVs for both eras, this resulted in a similar estimation as Model 25.1b for the standard error.

Selectivity and retention explorations that may include: exploring parameters that allow for the retention curve to asymptote below one, exploring splines for selectivity, and exploring models using time-varying selectivity to better understand model dynamics.

Response: Model sensitivity to selectivity and retention assumptions should be explored but was not prioritized this year. Further direction from the CPT on hypotheses for these model runs would help in determining the appropriate parameterizations to explore moving forward.

Explore including larger size bins in the model to explore dome shaped selectivity.

Response: Including larger size bins than the current model uses (>160mm for males specifically) would require re-visiting the growth matrix for this stock. This matrix has been established for some time and would require some historic data recovery to determine if larger size bin growth could be determined from the same data. To include larger size bins assumptions would need to be made for the growth matrix unless the historic data was recoverable, which is what was done in model 26.0 here. Growth was assumed to be the same for all the former "plus size" size bins. Model 26.0 in this document uses extended size bins for both males and females; this is explained in detail in the "model explorations" section of the document.

Remove shell condition from the model since it's not being used currently

Response: Shell condition was removed from the model, reflected as model 24.0c.2, and has no measurable effect on results since it was not being implemented in the current base model.

Response to SSC Comments specific to this assessment (from October 2023):

Provide basis for the tight prior on M and catchability.

Response: The prior on trawl survey catchability is estimated with a mean of 0.896 and a standard deviation of 0.025 (CV about 0.03) that is based on double-bag experiment results (Weinberg et al. 2004). The prior on M is based on the balance of allowing M to be estimated above the default, historic 0.18 value for males but realizing the limitations of the data to estimate M freely. Future work is planned and will continue to explore the most appropriate estimation of M.

Consider tracking Dungeness crab abundance in the EBS and how this might affect BBRKC dynamics.

Response: Currently there is no abundance estimate of Dungeness crab in the EBS. Conversations have occurred between the author and regional biologist on possible general affects, with the overall consensus that these two species are likely not occupying the same habitat as juveniles/adults. However, the early life spatial occupation for both of these stocks is unknown, so there may be competition for food in these stages. Trends of Dungeness catch over time are being obtained and will be explored in future work.

Explain why equal sample sizes are used for male and female size composition data.

Response: The size composition data for surveys is entered into the model as aggregate data since they are derived from the same survey samples. Therefore the sample size for each is based on the total number of crab measured not those measured by sex.

MCMC output diagnostics, autocorrelation plots and parameter chains

Response: These will be provided in Sept 2026 when a full MCMC is performed on the preferred models. The CPT has had discussions in May 2025 and will continue to explore and develop the suite of diagnostics to report for MCMC output.

Possible effect of high 2011 recruitment as seen in survey size composition figures

Response: Size composition plots in Sept 2023 highlighted a potential recruitment event in 2011 for both males and females from the NMFS survey data (Figures 6 and 7 - Sept 2023 SAFE). This peak occurs as size classes that are not included in the assessment model (< 65mm, figures 43 and 44 - Sept 2023 SAFE), therefore this recruitment likely plays little role in the model estimates and resulting retrospective pattern since it is not seen in subsequent years to be included in the model.

Response to SSC/CPT comments prior to 2024: See Fall 2024 document, found on the NPFMC website, for further historical discussion of CPT and SSC comments.

C. Modeling Approaches and Explorations for spring 2026

Assessment Methodology

This assessment model uses the GMACS modeling framework (since 2019) and is detailed in Appendix A of the last full SAFE report (link in the summary section). An updated version of GMACS (version 2.20.34a, 2026-01-15) was used in this document compared to that used for the final assessment in fall of 2025 (version 2.20.20, 2025-01-30). The newer version includes updates made during winter 2025/26, including those during the Jan modeling workshop, but did not include any substantive changes to code and therefore did not change model fit. Progress of GMACS development has been documented on the GitHub development site (**GMACS GitHub**).

Model explorations

Models explored in this document:

- **24.0c.2**: base model (fall 2005, GMACS v2.20.20), M for males estimated in the model, molt time block removed, no shell condition
- **24.0c.2_v34a**: + updated GMACS (version 2.20.34a)
- **26.0**: 24.0c.2 (updated GMACS) + extended size bins for all size comp data sets, includes updated bycatch size composition data
- **26.0a**: 24.0c.2 using updated size composition data for bycatch series ONLY prior to extending the size bins

Reasoning for model explorations

Three models are presented in this report, which are all referenced to the 2025 accepted base model (m24.0c.2, GMACS version 2.20.20). The first model is updates to the base model to reflect GMACS versioning and development (from v2.20.20 to v2.20.34a). The second model is the base model (24.0c.2) framework with extended size bins for all size composition indices for both males and females (model 26.0). The last model (model 26.0a) was done as a step-wise progression since the size composition data for the bycatch fleets was updated from the base model.

Updating to a new version of GMACS produced identical model results, with identical MLE and likelihood components (Table 4), which is expected due the updates to GMACS code not affecting the model structure. The base model, 24.0c.2 (estimates the base M for males using a log-normal prior with a mean of 0.18 and a CV of 0.04, has no time block for molt probability, has updated catch data, and removal of shell condition considerations), is the 2025 accepted model and future modeling work is based off this model and GMACS version 2.20.34a.

The second model explored here was model 26.0 which uses extended size bins for both males and females. CPT/SSC comments in the last few cycles have highlighted the potential build up of crab into the plus group size bins (Figure 3) and suggested exploring extending the size bins included in the model. The NMFS trawl survey data was used to established a new size range and plus group designation for males and females. It was determined that male size groups could increase from a plus group of 160 mm CL to a plus group size of 175 mm CL. This increased the number of size bins in the model from 20 in the base model to 23 in model 26.0. Similarly for females it was determined that the plus group could increase from 140 mm CL to 150 mm CL, increasing the number of size bins in the model from 16 to 18. Once the size bins range was determined for both males and females the size composition data were recalculated to include these size bins.

There are eight size composition data sources in the model, each of which were updated to include the extended size bins; however some needed additional updating due to historical data carry overs. Data series 1, 2, and 3 are from the directed BBRKC fishery and include retained male catch and total catch, both males and females. These data sets were recently updated for historical accuracy (see May 2025 documents) and therefore were edited to include the extended size bins. Series 4 and 6 are groundfish trawl and fixed gear bycatch and prior to 2021 the data for these series had small updates, likely due to data base edits or changes. Post 2021 only the extended size bins were added. Series 5 is the size composition of bycatch in the directed Tanner crab fishery, only representing a small number of years and sample size. This series was entirely updated from the base model due to changes in the ADFG observer catch data processing. Series 7 and 8 represent the index time series - the NMFS trawl survey data and BSFRF data - and these were only edited to reflect the extended size bins for males and females.

In addition to data updates for model 26.0, adjustments to the model had to be made to accommodate the extended size range, specifically assumptions on growth and molting in these extended size bins. Model 26.0 assumes that growth and molting for these extended size bins was the same as the "plus group" size bins they were part of in the base model. Model 26.0a was performed to determine the effect of size composition data changes onyl for the bycatch fleets prior to adding the extended size range (Figures 4 – 6).

Model exploration work in spring of both 2024 and 2025 included work on selectivity and catchability, specifically the relationship between the NMFS survey and BSFRF surveys. These explorations are detailed in the spring documents in May 2024 and 2025, but further work on selectivity was not explored in this cycle. This topic still remains a priority for the author, and will be explored in the future.

Results

a. Sensitivity to data and code clarification changes

Model 24.0c.2 using GMACS version 2.20.34a reflects updates to GMACS code but there were no changes to model configurations. THe updated GMACS version produced the same model output as the 2025 accepted base model in version 2.20.20 which is reflected in the likelihood table (Table 4). Model 24.0c.2 was used as the updated base model for further explorations. Model 26.0a reflects updates to only the bycatch size composition data sets (groundfish fixed and trawl gear, along with tanner crab directed fishery) that were discovered when pulling data for the extended size range model (26.0), but does not include the extended size bins. These updates reflect small changes in the model output but the overall total likelihood was similar to the base model.

b. Effective sample sizes and weighting factors

- CVs are assumed to be 0.03 for retained catch biomass, 0.04 for total male biomass, 0.07 for pot bycatch biomass, 0.10 for groundfish bycatch biomass, and 0.23 for recruitment sex ratio. Models also estimate sigmaR for recruitment variation and have a penalty on M variation and many prior-densities.

Refer to the 2024 completed SAFE document for further information on this section.

b. Tables of estimates

- Negative log-likelihood values are summarized in Table 4 for all models, while parameter estimates are summarized in Tables 6 – 7 for models 24.0c.2 and 26.0.
- Natural mortality estimates are shown in Table 3.
- Abundance, MMB, and recruitment time series for models 24.0c.2 and 26.0 are found in Tables 8 – 9.

c. Evaluation of the fit to the data and model estimates.

- Selectivities by length (Figures 7 - 9)

Model explorations focused on extended size bins, which can influence the selectivity estimates. Selectivity for the NMFS survey data and directed pot fishery were similar between the base model and model 26.0. The selectivity estimates for the groundfish trawl bycatch did change in model 26.0, due to the extended size bins, but the overall shape was similar. Generally, the sample size for bycatch fleets is effectively smaller than for the survey or directed fishery fleets.

- NMFS trawl survey biomass and BSFRF surveys (Figures 10 – 13).

Among the model scenarios, model estimated NMFS and BSFRF survey fits are similar, with some small changes in scale due to extended size ranges in the model.

All models fit the bycatch biomasses very well and similarly so they are not presented in this document.

- Recruitment (Figure 14)

Recruitment is estimated at the end of year in GMACS. Estimated recruitment time series are generally similar with some small differences in the beginning of the time series.

- Fishing mortality and catch (Figure 15)

The full fishing mortalities for the directed pot fishery at the time of fishing are plotted against mature male biomass on Feb. 15 in the last full SAFE (See BBRKC 2025 SAFE link and Figures 26, 27, and 29). Estimated fishing mortalities in most years before the current harvest strategy was adopted in 1996 were above F35%. Under the current harvest strategy, estimated fishing mortalities were at or above the F35% limits in 1998, 2007-2009, and 2014-2019 for model 24.0c.2, but below the F35% limits in the other post-1995 years.

Estimated fishing mortalities for pot female and groundfish fisheries bycatches are generally small and less than 0.07 (not shown in this document but available in last full SAFE). Fits to catch from the directed and non-directed fisheries are displayed in Figure 18 to illustrate the model fit to small updates in the crab catch data from ADF&G.

- Estimated mature male biomass (Figures 16 and 17)

Estimated mature male biomass for all models has a similar trend over time, but the scaling of the biomass is slightly higher with the extended size bins. This could be due to an overall better fit for the size composition data in model 26.0.

- Size composition fits by length and residual plots (Figures 4 – 6 and 20 – 29).

Length composition fit is the largest difference in the base model vs the model with the extended size bins. All size composition data sets show improved fit with the extended size range bins. This is especially apparent in the model estimates of size composition in the directed fishery (Figures 20 – 22), all of which demonstrate the raw data (base model data in light grey and model 26.0 in dark grey) and resulting model fit. Fits to the size composition data in the NMFS trawl survey also illustrate the build up of individuals in the larger size bin, especially for females and the improved fit using the extended size range.

One-step-ahead (OSA) residuals of proportions of survey males and females appear to be random over length and year for all models, although only the base model representation is presented here. The author looks for guidance from the CPT and other assessment authors on how best to present these results for model comparisons.

d. Retrospective and historical analyses

Retrospective analysis was not performed on these model explorations. Topics explored in these models were not expected to improved retrospective trends and therefore these were not explored at this time. They will be performed on models for the fall full SAFE. Retrospective runs performed for the 2023 SAFE suggested an improvement with estimation of M for males, as reported in the Mohn's *rho* values, from a Mohn's *rho* of 0.373 to 0.226. The improved retrospective pattern in MMB was one of the reasons the model with estimation of a base M value for males was approved in 2023. Model explorations since 2023 have not improved the retrospective patterns.

e. Uncertainty and sensitivity analyses.

- Estimated standard deviations of parameters are summarized in Tables 5 – 7 for models 24.0c.2 and 26.0.
- The last completed SAFE document in 2025 details uncertainty estimates in the current base model parameterization (**BBRKC 2025 SAFE**).

f. Comparison of alternative model scenarios.

In this report (May 2026), three models are presented. Two of these were not expected to have large changes in model fit or likelihood values. For negative likelihood value comparisons (Table 4), the base model comparisons of GMACS version (model 24.0c.2(ref) and model 24.0c.2(v34)) were identical. Small differences in likelihood, management quantities and MMB scale exist between model 24.0c.2(v34) and 26.0a, which was expected due to updated size composition data for the bycatch fleets - groundfish and tanner crab bycatch. Model 24.0c.2(v34) should be considered the most updated reference model and was used to compare other model explorations.

Model 26.0 explores the extension of the size range for both males and females in all the size composition data sets in the model. This has been a suggestion of the CPT/SSC for a few cycles now but it took some effort and time for the author to update the data sets to include the extended size bins. All data sets are updated with current pulls from their respective data bases and calculated using the new plus groups. Extending the size bins appeared appropriate for both males and females, even though it was only suggested for females, due to similar "build up" of individuals in the previous plus groups category in the base model. Overall model 26.0 has a better fit to all size composition data sets with the addition of a few more parameters to accommodate the increased size bins.

Based on the above considerations, the author recommends bringing forward model 26.0 - with either model 24.0c.2 or model 26.0a as a reference model - for setting specifications for this fall. The improved model fit balances out the need for an increase in the number of parameters for this model. Additionally, based on the size composition fits (Figures 20 – 24) this model appears to track the larger size bins more consistently in all data sources.

The CPT/SSC comments above address many other topics that were not able to be addressed in this round of model improvements but are on the author's list for consideration. Some of these topics require more extensive data mining and time prioritization than is currently allotted in the author's workplan. Additionally, the author is currently collaborating with colleagues at Alaska Department of Fish and Game to begin work on a MSE for this stock in the next few cycles and will update on progress on that front when appropriate in the Council process.

D. Calculation of the OFL and ABC

Tier 3 control rules and methodology behind these calculations are explained in detail in the last full SAFE report published on the NPFMC website (see summary section for link).

Table 1: Changes in management quantities for each scenario explored. Reported quantities are derived from maximum likelihood estimates. MMB, B35, and OFL are reported in 1,000 t. Average male recruitment in millions of animals.

Model	Current MMB	B35	MMB/B_{MSY}	F35	F_{OFL}	OFL	avg male rec	maleM
m24.0c.2	16.84	18.52	0.91	0.40	0.36	5.85	9.69	0.23
m26.0	17.31	18.91	0.92	0.40	0.36	6.17	10.26	0.23
m26.0a	16.76	18.70	0.90	0.40	0.35	5.67	9.68	0.23

E. Projections and Future Outlook

Projections into the future will be performed in the Sept. 2026 assessment with the models selected from this document.

J. Acknowledgements

The author thanks Drs. Andre Punt, Jie Zheng, James Ianelli, and D'Arcy Webber who all worked towards the application of BBRKC data to GMACS for stock assessments and our GMACS model mainly comes from their work. Thanks to Andre Punt and Buck Stockhausen for their work on current GMACS development. Thanks to Tyler Jackson and Caitlin Stern (ADF&G) for assistance with graphical output for GMACS, survey data summaries, REMA modeling code and review of this document. Specific thanks to Tyler Jackson (ADF&G) for developing and maintaining the *gmacsr* R package used for producing many of the figures in this document.

K. References

References can be found in the last full SAFE published on the NPFMC website and will not be repeated here. (**BBRKC 2025 SAFE**)

Tables

Catch, sample size, and survey results tables are not repeated here but can be found in the last full completed SAFE (link in summary).

Table 2: Changes in management quantities for each scenario explored. Report quantities are derived from maximum likelihood estimates. Average recruitment is males in millions of animals.

Model	Current MMB	B35	F35	F_{OFL}	OFL	avg male rec
m24.0c.2	16.84	18.52	0.40	0.36	5.85	9.69
m26.0a	16.76	18.70	0.40	0.35	5.67	9.68
m26.0	17.31	18.91	0.40	0.36	6.17	10.26

Table 3: Natural mortality estimates for model scenarios during different year blocks.

Model	Sex	baseM	1980-84
m24.0c.2	female	0.26	1.16
m24.0c.2	male	0.23	1.02
m26.0	female	0.27	1.19
m26.0	male	0.23	1.02
m26.0a	female	0.26	1.17
m26.0a	male	0.23	1.02

Table 4: Comparisons of negative log-likelihood values and some parameters for all model scenarios.

Component	m24.0c.2(ref)	m24.0c.2(v34)	m26.0a	m26.0
Pot-ret-catch	-63.56	-63.56	-64.87	-64.98
Pot-totM-catch	28.82	28.82	27.13	27.56
Pot-F-discC	-60.93	-60.93	-60.93	-60.94
Trawl-discC	-67.91	-67.91	-67.91	-67.90
Tanner-M-discC	-45.28	-45.28	-45.28	-45.28
Tanner-F-discC	-45.24	-45.24	-45.24	-45.24
Fixed-discC	-40.20	-40.20	-40.20	-40.20
Traw-suv-bio	-41.39	-41.39	-41.09	-38.52
BSFRF-sur-bio	-5.13	-5.13	-5.22	-5.81
Pot-ret-comp	-4173.13	-4173.13	-4170.78	-4808.88
Pot-totM-comp	-2603.18	-2603.18	-2599.35	-3045.89
Pot-discF-comp	-1583.69	-1583.69	-1582.79	-1832.65
Trawl-disc-comp	-6171.05	-6171.05	-6168.79	-7070.20
Tanner-disc-comp	-1276.73	-1276.73	-1264.37	-1487.69
Fixed-disc-comp	-3734.15	-3734.15	-3748.45	-4301.64
Trawl-sur-comp	-7440.87	-7440.87	-7443.27	-8724.29
BSFRF-sur-comp	-844.86	-844.86	-847.64	-988.86
Recruit-dev	74.65	74.65	74.74	74.54
Recruit-ini	0.00	0.00	0.00	0.00
Recruit-sex-R	82.02	82.02	81.95	81.98
Sex-specific-R	0.07	0.07	0.10	0.05
Ini-size-struct	33.36	33.36	33.35	70.85
PriorDensity	223.68	223.68	223.73	242.11
Tot-likelihood	-27754.69	-27754.69	-27755.18	-32131.88
Tot-parms	391.00	390.00	390.00	395.00
MMB35	18524.40	18524.40	18700.91	18911.08
MMB-terminal	16836.02	16836.02	16757.97	17309.41
F35	0.40	0.40	0.40	0.40
$Fofl$	0.36	0.36	0.35	0.36
OFL	5851.79	5851.79	5674.62	6165.62

Table 5: Summary of a selection of estimated model parameter values and standard deviations for model 24.0c.2 (ref) for Bristol Bay red king crab.

Index	Name	Value	StdDev
1	Log(Rinitial):	20.0535	0.0557
2	Log(Rbar):	16.5591	0.1393
3	Recruitment-rb-males:	0.7890	0.1354
4	Recruitment-rb-females:	-0.6168	0.2188
5	Gscale-base-male:	1.0370	0.1947
6	Gscale-base-female:	1.3980	0.1215
7	Molt-probability-mu-base-male-period-1:	141.1201	0.5631
8	Molt-probability-CV-base-male-period-1:	0.0674	0.0031
9	M-base-male-mature:	0.2295	0.0063
10	M-male-mature-block-group-1-block-1:	1.4870	0.0307
11	M-base-female-mature:	0.1359	0.0185
12	Sel-Pot-Fishery-male-base-Logistic-mean:	4.7796	0.0079
13	Sel-Pot-Fishery-male-base-Logistic-cv:	2.2642	0.0413
14	Sel-Trawl-Bycatch-male-base-Logistic-mean:	5.1397	0.0470
15	Sel-Trawl-Bycatch-male-base-Logistic-cv:	2.7944	0.0404
16	Sel-Bairdi-Fishery-Bycatch-male-base-Logistic-mean:	4.6905	0.2404
17	Sel-Bairdi-Fishery-Bycatch-male-base-Logistic-cv:	2.1684	0.3039
18	Sel-Fixed-Gear-male-base-Logistic-mean:	4.7844	0.0184
19	Sel-Fixed-Gear-male-base-Logistic-cv:	2.2894	0.0752
20	Sel-NMFS-Trawl-male-base-Logistic-mean:	4.1221	0.1425
21	Sel-NMFS-Trawl-male-base-Logistic-cv:	2.2303	0.3870
22	Sel-NMFS-Trawl-male-Logistic-mean-block-group-5-block-1:	4.0887	0.2348
23	Sel-NMFS-Trawl-male-Logistic-cv-block-group-5-block-1:	3.4661	0.3554
24	Sel-BSFRF-male-base-Logistic-mean:	4.4657	0.0263
25	Sel-BSFRF-male-base-Logistic-cv:	2.5364	0.0770
26	Sel-Pot-Fishery-female-base-Logistic-mean:	4.5597	0.0181
27	Sel-Pot-Fishery-female-base-Logistic-cv:	2.1979	0.0902
28	Sel-Bairdi-Fishery-Bycatch-female-base-Logistic-mean:	4.7365	0.0895
29	Sel-Bairdi-Fishery-Bycatch-female-base-Logistic-cv:	0.9028	0.3028
30	Ret-Pot-Fishery-male-base-Logistic-mean:	4.9240	0.0015
31	Ret-Pot-Fishery-male-base-Logistic-cv:	0.6856	0.0522
32	Ret-Pot-Fishery-male-Logistic-mean-block-group-6-block-1:	4.9321	0.0019
33	Ret-Pot-Fishery-male-Logistic-cv-block-group-6-block-1:	0.7193	0.0957
34	Log-fbar-Pot-Fishery:	-1.7673	0.0428
35	Log-fbar-Trawl-Bycatch:	-4.4646	0.0737
36	Log-fbar-Bairdi-Fishery-Bycatch:	-5.6320	0.2944
37	Log-fbar-Fixed-Gear:	-6.5918	0.0648
38	Survey-q-survey-1:	0.9305	0.0258
39	Log-add-cvt-survey-2:	-1.0153	0.2882

Table 6: Summary of a selection of estimated model parameter values and standard deviations for model 24.0c.2 (v34) for Bristol Bay red king crab.

Index	Name	Value	StdDev
1	Log(Rinitial):	20.0535	0.0557
2	Log(Rbar):	16.5591	0.1393
3	Recruitment-rb-males:	0.7890	0.1354
4	Recruitment-rb-females		0.4000
5	Gscale-base-male:	1.0370	0.1947
6	Gscale-base-female:	1.3980	0.1215
7	Molt-probability-mu-base-male-period-1:	141.1201	0.5631
8	Molt-probability-CV-base-male-period-1:	0.0674	0.0031
9	M-base-male-mature:	0.2295	0.0063
10	M-male-mature-block-group-1-block-1:	1.4870	0.0307
11	M-base-female-mature:	0.1359	0.0185
12	Sel-Pot-Fishery-male-base-Logistic-mean:	4.7796	0.0079
13	Sel-Pot-Fishery-male-base-Logistic-cv:	2.2642	0.0413
14	Sel-Trawl-Bycatch-male-base-Logistic-mean:	5.1397	0.0470
15	Sel-Trawl-Bycatch-male-base-Logistic-cv:	2.7944	0.0404
16	Sel-Bairdi-Fishery-Bycatch-male-base-Logistic-mean:	4.6905	0.2404
17	Sel-Bairdi-Fishery-Bycatch-male-base-Logistic-cv:	2.1684	0.3039
18	Sel-Fixed-Gear-male-base-Logistic-mean:	4.7844	0.0184
19	Sel-Fixed-Gear-male-base-Logistic-cv:	2.2894	0.0752
20	Sel-NMFS-Trawl-male-base-Logistic-mean:	4.1221	0.1425
21	Sel-NMFS-Trawl-male-base-Logistic-cv:	2.2303	0.3870
22	Sel-NMFS-Trawl-male-Logistic-mean-block-group-5-block-1:	4.0888	0.2348
23	Sel-NMFS-Trawl-male-Logistic-cv-block-group-5-block-1:	3.4661	0.3554
24	Sel-BSFRF-male-base-Logistic-mean:	4.4657	0.0263
25	Sel-BSFRF-male-base-Logistic-cv:	2.5364	0.0770
26	Sel-Pot-Fishery-female-base-Logistic-mean:	4.5597	0.0181
27	Sel-Pot-Fishery-female-base-Logistic-cv:	2.1979	0.0902
28	Sel-Bairdi-Fishery-Bycatch-female-base-Logistic-mean:	4.7365	0.0895
29	Sel-Bairdi-Fishery-Bycatch-female-base-Logistic-cv:	0.9028	0.3028
30	Ret-Pot-Fishery-male-base-Logistic-mean:	4.9240	0.0015
31	Ret-Pot-Fishery-male-base-Logistic-cv:	0.6856	0.0522
32	Ret-Pot-Fishery-male-Logistic-mean-block-group-6-block-1:	4.9321	0.0019
33	Ret-Pot-Fishery-male-Logistic-cv-block-group-6-block-1:	0.7193	0.0957
34	Log-fbar-Pot-Fishery:	-1.7673	0.0428
35	Log-fbar-Trawl-Bycatch:	-4.4646	0.0737
36	Log-fbar-Bairdi-Fishery-Bycatch:	-5.6320	0.2944
37	Log-fbar-Fixed-Gear:	-6.5918	0.0648
38	Survey-q-survey-1:	0.9305	0.0258
39	Log-add-cvt-survey-2:	-1.0153	0.2882

Table 7: Summary of a selection of estimated model parameter values and standard deviations for model 26.0 for Bristol Bay red king crab.

Index	Name	Value	StdDev
1	Log(Rinitial):	20.0875	0.0738
2	Log(Rbar):	16.6340	0.1399
3	Recruitment-rb-males:	0.8007	0.1476
4	Recruitment-rb-females		0.4000
5	Gscale-base-male:	0.8947	0.1745
6	Gscale-base-female:	1.4401	0.1223
7	Molt-probability-mu-base-male-period-1:	140.8137	0.5138
8	Molt-probability-CV-base-male-period-1:	0.0601	0.0021
9	M-base-male-mature:	0.2336	0.0064
10	M-male-mature-block-group-1-block-1:	1.4779	0.0312
11	M-base-female-mature:	0.1534	0.0185
12	Sel-Pot-Fishery-male-base-Logistic-mean:	4.7637	0.0071
13	Sel-Pot-Fishery-male-base-Logistic-cv:	2.2021	0.0407
14	Sel-Trawl-Bycatch-male-base-Logistic-mean:	4.9909	0.0254
15	Sel-Trawl-Bycatch-male-base-Logistic-cv:	2.6850	0.0439
16	Sel-Bairdi-Fishery-Bycatch-male-base-Logistic-mean:	4.7033	0.2358
17	Sel-Bairdi-Fishery-Bycatch-male-base-Logistic-cv:	2.1674	0.3042
18	Sel-Fixed-Gear-male-base-Logistic-mean:	4.7841	0.0165
19	Sel-Fixed-Gear-male-base-Logistic-cv:	2.2835	0.0714
20	Sel-NMFS-Trawl-male-base-Logistic-mean:	4.0958	0.2041
21	Sel-NMFS-Trawl-male-base-Logistic-cv:	2.2191	0.4461
22	Sel-NMFS-Trawl-male-Logistic-mean-block-group-5-block-1:	3.8450	0.4571
23	Sel-NMFS-Trawl-male-Logistic-cv-block-group-5-block-1:	3.4186	0.3840
24	Sel-BSFRF-male-base-Logistic-mean:	4.4949	0.0233
25	Sel-BSFRF-male-base-Logistic-cv:	2.5288	0.0658
26	Sel-Pot-Fishery-female-base-Logistic-mean:	4.6008	0.0202
27	Sel-Pot-Fishery-female-base-Logistic-cv:	2.3214	0.0847
28	Sel-Bairdi-Fishery-Bycatch-female-base-Logistic-mean:	4.7773	0.0907
29	Sel-Bairdi-Fishery-Bycatch-female-base-Logistic-cv:	0.9038	0.3019
30	Ret-Pot-Fishery-male-base-Logistic-mean:	4.9235	0.0015
31	Ret-Pot-Fishery-male-base-Logistic-cv:	0.6752	0.0509
32	Ret-Pot-Fishery-male-Logistic-mean-block-group-6-block-1:	4.9308	0.0019
33	Ret-Pot-Fishery-male-Logistic-cv-block-group-6-block-1:	0.6933	0.0955
34	Log-fbar-Pot-Fishery:	-1.8429	0.0430
35	Log-fbar-Trawl-Bycatch:	-4.6224	0.1003
36	Log-fbar-Bairdi-Fishery-Bycatch:	-5.6881	0.3053
37	Log-fbar-Fixed-Gear:	-6.6181	0.0643
38	Survey-q-survey-1:	0.9125	0.0260
39	Log-add-cvt-survey-2:	-1.0946	0.3018

Table 8: Annual abundance estimates (mature males, legal males, and mature females in million crab), mature male biomass (MMB, 1000 t), and total survey biomass (1000 t) both estimated by the model and area swept calculated for red king crab in Bristol Bay estimated by length-based model 24.0c.2 during 1975-2024. MMB for year t is on Feb. 15, year t+1.

	Males				Females	Total	Total Survey Biomass	
Year	Mature >119mm	Legal >134mm	MMB >119mm	sd MMB	Mature >89mm	Recruits	Model Est >64mm	Area-Swept >64mm
1975	66.838	33.237	97.063	6.698	66.125		262.430	199.640
1976	76.709	40.995	112.590	6.257	98.316	78.874	301.910	327.610
1977	83.399	46.504	124.541	5.483	130.755	53.463	320.720	371.220
1978	87.656	50.988	128.826	4.704	133.937	82.719	319.210	343.190
1979	75.845	50.923	105.827	3.895	126.010	153.027	303.660	165.450
1980	55.523	40.237	27.422	1.455	126.882	202.481	288.150	247.230
1981	15.890	8.565	6.038	0.839	57.446	89.569	116.100	131.140
1982	7.478	2.359	5.650	0.625	25.803	346.371	65.620	141.900
1983	6.283	2.201	5.800	0.448	17.744	129.842	57.580	48.480
1984	6.390	2.122	4.036	0.328	17.850	87.133	49.670	152.610
1985	7.780	1.801	9.102	0.632	12.291	14.323	33.360	34.140
1986	12.779	4.676	14.710	0.996	16.868	41.167	44.580	47.430
1987	15.477	6.949	20.611	1.253	21.088	13.458	51.200	69.240
1988	15.756	8.992	25.579	1.334	26.559	8.754	55.390	54.600
1989	17.021	10.389	28.603	1.298	24.765	11.103	58.400	55.140
1990	16.315	11.126	24.750	1.227	21.941	28.634	58.360	59.450
1991	12.474	9.224	19.010	1.140	21.319	18.881	53.310	83.890
1992	10.209	6.912	17.796	1.102	23.008	4.587	49.110	37.330
1993	11.780	6.651	16.935	1.202	21.392	12.603	49.020	52.910
1994	11.836	6.752	22.947	1.329	18.061	3.887	44.880	32.100
1995	12.146	8.706	25.740	1.304	16.646	79.906	50.480	38.070
1996	12.171	9.190	23.823	1.216	24.904	13.145	59.060	43.960
1997	11.481	8.225	22.249	1.175	36.358	6.339	65.240	84.030
1998	17.488	8.198	25.711	1.453	31.284	16.644	69.500	84.100
1999	18.757	10.568	29.811	1.628	26.161	46.464	68.520	64.750
2000	16.038	11.568	29.683	1.588	28.035	17.987	70.170	67.380
2001	15.834	10.880	29.882	1.535	32.057	16.248	73.730	52.460
2002	19.085	11.084	34.151	1.582	30.727	71.736	78.700	69.090
2003	19.894	12.924	33.779	1.552	38.155	16.467	84.680	115.760
2004	17.795	12.454	31.036	1.452	47.654	15.050	86.520	130.560
2005	20.094	11.566	32.092	1.457	43.622	52.769	87.620	105.730
2006	19.032	12.394	32.383	1.419	43.763	27.716	87.550	94.480
2007	17.056	12.011	27.265	1.323	48.556	18.192	89.220	103.330
2008	17.702	10.255	26.255	1.382	45.290	10.433	86.120	113.080
2009	17.801	10.384	27.592	1.466	39.103	11.889	80.600	90.550
2010	16.731	10.797	27.201	1.437	33.983	29.055	75.630	80.500
2011	14.193	10.283	26.674	1.331	33.452	18.534	70.910	66.410
2012	12.515	9.546	24.665	1.201	35.525	10.223	68.830	60.700
2013	12.419	8.616	23.464	1.114	33.601	7.536	65.760	62.220
2014	12.126	8.314	21.487	1.043	29.458	4.599	60.680	113.140
2015	10.344	7.625	18.306	0.963	24.922	7.266	53.500	64.170
2016	8.319	6.385	15.003	0.895	21.112	14.307	46.390	60.960
2017	6.500	5.129	12.101	0.835	19.265	6.635	41.050	52.930
2018	5.650	4.078	10.648	0.806	17.749	13.288	37.900	28.800
2019	6.506	3.763	11.537	0.884	15.757	7.155	36.540	28.540
2020	7.171	4.328	13.194	0.991	14.738	8.623		

2021	8.323	4.998	16.725	1.117	13.678	6.894	36.290	28.480
2022	8.961	6.219	19.033	1.192	12.556	16.963	37.740	36.200
2023	9.253	6.767	19.504	1.238	12.953	14.167	39.560	37.970
2024	9.212	6.761	19.738	1.295	15.067	6.593	40.600	46.130
2025	10.022	6.799	16.836	0.935	15.405	14.890	41.630	49.080

Table 9: Annual abundance estimates (mature males, legal males, and mature females in million crab), mature male biomass (MMB, 1000 t), and total survey biomass (1000 t) both estimated by the model and area swept calculated for red king crab in Bristol Bay estimated by length-based model 26.0 during 1975-2024. MMB for year t is on Feb. 15, year t+1.

	Males				Females	Total	Total Survey Biomass	
Year	Mature >119mm	Legal >134mm	MMB >119mm	sd MMB	Mature >89mm	Recruits	Model Est >64mm	Area-Swept >64mm
1975	63.944	31.913	92.480	6.241	67.469		250.890	199.640
1976	74.352	39.225	107.104	6.094	104.995	93.903	290.980	327.610
1977	83.163	45.002	121.290	5.725	139.718	55.489	311.720	371.220
1978	88.614	50.823	127.925	4.849	141.953	90.011	312.050	343.190
1979	76.200	51.407	105.233	4.005	132.953	166.060	297.370	165.450
1980	55.692	40.556	27.165	1.517	134.324	230.312	282.950	247.230
1981	15.926	8.543	5.832	0.900	60.143	102.659	114.030	131.140
1982	7.505	2.314	5.586	0.672	26.669	366.667	67.160	141.900
1983	6.632	2.223	6.039	0.465	18.383	139.201	59.000	48.480
1984	6.727	2.248	4.307	0.361	18.157	93.325	50.940	152.610
1985	8.174	1.903	9.683	0.693	12.526	14.983	34.170	34.140
1986	13.444	5.015	15.846	1.093	17.234	43.981	45.800	47.430
1987	16.365	7.523	22.262	1.363	21.769	15.008	52.870	69.240
1988	16.669	9.761	27.435	1.448	27.609	9.553	57.350	54.600
1989	17.931	11.146	30.482	1.416	25.720	11.669	60.350	55.140
1990	17.294	11.895	26.743	1.353	22.757	30.725	60.170	59.450
1991	13.322	10.003	20.874	1.262	22.156	22.743	55.270	83.890
1992	10.938	7.572	19.470	1.218	24.058	5.070	51.490	37.330
1993	12.734	7.245	18.850	1.339	22.402	12.604	51.820	52.910
1994	13.388	7.549	25.793	1.498	18.787	4.016	47.960	32.100
1995	13.744	9.910	28.959	1.476	17.057	80.467	53.190	38.070
1996	13.435	10.397	26.689	1.362	25.354	16.933	61.240	43.960
1997	12.332	9.210	24.460	1.290	36.632	7.346	67.240	84.030
1998	18.260	8.858	27.598	1.563	31.562	15.957	71.480	84.100
1999	20.057	11.324	32.349	1.760	26.176	48.772	70.530	64.750
2000	17.442	12.647	32.551	1.713	28.096	19.972	72.080	67.380
2001	16.908	11.946	32.344	1.641	32.454	16.001	75.450	52.460
2002	20.113	11.941	36.402	1.685	30.931	71.065	79.950	69.090
2003	20.982	13.802	36.072	1.658	37.708	19.304	85.390	115.760
2004	18.703	13.339	33.089	1.549	46.849	15.418	86.930	130.560
2005	20.880	12.278	33.851	1.548	43.136	53.481	87.710	105.730
2006	19.791	13.090	34.041	1.507	43.091	30.655	87.450	94.480
2007	17.743	12.653	28.788	1.398	47.884	19.322	89.100	103.330
2008	18.518	10.815	27.899	1.461	45.044	11.925	86.270	113.080
2009	18.735	11.073	29.464	1.567	38.852	12.381	81.050	90.550
2010	17.745	11.575	29.263	1.561	33.759	28.301	76.100	80.500
2011	15.229	11.112	28.819	1.454	32.842	21.393	71.280	66.410
2012	13.427	10.358	26.649	1.312	34.887	10.788	69.100	60.700
2013	13.233	9.322	25.249	1.215	33.677	8.217	66.010	62.220
2014	12.837	8.961	23.079	1.135	29.542	5.162	60.880	113.140
2015	10.936	8.197	19.681	1.044	24.985	7.878	53.680	64.170
2016	8.821	6.858	16.167	0.964	21.164	15.888	46.600	60.960
2017	6.962	5.527	13.150	0.894	19.419	7.298	41.390	52.930
2018	6.101	4.436	11.644	0.865	17.972	13.812	38.460	28.800
2019	7.161	4.123	12.795	0.971	16.037	7.798	37.300	28.540
2020	7.852	4.839	14.585	1.096	15.051	9.165		

2021	8.915	5.523	18.028	1.217	13.989	7.273	37.120	28.480
2022	9.470	6.708	20.187	1.282	12.859	17.864	38.420	36.200
2023	9.701	7.183	20.497	1.319	13.312	15.080	40.080	37.970
2024	9.586	7.121	20.554	1.368	15.512	6.960	41.050	46.130
2025	10.397	7.099	17.309	0.973	15.794	16.016	42.040	49.080

Figures

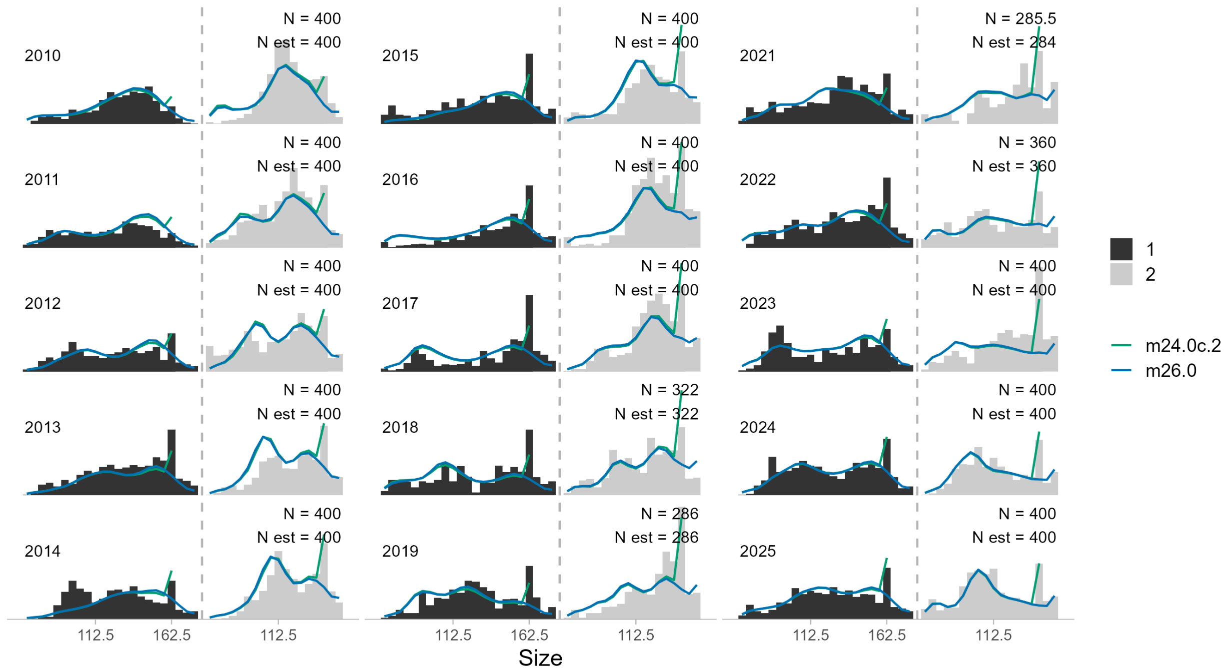

Figure 3: Comparison of area-swept and model estimated NMFS survey length frequencies of Bristol Bay male (black, 1) and female (gray, 2) red king crab by year for models 24.0c.2 and 26.0 for the last ten years. This figure illustrates the build up of both males and females in the larger size bin in recent years.

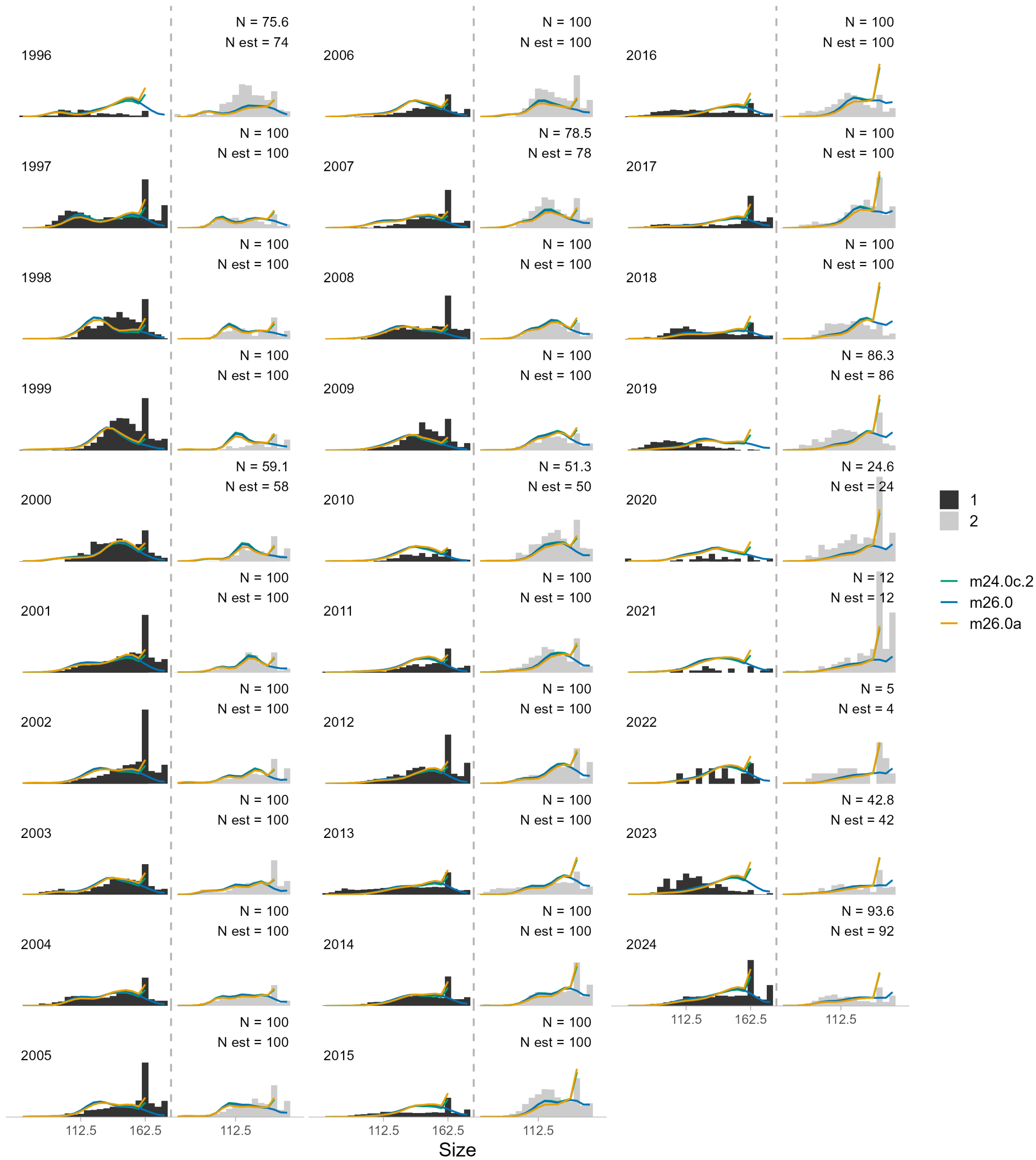

Figure 4: Comparison of length compositions from fixed gear groundfish bycatch of Bristol Bay male (black) and female (gray) red king crab by year for the reference model, updated bycatch data, and extended size range scenarios.

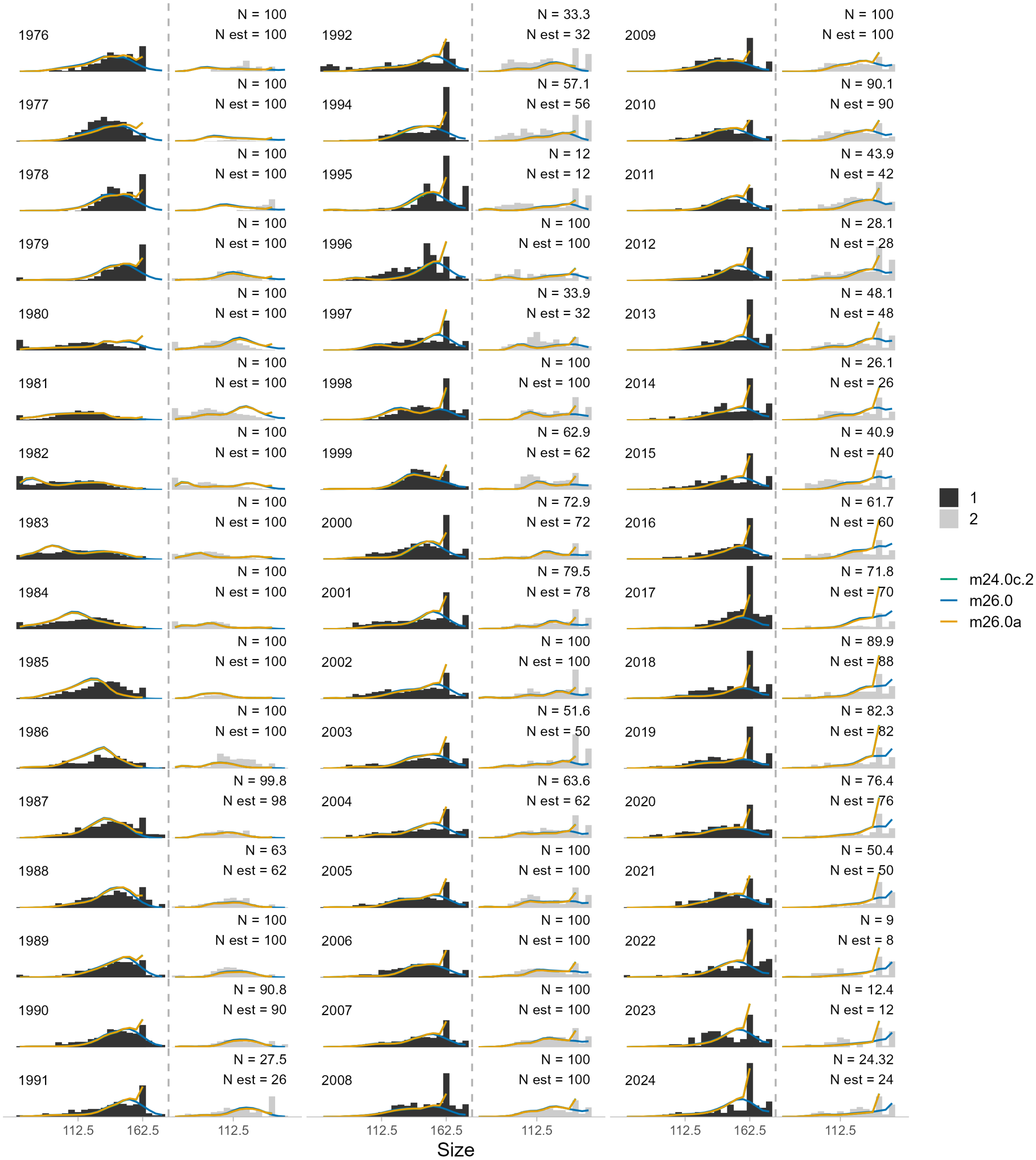

Figure 5: Comparison of length compositions from trawl gear groundfish bycatch of Bristol Bay male (black) and female (gray) red king crab by year for the reference model, updated bycatch data, and extended size range scenarios.

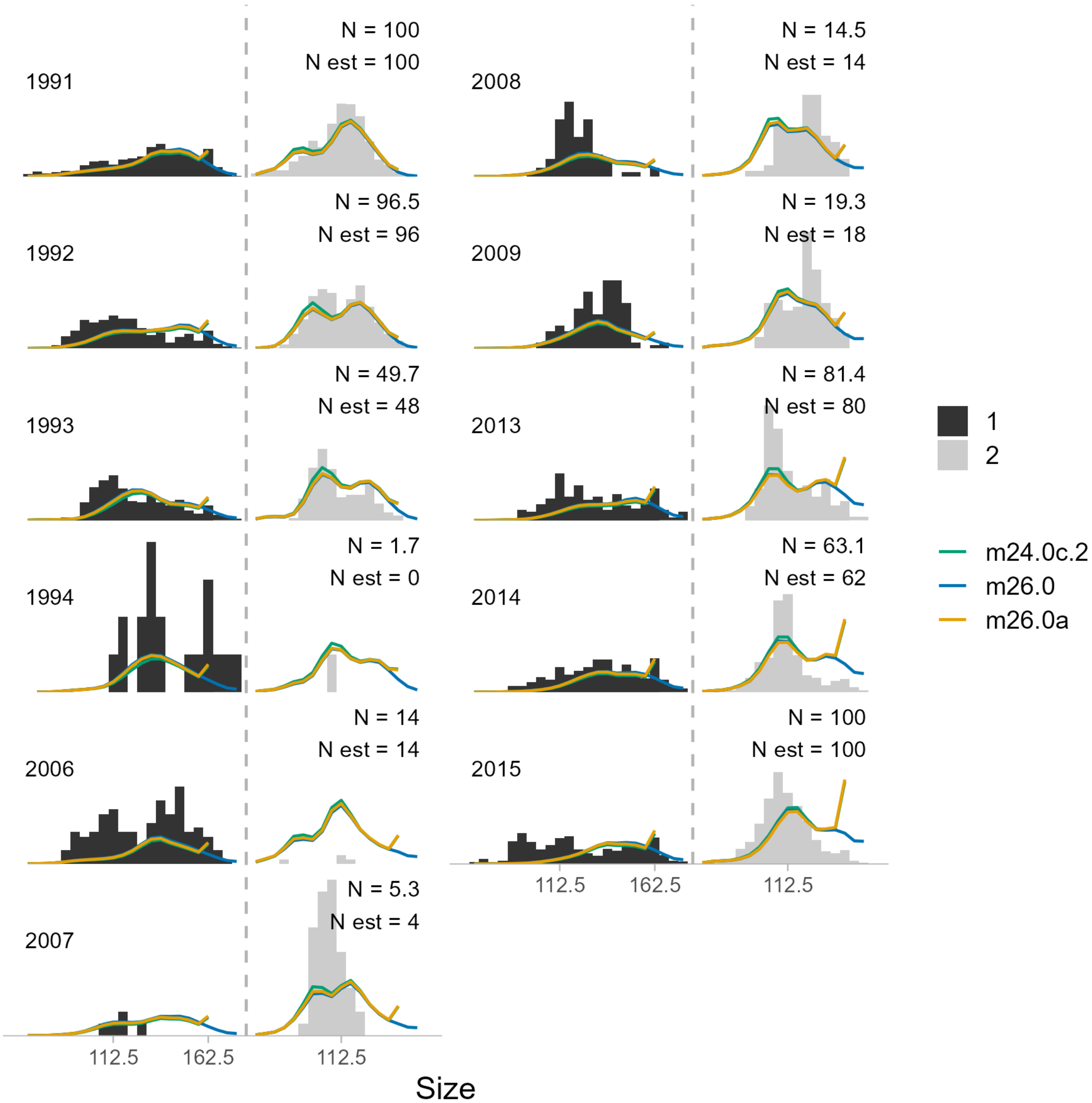

Figure 6: Comparison of length compositions from Tanner crab fishery bycatch of Bristol Bay male (black) and female (gray) red king crab by year for the reference model, updated bycatch data, and extended size range scenarios.

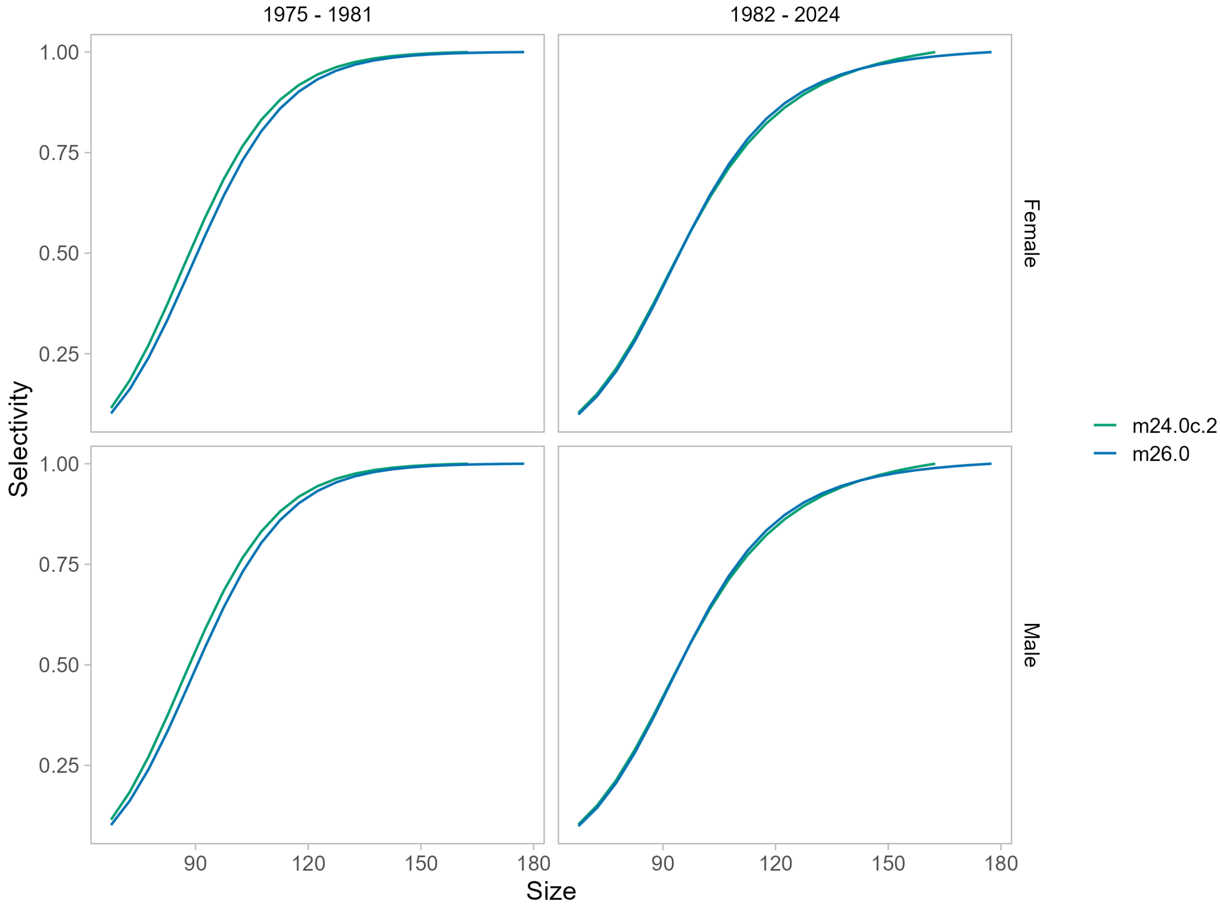

Figure 7: Estimated NMFS trawl survey selectivities under base model updates.

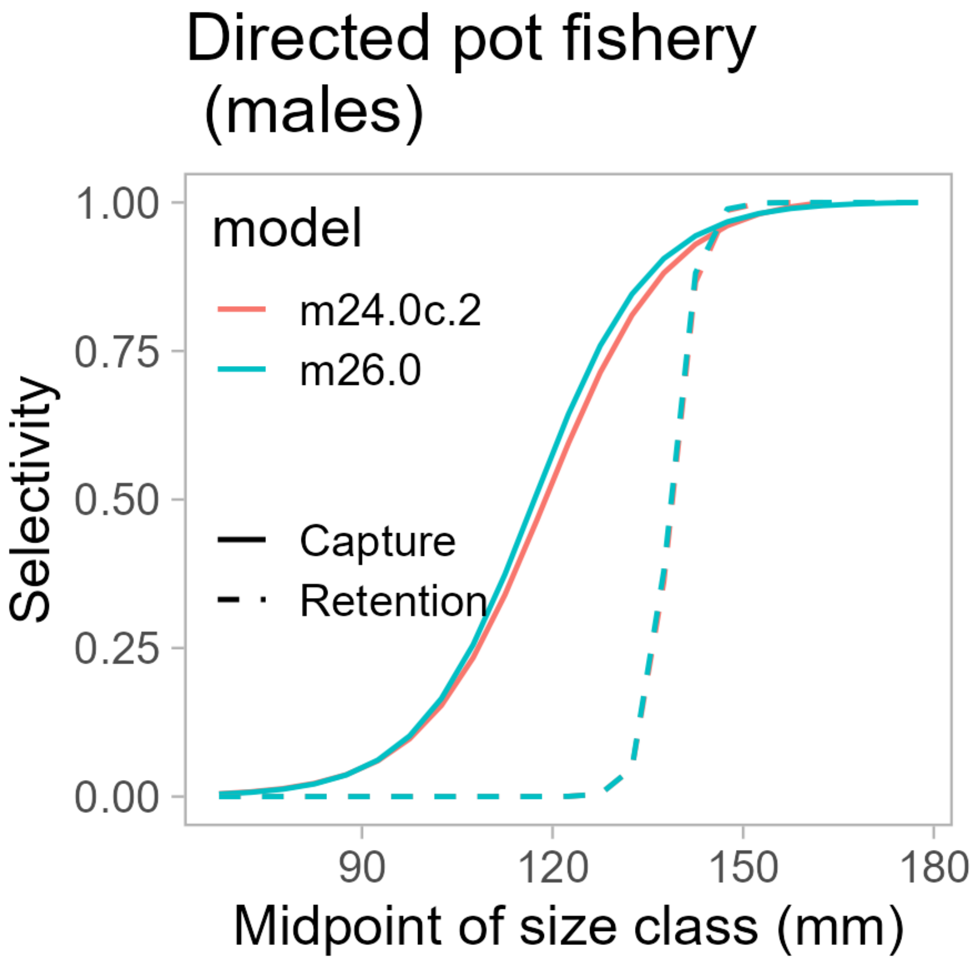

Figure 8: Capture and retained selectivity estimates for the BBRKC directed pot fishery, for models 24.0c.2 and 26.0.

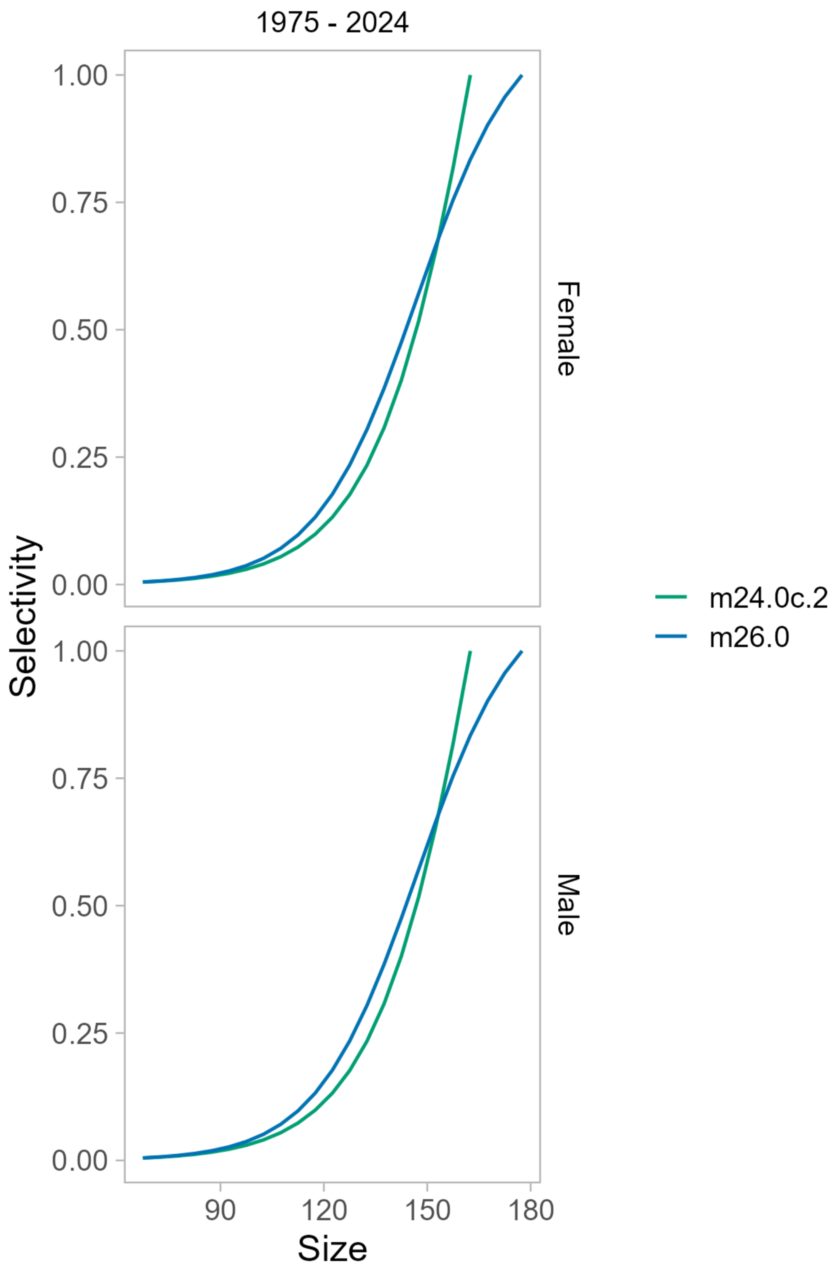

Figure 9: Selectivity estimates for the groundfish trawl fishery bycatch, for models 24.0c.2 and 26.0.

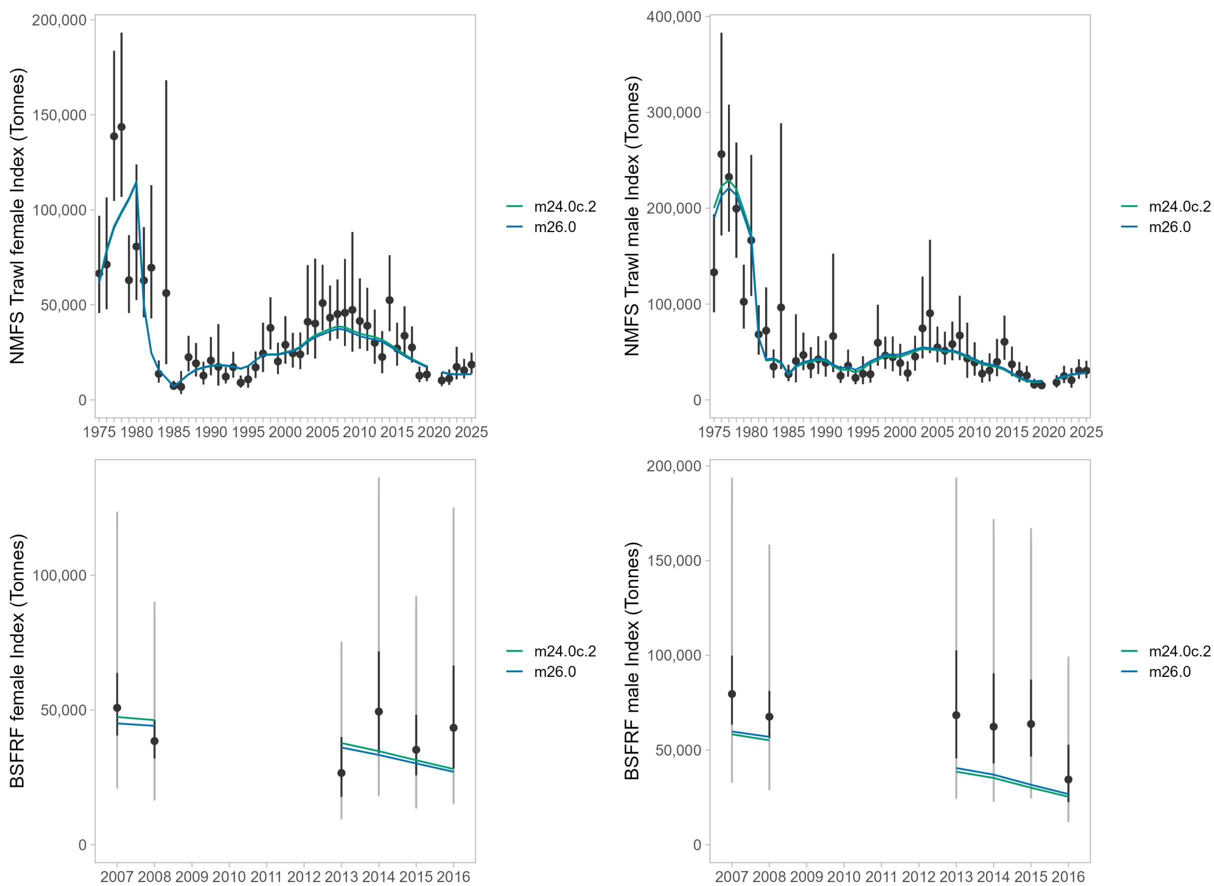

Figure 10: Comparisons of area-swept estimates and model predictions for both the NMFS trawl survey and the BSFRF trawl survey for the base model, 24.0c.2, and extended size range model, 26.0. The error bars are plus and minus 2 standard deviations of the area swept estimates.

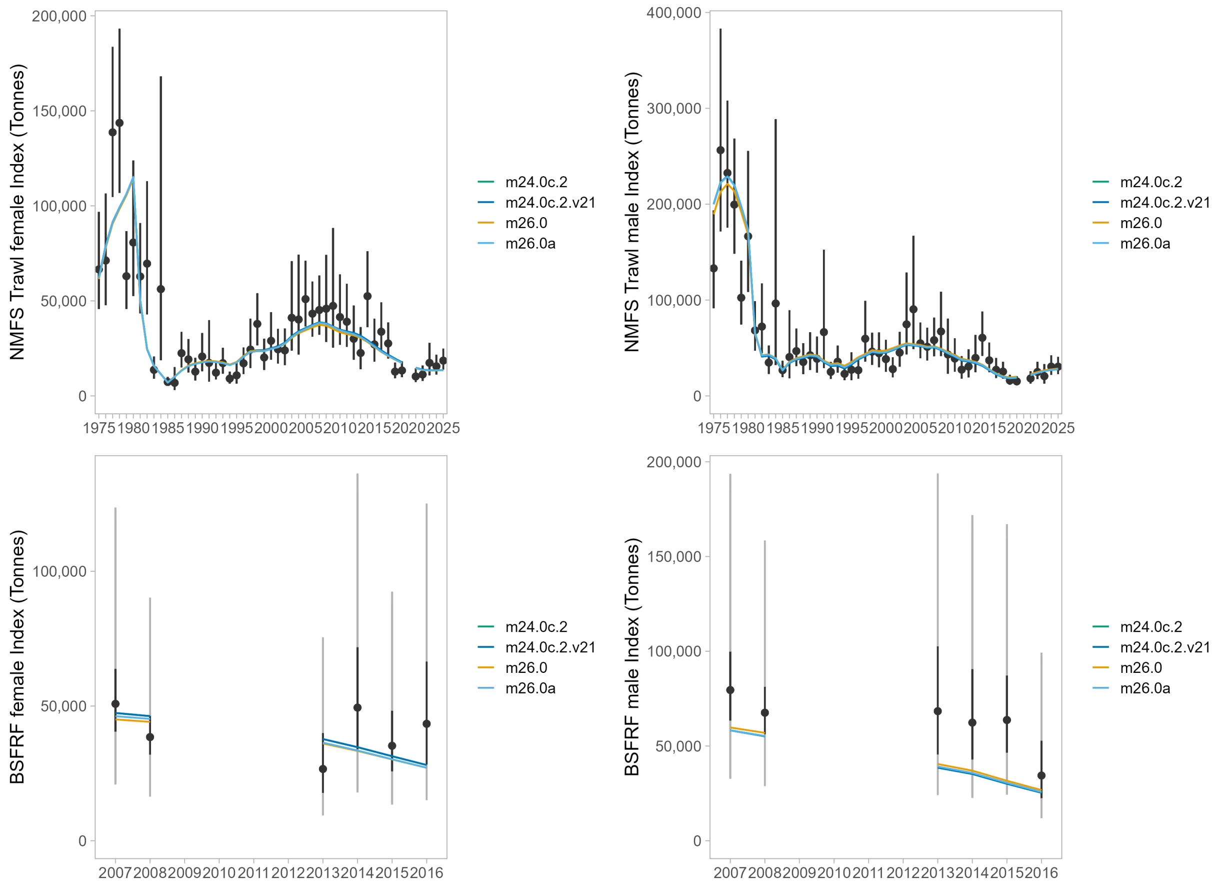

Figure 11: Comparisons of area-swept estimates and model predictions for both the NMFS trawl survey and the BSFRF trawl survey for the base model, 24.0c.2, model with updated bycatch size data, 26.0a, and extended size range model, 26.0. The error bars are plus and minus 2 standard deviations of the area swept estimates.

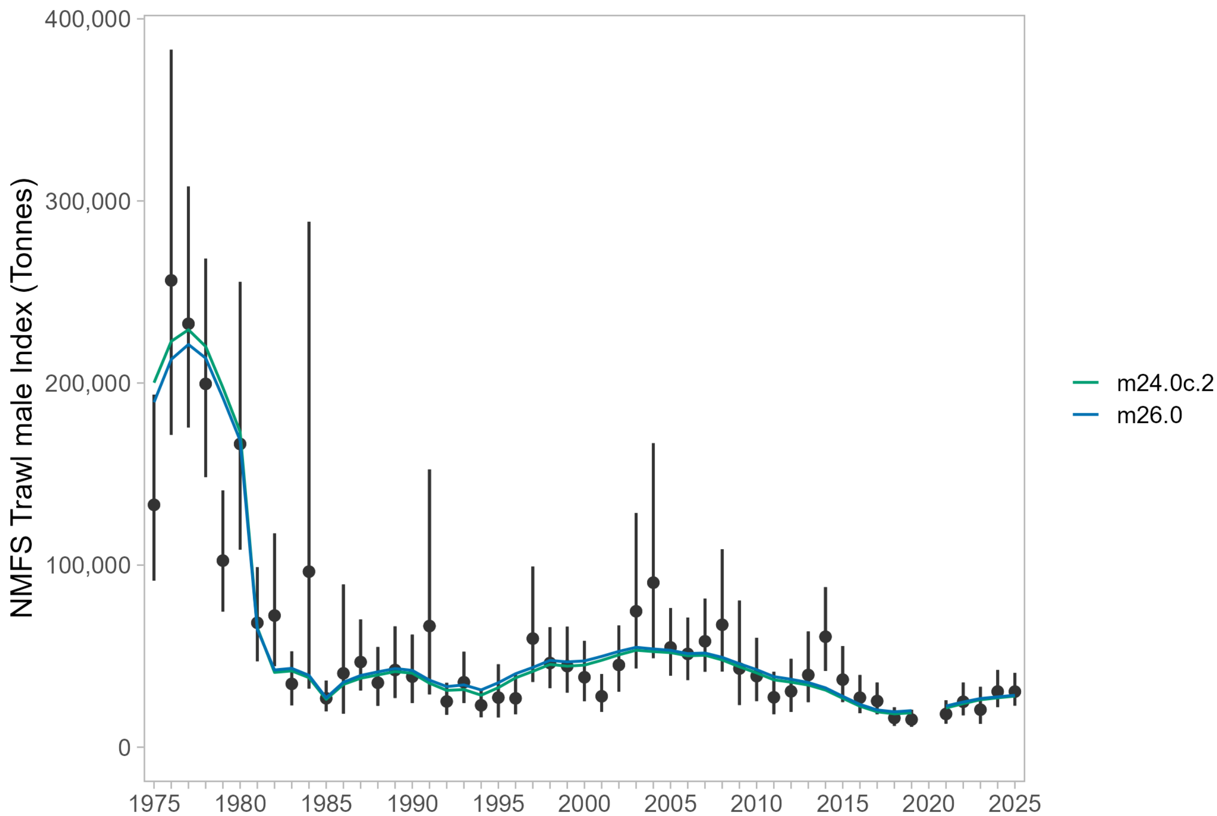

Figure 12: Comparisons of area-swept estimates of total male NMFS survey biomass and model predictions for model estimates in the base model, 24.0c.2, and extended size range model, 26.0. The error bars are plus and minus 2 standard deviations of the area swept estimates.

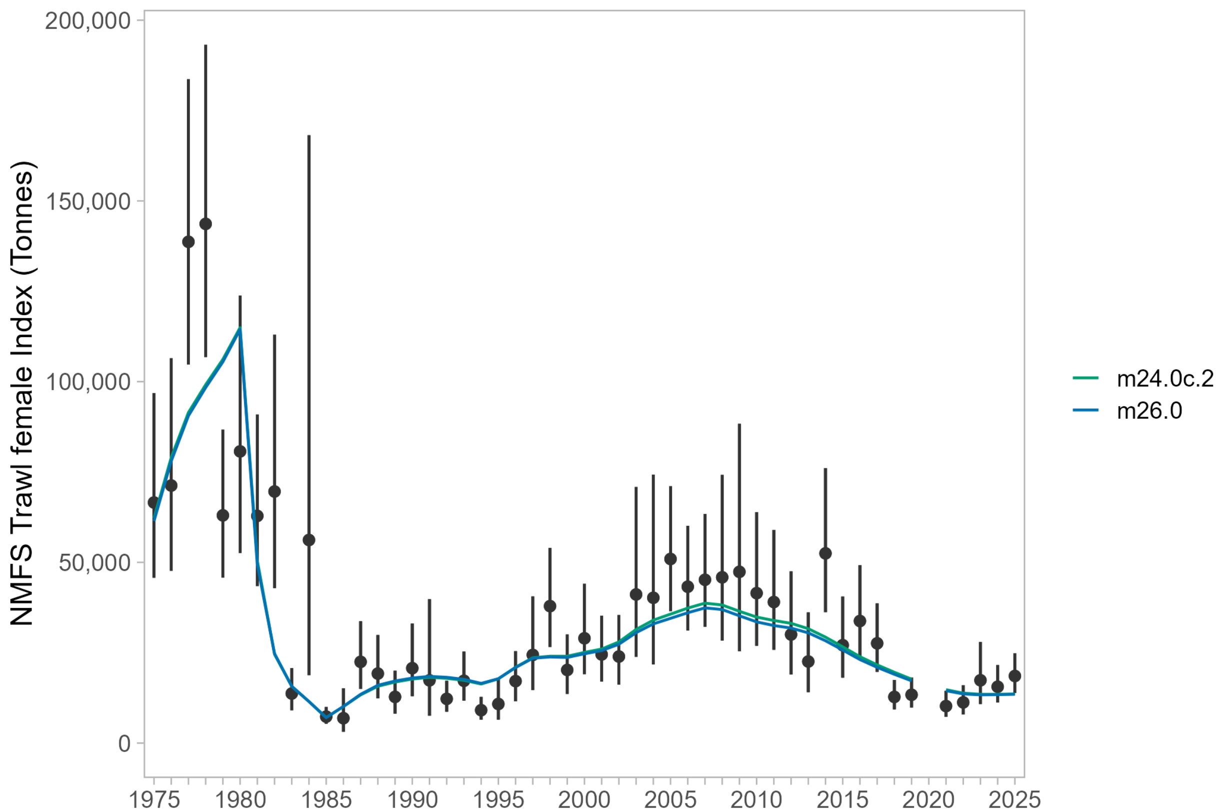

Figure 13: Comparisons of area-swept estimates of total female NMFS survey biomass and model predictions for model estimates in the base model, 24.0c.2, and extended size range model, 26.0. The error bars are plus and minus 2 standard deviations of the area swept estimates.

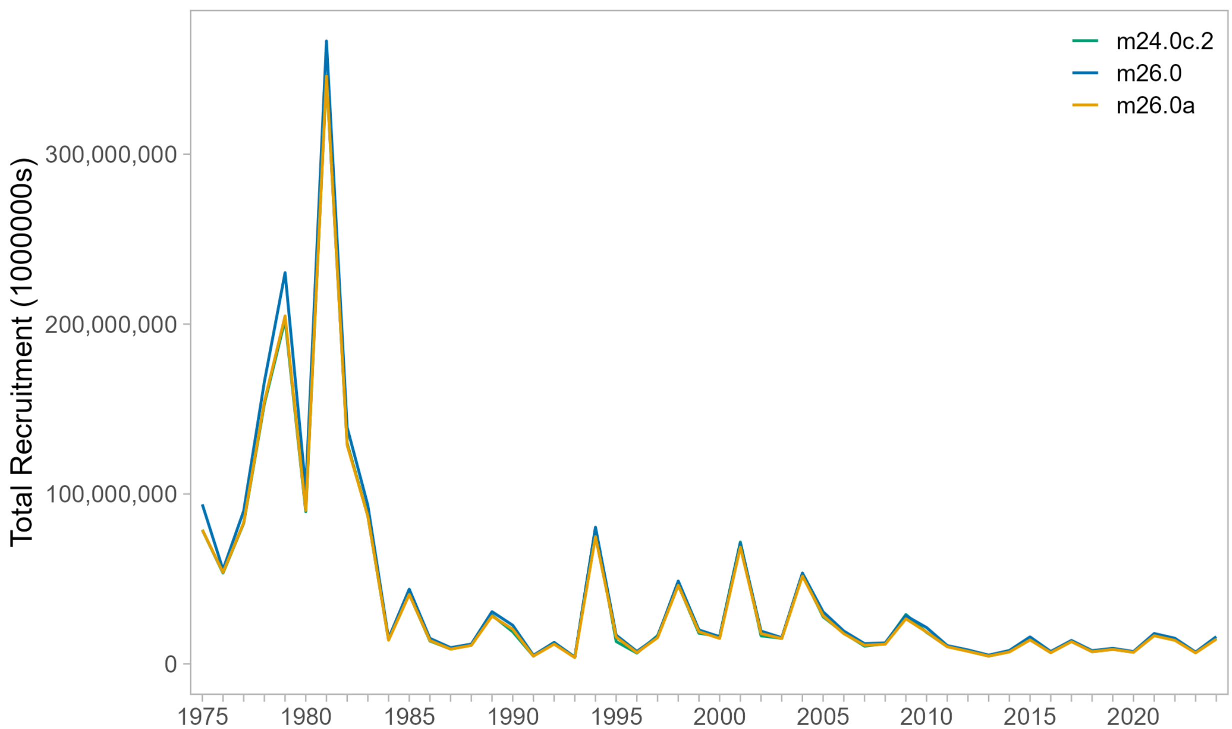

Figure 14: Estimated recruitment (million of individuals) time series during 1976-2024 with models 24.0c.2, 26.0a, and 26.0. Mean male recruits during 1984-2022 was used to estimate B35. Recruitment estimates in the terminal year (2024) are unreliable.

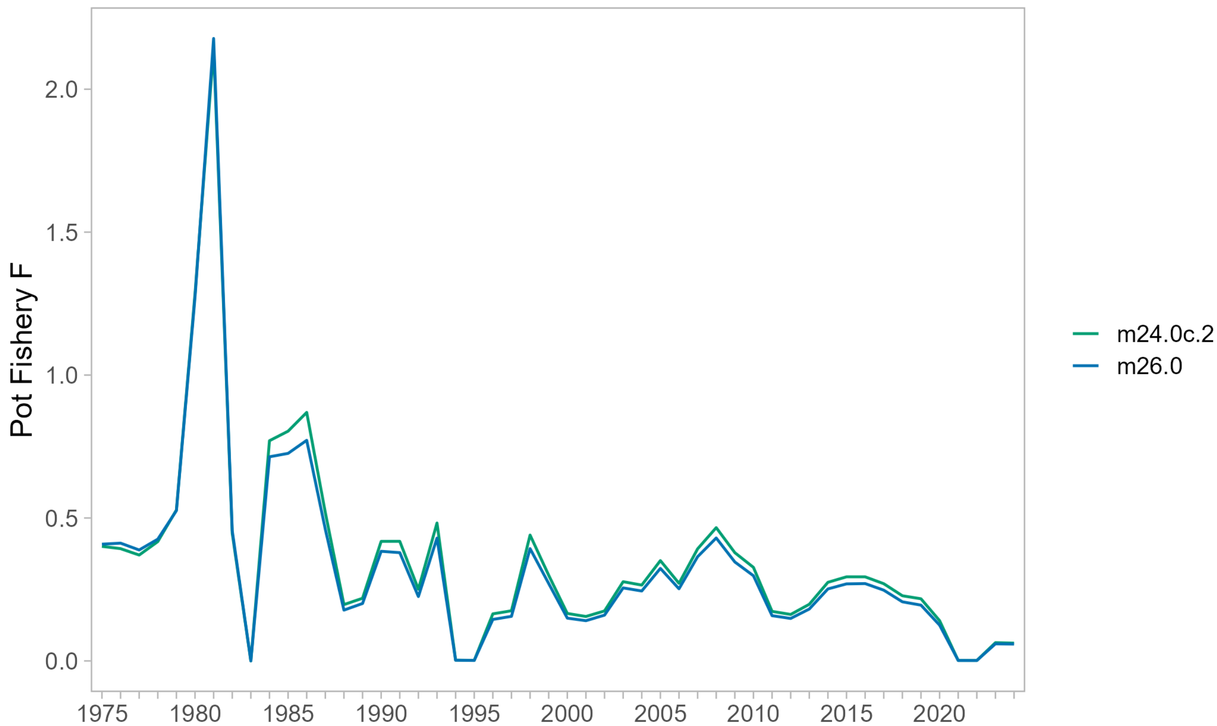

Figure 15: Comparison of estimated fishing mortality for models 24.0c.2 and 26.0. All other models are similar to the base models shown here.

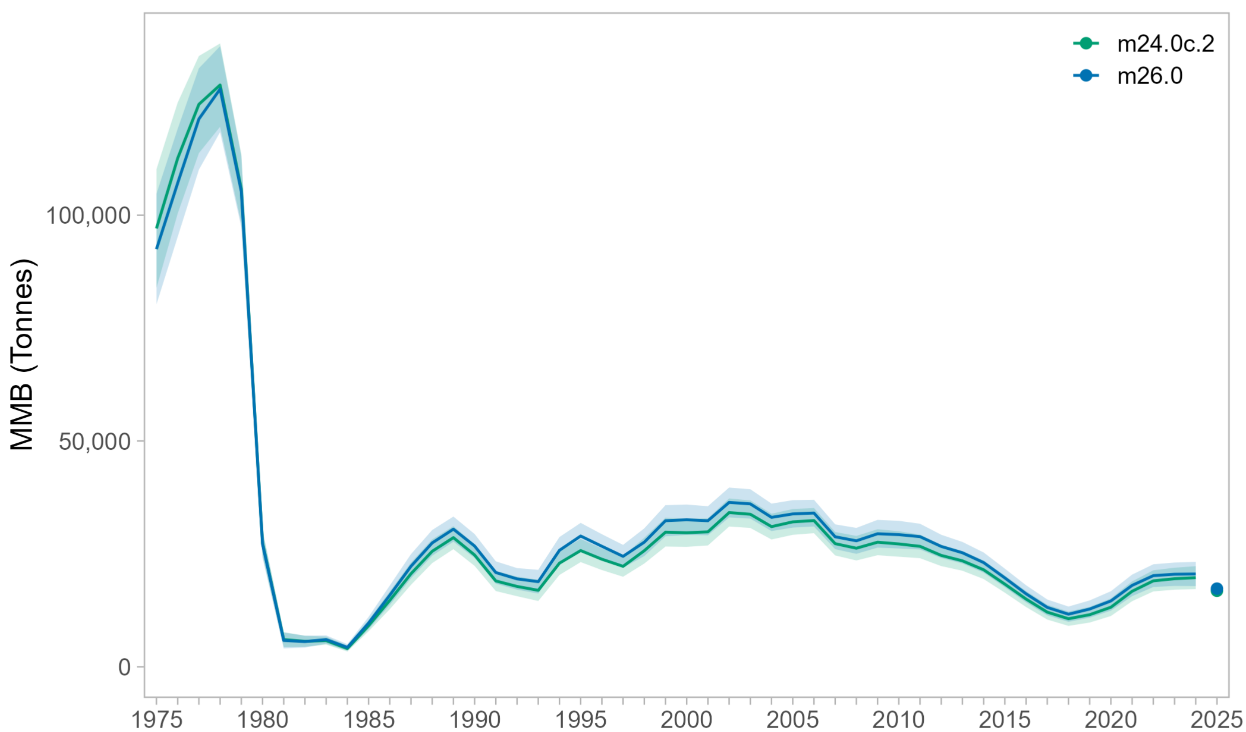

Figure 16: Estimated absolute mature male biomasses during 1975-2024 for models 24.0c.2 and 26.0, with projected biomass for 2025. Mature male biomass is estimated on Feb. 15, year+1 (i.e. 2025 value is Feb. 15 2026).

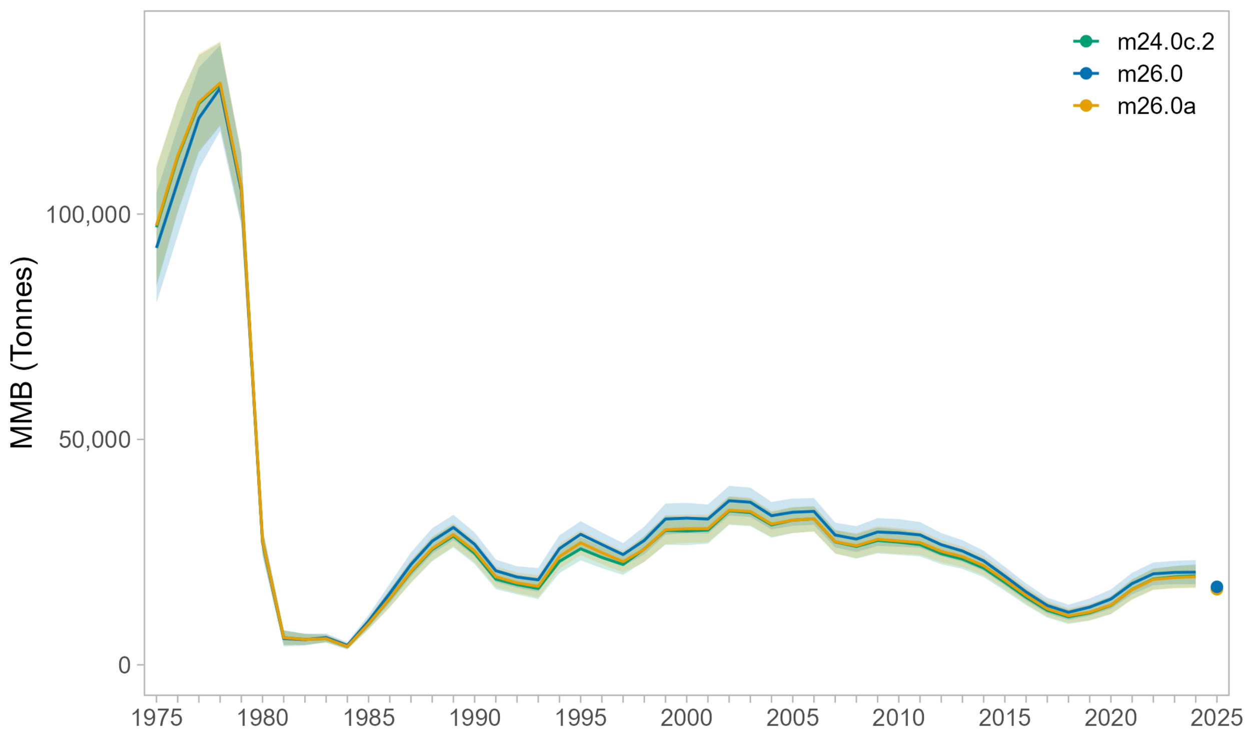

Figure 17: Estimated absolute mature male biomasses during 1975-2024 for models 24.0c.2, 26.0a, and 26.0, with projected biomass for 2025. Mature male biomass is estimated on Feb. 15, year+1 (i.e. 2025 value is Feb. 15 2026).

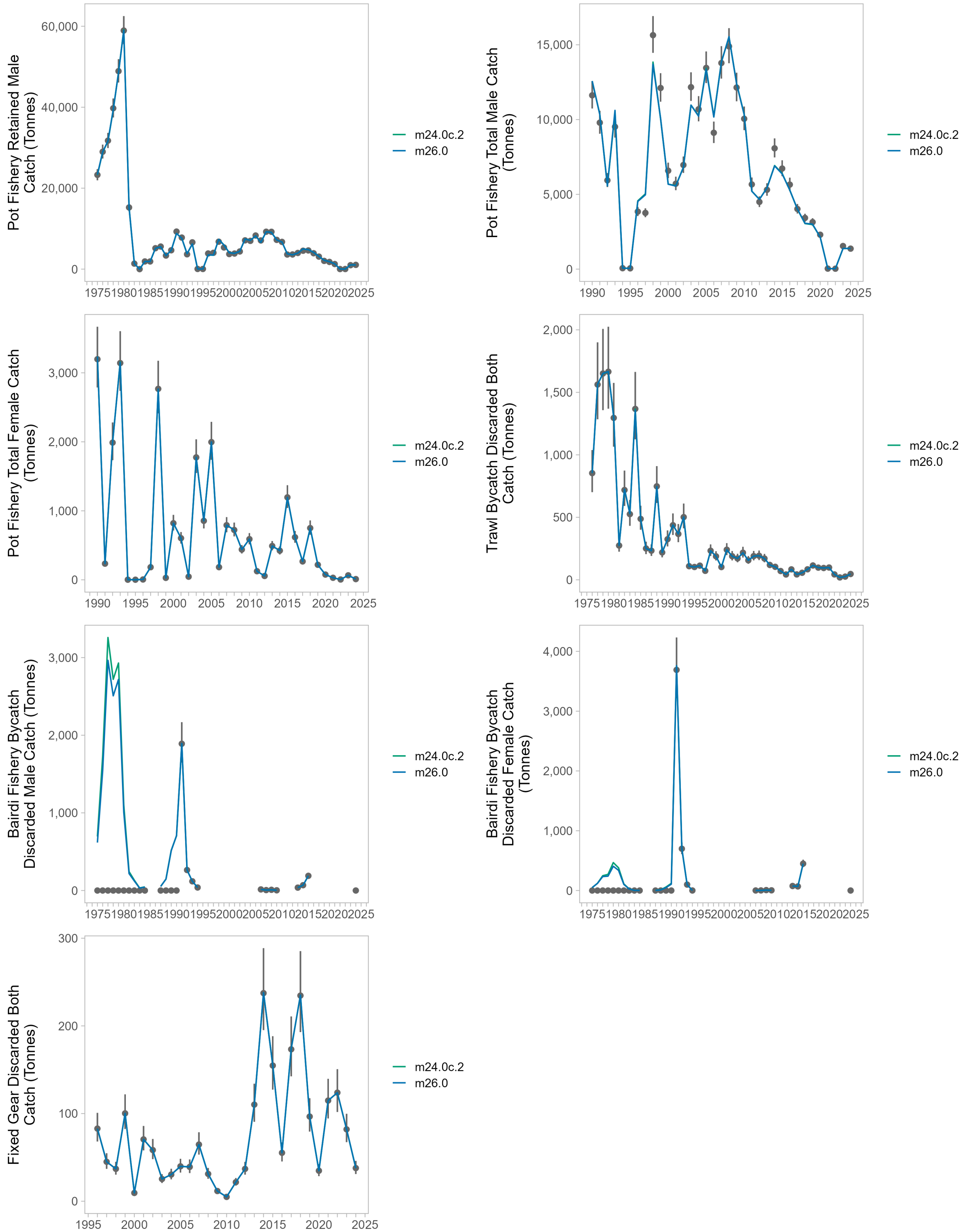

Figure 18: Observed (dots) and predicted (lines) RKC catch and bycatch biomass under models 24.0c.2 and 26.0. Note that model fit for Tanner crab fishery bycatch reflects utilizing effort data for extrapolation to bycatch in the early part of the time series.

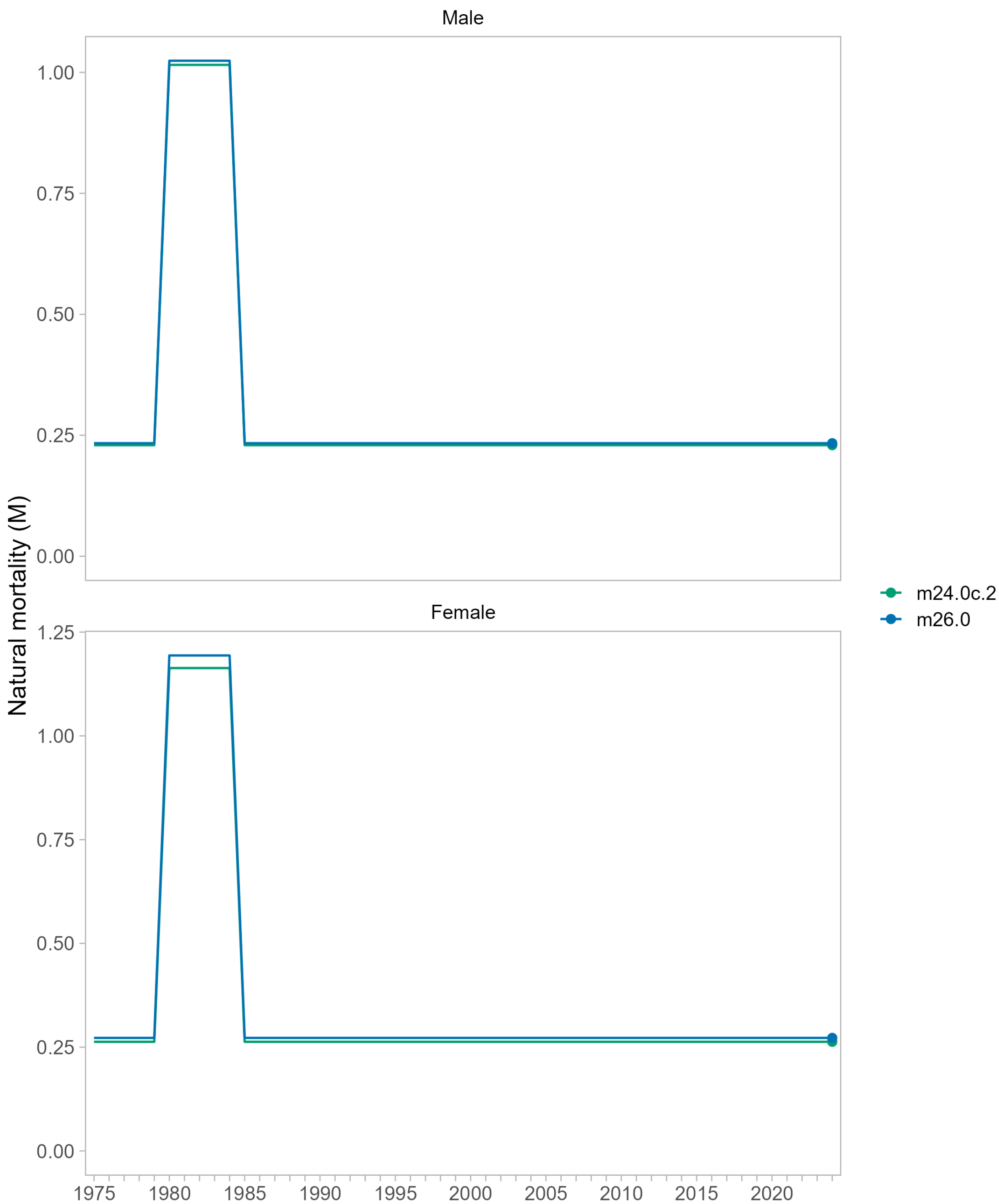

Figure 19: Comparison of natural mortality - either estimated or fixed depending on the model - for models 24.0c.2, and 26.0. The table above details the differences in the natural mortality event for males between these models.

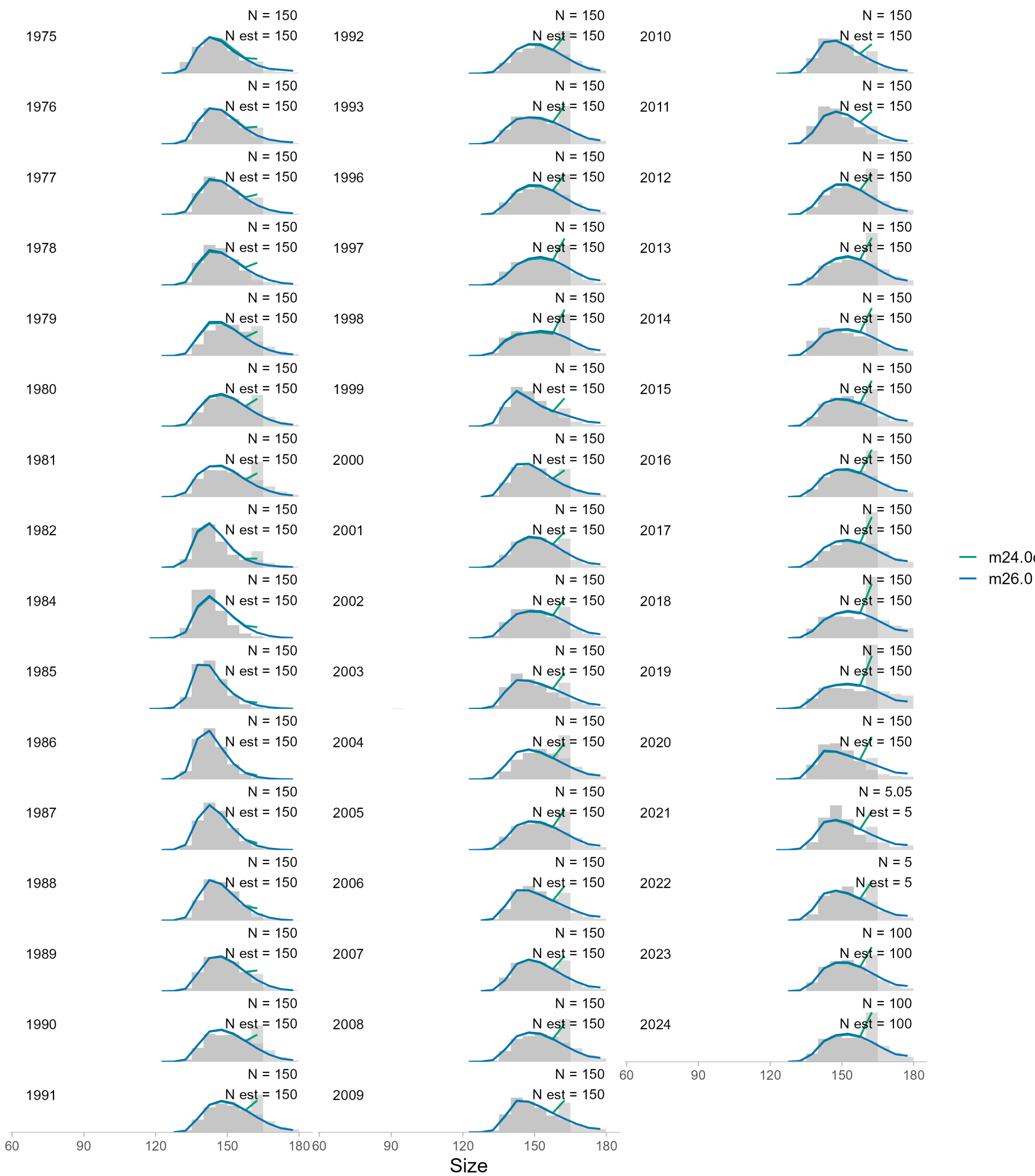

Figure 20: Observed and model estimated length-frequencies of male BBRKC by year retained in the directed pot fishery for models 24.0c.2 and 26.0.

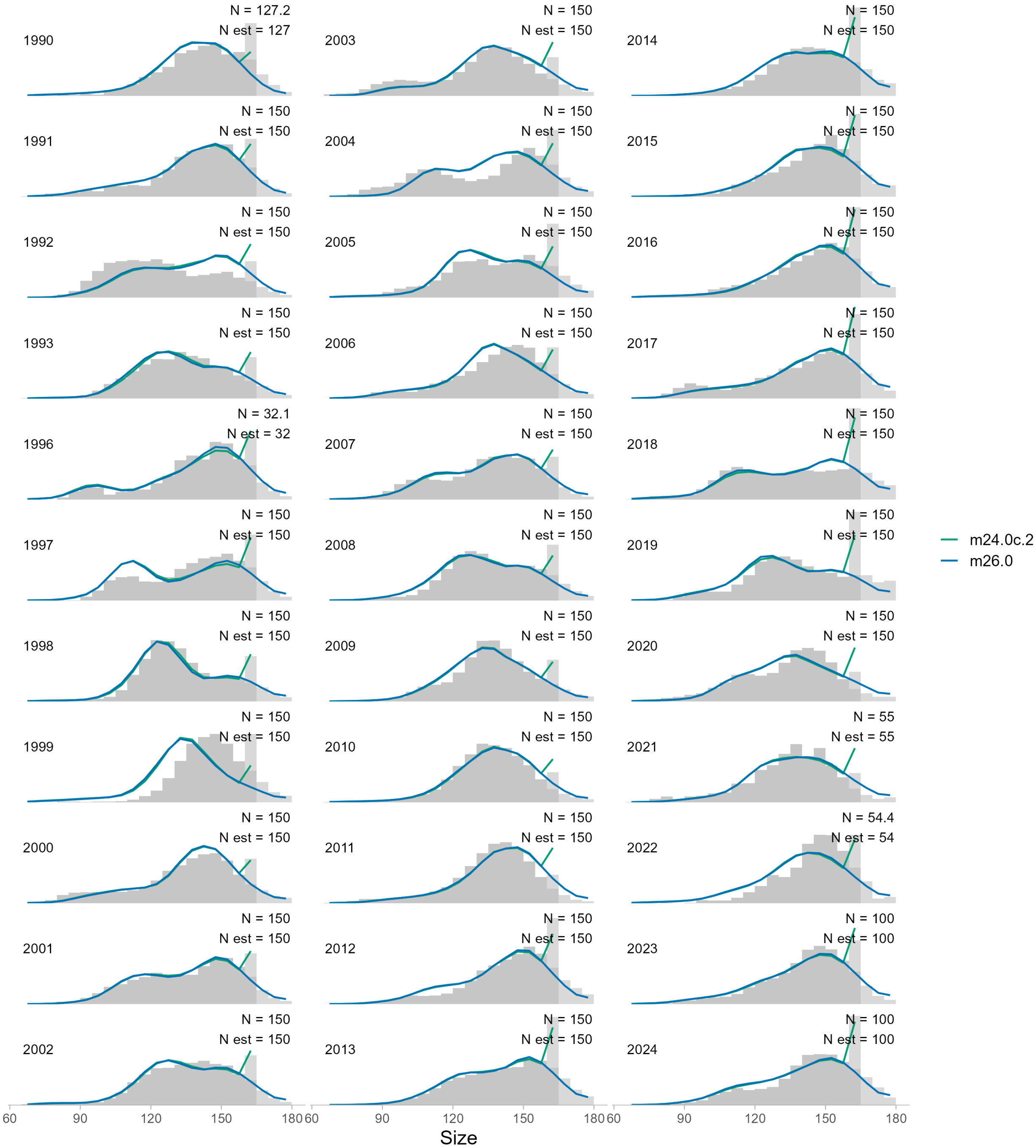

Figure 21: Observed and model estimated length-frequencies of TOTAL male BBRKC by year in the directed pot fishery for models 24.0c.2 and 26.0.

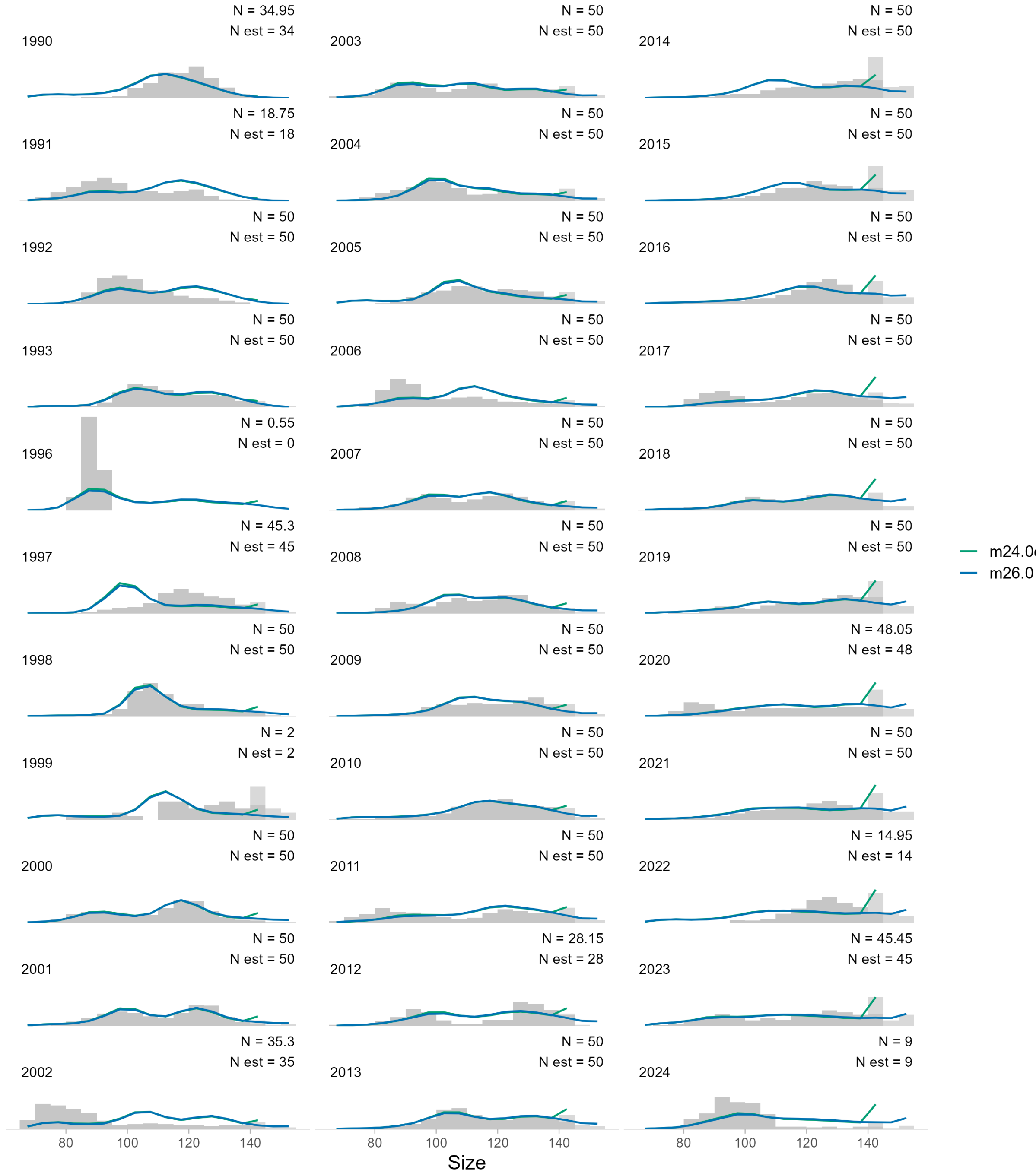

Figure 22: Observed and model estimated length-frequencies of TOTAL female BBRKC by year in the directed pot fishery for models 24.0c.2 and 26.0.

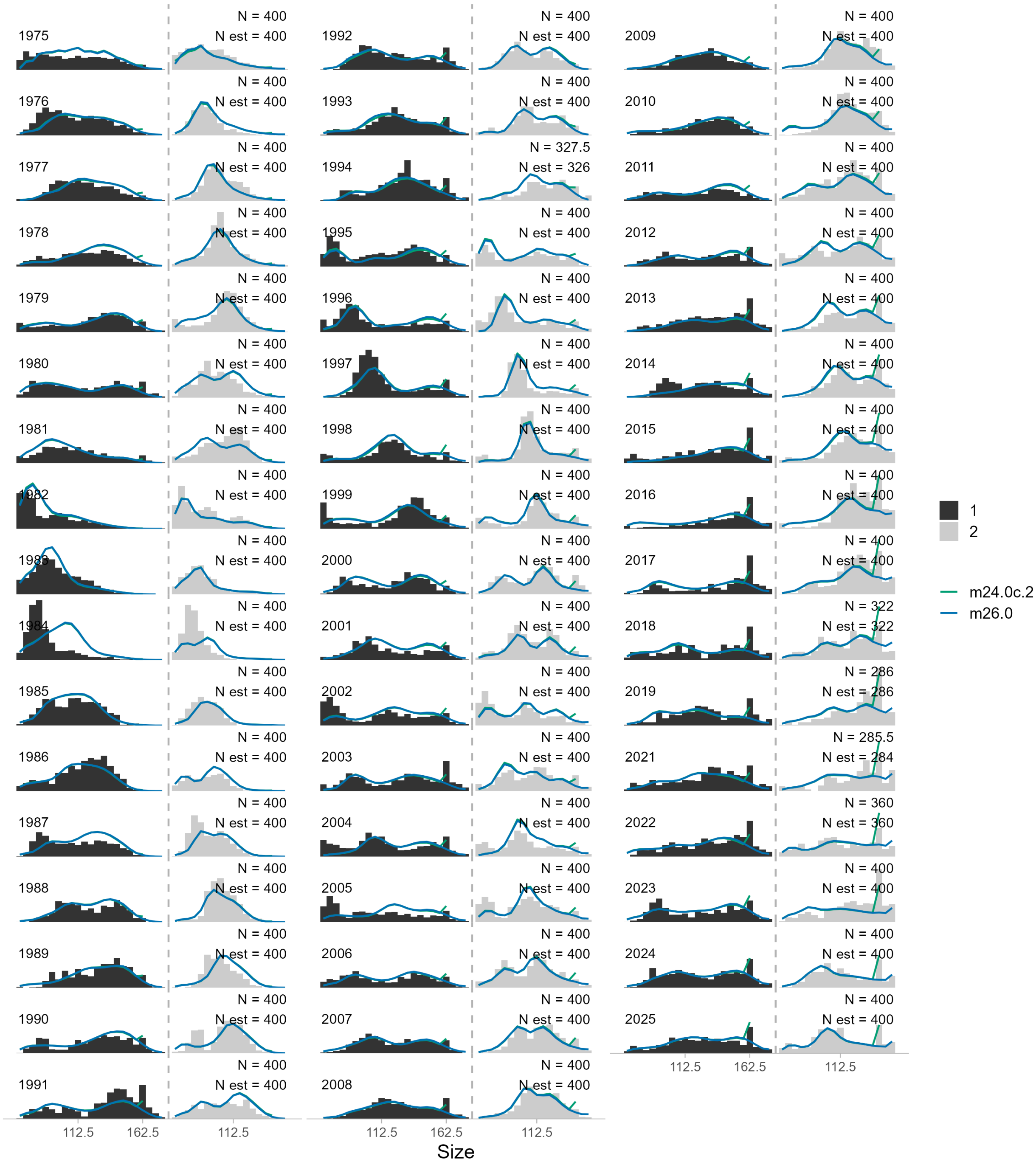

Figure 23: Comparison of area-swept and model estimated NMFS survey length frequencies of Bristol Bay male (black, 1) and female (gray, 2) red king crab by year for models 24.0c.2 and 26.0.

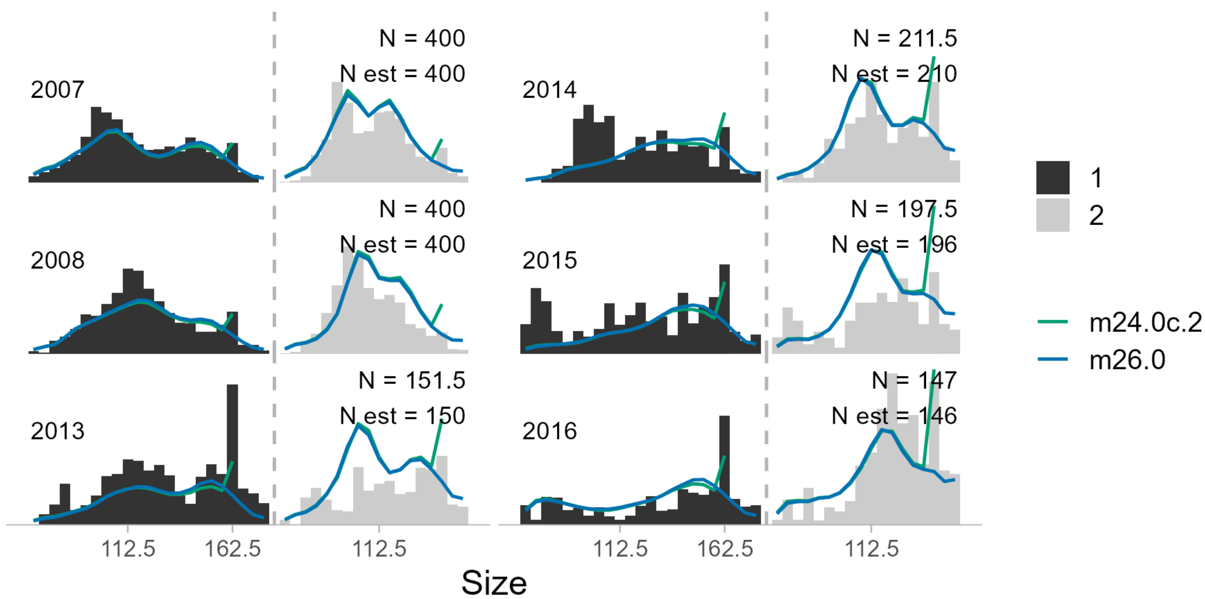

Figure 24: Comparisons of length compositions by the BSFRF survey and the model estimates during 2007-2008 and 2013-2016 for base model scenarios (male (black) and female (gray) red king crab).

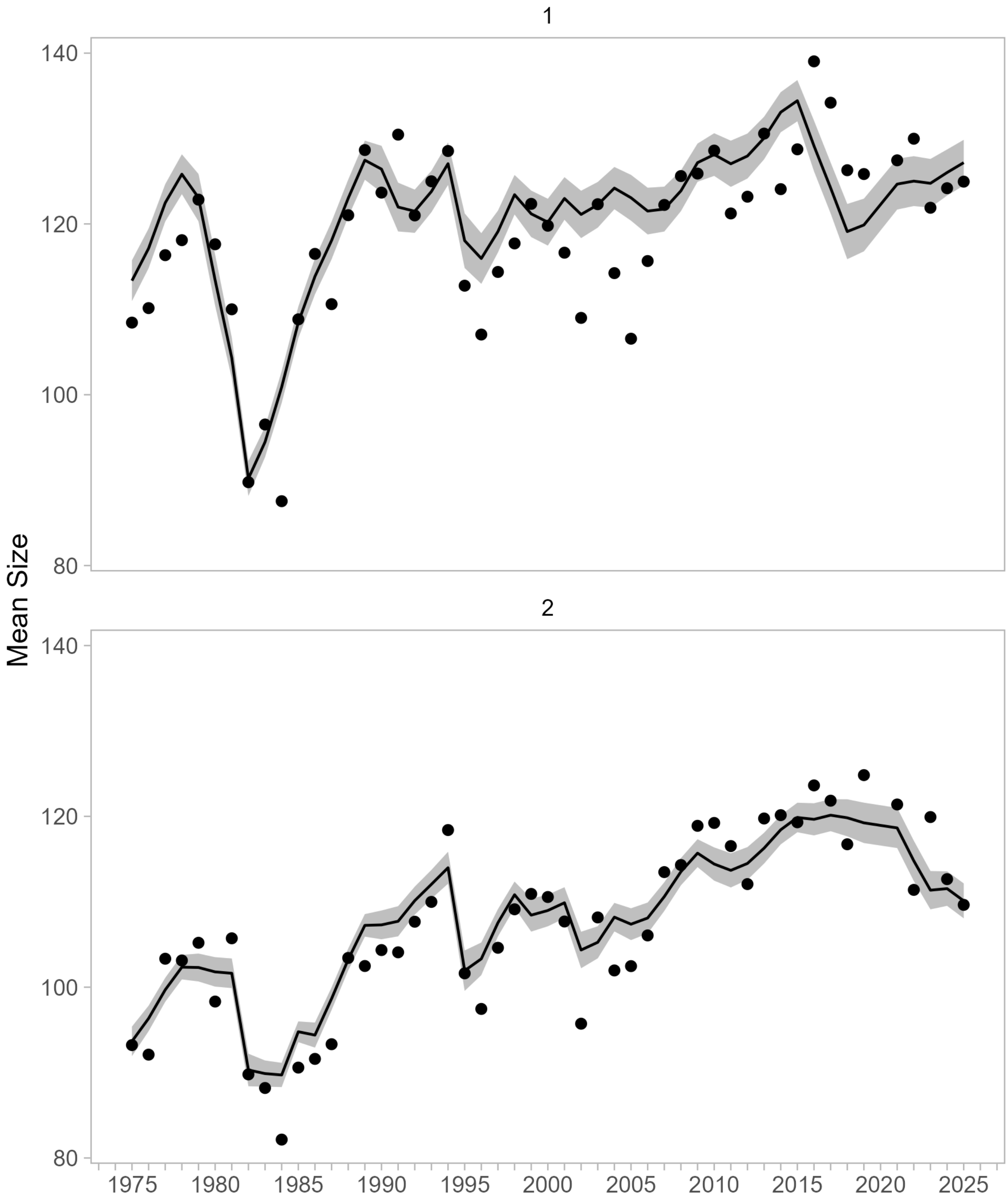

Figure 25: Mean size over all years for the NMFS survey for males (1) and females (2) under model 24.0c.2 (updated base model based on 2025 accepted model).

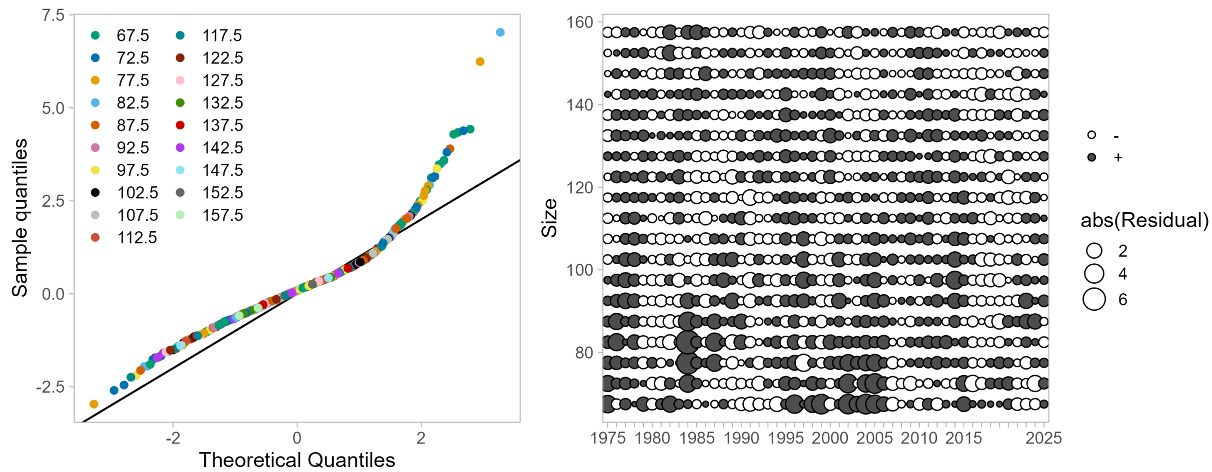

Figure 26: One-step-ahead residuals of size comps for males for the NMFS survey under model 24.0c.2 (updated base model based on 2025 accepted model).

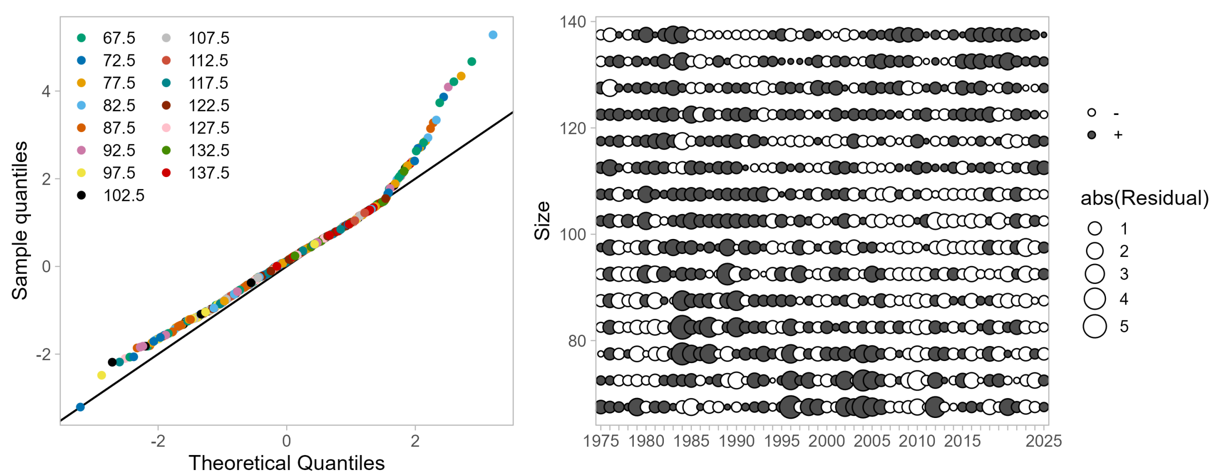

Figure 27: One-step-ahead residuals of size comps for females for the NMFS survey under model 24.0c.2 (updated base model based on 2025 accepted model).

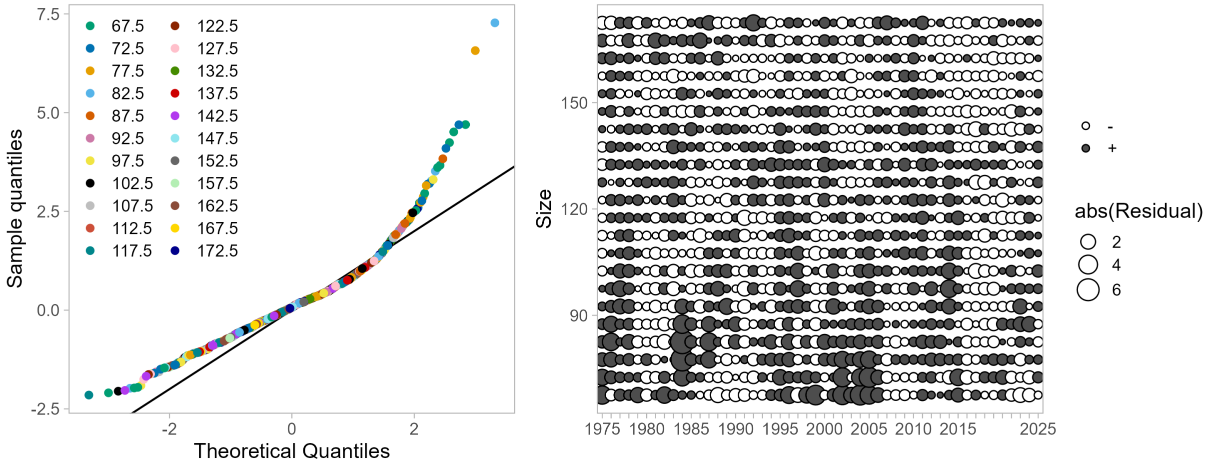

Figure 28: One-step-ahead residuals of size comps for males for the NMFS survey under model 26.0 (extended size range)).

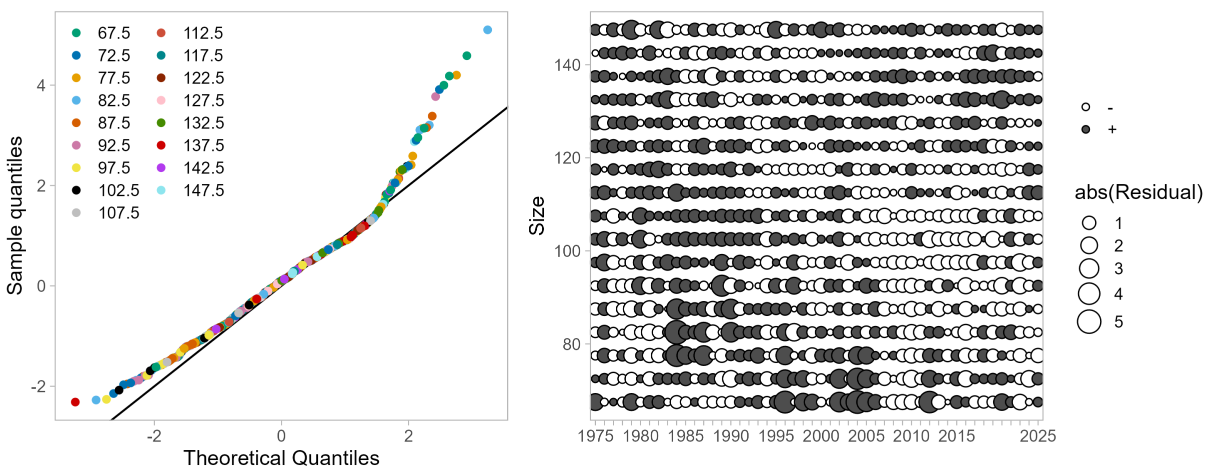

Figure 29: One-step-ahead residuals of size comps for females for the NMFS survey under model 26.0 (extended size range).