May 2022 Tanner Crab Report:
Updates on Issues and Proposed Models for September

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Introduction

This report provides an in-progress update on work related to the Tanner crab assessment since September 2021 and proposed models to be evaluated for the September 2022 assessment.

Issues

A number of issues raised in previous assessments and since September 2021 are addressed here. These include:

- the potential impact of dropping so-called "corner stations" from the NMFS EBS survey grid as part of an effort to optimize survey workloads
- the impact of changes made by the Regional Office to the expansion algorithm for bycatch of crab in the groundfish fisheries
- the appropriateness of input sample sizes for survey size composition data
- the potential for better characterizing the directed fishery in the assessment model by not aggregating data across the ADFG management areas (i.e., east and west of 166°W longitude)
- the potential for simplifying the assessment by estimating the initial population size structure in a year informed by survey data

These are described in more detail in the individual sections below that address each issue.

Modifications to the assessment model code

TCSAM02, the assessment model code, was modified to:

- provide uncertainty estimates for management-related quantities (e.g., OFL, F_{MSY}) based on ADMB's delta approximation, as an alternative to MCMC [SSC request]
- allow direct estimation of initial population size structure, as an alternative to building up population size structure based solely on recruitment [CPT request]
- allow multi-year projections under specified fishing mortality rates in the directed fishery [SSC request]

All model modifications were tested to make sure that they did not affect results from the 2021 assessment model. The current code is available at GitHub on the "202205CPTMeeting" branch.

Model descriptions

In total, 14 different model configurations were evaluated for this report (not including the 2021 assessment model; Table 1). The model configurations in Table 1 are discussed in more detail below.

21.22a: 2021 assessment model

The data, processes and likelihood components included in the current assessment model (21.22a) are summarized in Tables 2-5 (see Stockhausen, 2021, for more details). The timelines associated with different model processes and datasets are illustrated in Table 6.

No Corner Stations (Appendix A)
This model was developed to address the consequences of a potential change in the manner in which the EBS shelf survey is conducted. **It is not considered a potential candidate for the September 2022 assessment.** The AFSC Survey Workload Optimization workgroup was formed earlier this year to consider the consequences of various forms of workload optimization or reduction on the surveys conducted by the Resource Assessment and Conservation Engineering (RACE) Division through its Groundfish and Shellfish Assessment Programs (GAP and SAP). One suggestion for workload reduction on the annual Eastern Bering Sea Shelf Bottom Trawl Survey was to eliminate the so-called "corner" stations in the survey grid from sampling strata near the Pribilof Islands and St. Matthew Island in future surveys. To determine the impact such a change might make to the Tanner crab assessment, it was suggested that the assessment model be re-run with time series for survey biomass and size compositions for Tanner crab recalculated by dropping the corner stations in all previous years. This scenario, referred to "No Corner Stations" here, was regarded as having the maximum potential impact on the assessment.

22.01: updated bycatch estimates in the groundfish fisheries (Appendix B)
In 2022, the National Marine Fisheries Service Alaska Regional Office (AKRO) changed the way it calculated crab bycatch to better account for unspeciated king and Chionoecetes (Tanner and snow) crab, correct an error in an extrapolation method, and improve the logic used to identify fishing trips. The improved algorithm was applied to observer data from the groundfish fisheries back to 2017, beyond which it could not be further applied due to changes in the underlying database. Although the 2021 assessment model (21.22a) was not changed in structure itself, the model number 22.01 was chosen for this run to emphasize that the data processing underlying the model had undergone a possibly significant change.

The changes in bycatch estimates for Tanner crab in the groundfish fisheries were small and had essentially no effect on model results (Appendix B). The changes only propagated back to 2017 and were small in both relative (< 3%) and absolute terms (< 4 t) for data included in the assessment (i.e., aggregated to the EBS; Appendix B Table 2). With parameter estimates initialized using the final model estimates from the 2021 assessment, the model's optimization criteria were met within a few iterations, resulting in identical values, for all practical purposes, to the assessment. Changes in management -related quantities (e.g., average recruitment, F_MSY, and the OFL) were less than 0.01% (Appendix B Figure 6).

22.02: input sample sizes for survey size compositions from bootstrapping (Appendix C)
Survey size compositions in the Tanner crab assessment provide annual information on changes in size composition for male crab, as well as for immature and mature female crab, and thus inform estimates of growth, maturation, and natural mortality rates. Because the Tanner crab is an integrated assessment model that seeks to balance model fits to data across a variety of data types and sources (e.g., indexes of abundance and biomass, survey and fishery size compositions, growth and maturity data) in order to estimate underlying parameters governing population dynamics, reflecting fishery prosecution, and addressing management issues such as sustainable yield, it is important to accurately characterize the precision/uncertainty associated with the those data. The relative weights assigned to different data sources in the parameter estimation algorithm can influence the values of the estimated parameters, particularly when different data sources encompass conflicting information. The Tanner crab model uses a maximum likelihood approach to parameter estimation with input sample sizes for survey size compositions currently fixed at 200 in all years, where the value of 200 reflects a practical choice for the assumed precision of the size compositions that allows the estimation algorithm to converge. In past work to improve on using a fixed sample size when fitting the model, several iterative re-weighting schemes (Francis, 2011) were tried but resulted in adjusted sample sizes that approached zero. The Dirichlet-Multinomial distribution (Thorson et al. 2016), as a substitute for the multinomial, allows for the estimation of the "effective" sample size as a parameter with the input sample size as an upper bound. Application of this distribution in previous models resulted in the "effective" sample size being estimated

as the same as the input sample size, suggesting the default input sample size of 200 may not be a bad practical choice.

To investigate this issue more thoroughly, a "bootstrapping" technique (Stewart and Hamel, 2014) was applied to EBS survey data to estimate annual input sample sizes for survey size compositions for male Tanner crab, as well as immature and mature females. The resulting bootstrapped sample sizes (Appendix C) were used as input sample sizes for Model 22.02. In general, the bootstrapped sample sizes were larger than the default input sample sizes (Appendix C, Tables 1 and 2).

22.03: fitting to sex-aggregated fishery catch biomass

Annual fully-selected fishing mortality rates on females are modeled for each fishery fleet in the assessment model as proportional to those on males using ln-scale offsets, with the consequence that the rates on females exhibit the same temporal variation as those on males, but with a different overall scale. This choice is based on the desire to reduce the number of parameters in the model coupled with the observation that female bycatch is generally much smaller than that for males: an alternative approach would be estimate annual variation in fishing mortality rates on females completely independent of those on males. but this would add increase the number of estimated parameters substantially in a model that is already parameter-heavy.

In the current assessment model, annual sex-specific total catch biomass based on observer reports was fit for each fleet using lognormal likelihoods, which reflects the size of relative (proportional) errors between model predictions and observations. While using lognormal likelihoods is a standard approach to fitting fishery catch data (as well as survey indices of abundance), it may not be optimal to use it to fit sex-specific catch data in this case. Because female fishing mortalities are modeled as proportional to those on males, the model can be optimized by fitting the female catch data equally as well, proportionally, as the male catch data—with the consequence that when the male and female catch data follow different trends the optimization will "split the difference" in proportional error (i.e., equal but opposing errors on the log scale). Because bycatch of females is typically much less than that of males, equalizing proportional error rates will tend to underpredict male catch and overpredict female catch in absolute terms, thus underestimating removals from the stock. One potential approach to reducing this bias would be to fit estimates of total, rather than sex-specific, catch from fishery observers. Model 22.03 addresses. this issue.

22.04a,b models: fitting directed fishery by ADFG management area

ADFG manages the directed Tanner crab fishery on a two-area basis, with separate TACs and size limits set for fishing east and west of 166°W longitude. However, as a simplification, the current assessment model treats the two areas as a single unit and aggregates the annual catch data prior to fitting it, using single (sex-specific) selectivity and retention curves to describe the combined fleet. Because the Tanner crab stock has different size and sex characteristics in the two management areas, in addition to potential differences in fleet characteristics, the selectivity and retention curves of the combined fleet could vary annually even if the fleet-specific curves do not. More specifically, the fleet fishing west of 166°W tend to catch smaller crab than does the fleet fishing east of 166°W. To address this, the current assessment model (21.22a) describes selectivity in the combined fleet using a logistic function, and allows it to be time-varying by estimating annual deviations to the size-at-50%-selected parameter (the slope parameter is assumed to remain constant), thus incorporating some degree of flexibility with regards to inter-annual changes in combined-fleet selectivity. This might not be the best approach to take, however, particularly given that the area east of 166°W has been closed to fishing several times during the past decade when the fishery west of the line was prosecuted. In these years, the model-estimated selectivity reflects that of the western fleet and the size-at-50%-selected parameter is shifted toward smaller sizes. Unfortunately, it is also clear that, considered in isolation, the selectivity pattern for the western fleet has to be dome-shaped when relative to the combined area because the catch composition for this fleet is shifted toward smaller crab relative to the eastern fleet. Thus, the combined-area selectivity curve should not only shift toward smaller sizes, but also change shape.

Models 22.04a and 22.04b attempted to address this issue by modeling the fishing dynamics of the eastern and western fleets separately, starting in 2005/06 after the crab fisheries were rationalized and coinciding with the re-opening of the Tanner crab fishery in the EBS (which had been closed since 1997/98). The two fleets were represented in the models in a fashion similar to that for the combined-area fleet (which represented directed fishing in the model up to the closure in 1997/98):

- annual deviations from a fleet-specific mean were estimated on the ln-scale for fully-selected fishing mortality on male crab.
- Fishing mortality rates on female crab were estimated as a ln-scale offset to the rates on males (i.e., the rates on females are proportional to those on males, with a fixed constant of proportionality).
- Separate selectivity functions were estimated for males and females, but had the same functional form
    - selectivity for the eastern fleet was represented by an ascending normal curve (similar to the combined-area fleet, but time-invariant)
    - selectivity for the western fleet was represented by a time-invariant double normal curve, which can take on a domed shape depending on parameter values
    - the retention functions for both fleets were represented by ascending normal curves but estimated independently

In contrast to 21.22a, in which the size at 50% selected was allowed to vary annually starting in 1991 (when at-sea observer data first became available), the selectivity curves for the area-specific fleets did not vary in time. This was regarded as a simplification with respect to the former model because it reduced the overall number of estimated selectivity parameters somewhat.

The calculation of OFL-related quantities was based on the estimated dynamics of the western fleet, given that the eastern area has been closed several more time recently than the western area. To determine the longterm F (i.e., the proxy F_{MSY}=$F_{35\%}$) that resulted in the proxy B_{MSY} (=$B_{35\%}$), the fully-selected fishing mortality rate on the western fleet was varied to find the F that resulted in the longterm average MMB being 35% of the unfished biomass. During this search, the eastern fleet was treated in a fashion similar to that of the bycatch fleets, with average fully-selected fishing mortality rates on males fixed at an average of the previous 5 years. Other approaches could be considered (e.g., fully-selected fishing mortality in the eastern fleet could also be varied in some fashion), and the author is seeking advice on the best approach.

In Model 22.04a, data for the eastern and western fleets entered the model likelihood in the same manner as that for the combined fleet: time series for retained and sex-specific total catch biomass starting in 2005 were fit using lognormal likelihoods; associated annual size compositions were fit using multinomial likelihoods with input sample sizes calculated in the same manner as other fishery size compositions. While running 22.04a using the technique of jittering initial parameter values to evaluate model convergence and improve one's confidence in final parameter estimates, it was noted that ADMB's parameter optimization algorithm had trouble finding even a local minimum (at which the objective function gradient with respect to the parameters would be acceptably zero close to zero) and, out of 400 jittered runs, only one satisfied ADMB's maximum gradient criterion—and that took over 30,000 iteration to achieve (typically, the Tanner crab model converges to some local minimum within a few thousand iterations). It was hypothesized that using lognormal likelihoods to fit the disaggregated fleets might have accentuated potential conflicts in sex-specific catch trends (as addressed by Model 22.03), so Model 22.04b was developed, which used normal likelihoods to fit the catch biomass data as an alternative to using lognormal likelihoods.

22.05 and 22.06 models: starting the model in 1982

The current assessment model, 21.22a, is initialized in 1948 at zero population size and builds up population abundance and size composition (i.e., numbers-at-size) gradually over time through a “historical” recruitment period before transitioning to a “current” recruitment period in 1975. During the historical period, annual recruitment devs are modeled as an autoregressive (AR-1) process while those in the subsequent period are modeled as a random walk process. The transition at 1975 was chosen to coincide with the time at which NMFS EBS shelf survey data first inform the model on population abundance, biomass, and size composition. Prior to 1975, the only data that informs the model on population size is annual estimates of retained catch biomass from foreign and domestic fleets starting in 1965 and annual estimates of bycatch abundance, biomass, and size composition taken in the groundfish fisheries starting in 1973. These estimates are of uncertain reliability, particularly the foreign fleet data. In addition, the areal coverage of the NMFS EBS shelf bottom trawl survey varied annually and a completely different type of sampling gear was used prior to standardization to the current survey grid and gear in 1982. The current assessment model attempts to fit this early data through by estimating a large number of recruitment parameters, additional survey catchability and selectivity parameters, and extending selectivity patterns in the directed fishery estimated from domestic fleet data to foreign fisheries conducted with completely different gear (trawls, tangle nets). However, it might be better from several perspectives, to simply ignore these early (and problematic) data and initialize the model at some later date by estimating the initial population abundance and size composition.

Models 22.05a-d and 22.06a-d implemented this suggestion by estimating initial parameters reflecting population numbers-at-size/sex/maturity state/shell condition to start the model in 1982, coincident with the start of the gear standardization in the NMFS EBS shelf bottom trawl survey. In the 22.05 models, 124 parameters (1 for ln-scale mean abundance and 123 to account for ln-scale deviations to the mean by size/sex/maturity state/shell condition) were estimated to describe the population size composition at the start of 1982. The 22.06 models used an alternative logistic-scale parameterization. Both parameterizations were similar to those implemented in Gmacs. Initial parameter values were based on calculating equilibrium population numbers consistent with initial values for population processes and fishing mortality. The difference between the a, b, c and d variants for each model type was the degree of smoothing imposed on first-order differences between devs representing adjacent size bins, with the alphabetical indicator (a, b, c, d) indicating the applied smoothing factor (0, 0.1, 1.0, and 10).

This implementation eliminated 67 estimated parameters (33 recruitment parameters, 6 survey catchability and selectivity parameters, 2 natural mortality parameters, and 26 fishing mortality parameters) in model 21.22a but added 124 in the 22.05 models and 125 (and a sum-to-zero constraint) in the 22.06 models.

Results and comparisons

No Corner Stations (see also Appendix A)

Results from this scenario are discussed in detail in Appendix A and briefly summarized here. Annual estimates of recruitment with corner stations dropped were almost identical to those from the 2021 assessment (Appendix A: Figure 16). Estimated trends in population biomass and abundance were also similar (Appendix A: Figures 17-18), although the overall levels for mature males and females were slightly higher when the corner stations were not included. Estimates of most population processes (i.e., growth, molt to maturity), fishery characteristics (fishing mortality rates, fleet selectivities and retention functions), and survey characteristics (cathchability and selectivity) were essentially identical between the two scenarios. The difference in trend levels was traced back to slightly lower estimates of natural mortality (*M*) on mature crab without corner stations (Appendix A: Figure 19). As a result, management quantities such as average recruitment, F_{MSY} , and F_{OFL} were essentially unchanged when corner stations were dropped while OFL and biomass-related quantities were slightly larger (Appendix A: Figures 20 and 21).

Potential 2022 assessment candidates

Table 1 provides an initial evaluation of the models considered as potential candidates for the 2022 assessment in the fall. Unfortunately, models 22.04a and 22.04b that described directed fishing using two area-specific fleets in the post-rationalization period to better reflect actual fishing and management practices exhibited problematic behavior for model convergence and are not considered further here. It is suspected that something in the model parameterization or likelihoods introduced considerable correlation among some of the parameters, leading to difficulties in getting the models to converge (none of the 800 jittered initial parameter runs between the two models converged). One potential "culprit" may be is the manner in which dome-shaped selectivity is parameterized for the western fleet. The model estimates the size at full selection, but the resulting estimate is not guaranteed to fall on a bin location—with the result that estimates of fully-selected size and fully-selected catchability are confounded. However, the underlying cause has not been satisfactorily identified yet.

Models 22.05a and 22.06a, both of which were initialized starting in 1982 and included no smoothing on the initial parameters, exhibited poor performance in terms of parameters estimated at bounds (Tables 1, 8). Given that similar models with a small degree of smoothing (22.05b, 22.06b) exhibited better performance (although both still ended with two parameters at bounds), it seems that these could also be eliminated from further consideration.

The remaining models were considered to be "successful" in that they passed the first hurdles for further consideration: 1) apparent convergence, 2) at most a small number of parameters estimated at a bound, and 3) parameter uncertainty estimates obtained by inverting the converged model's hessian matrix. Data-related components of the objective function for converged models are compared in Tables 9-14, but many of these are not directly comparable due to changes in weighting factors or the data used. Values of non-data-related components in the objective function are summarized in Table 15, with differences relative to 21.22a summarized in Table 16. Model 22.02 appears to fit almost all the data components more poorly than 21.22a for all the components that can be compared (those related to survey size comps can't be, since the sample sizes used are different).

Parameter estimates and associated standard errors are reported in Tables 17-31. One result that stands out is the observation that the estimates for the width of selectivity for males in the NMFS survey increases to its upper bound as smoothing weights are increased across models 22.05b-d and 22.06b-d (Table 29).

Estimated values for M and survey Q's are shown in Tables 32 and 33. Estimates of "typical" M's (i.e., outside the 1980-1984 time block) are remarkably similar across all the models, as is the case for estimates of survey Q's in the 1982+ time frame (the exception is the estimate from 22.02 for females, which is about 30% smaller than the other estimates).

Management quantities from these "successful" models are compared in Table 7 and Figures 1-2. As noted in more detail below, results for Model 22.01 (which incorporates the revised estimates of Tanner crab bycatch in the groundfish fisheries) were essentially identical to those from 21.22a. For the other models, 22.02 exhibited the highest values in each management category, while 22.03 exhibited the lowest in the biomass-based categories, 21.22a exhibited the lowest in the *F*-based categories, and 22.06c exhibited the lowest average recruitment. It may be worthwhile noting the trends in management quantity values with the degree of smoothing imposed on the estimates of initial population size composition in the 22.05 and 22.06 models: F-related quantities decrease with increasing smoothing, while average recruitment and biomass-related quantities increase.

Estimated values for population processes (growth, molt to maturity, natural mortality) are compared across the models in Figure 3. Differences in molt increment and the size-specific probability of the molt to maturity are small. As noted above, estimates of "typical" M's (i.e., outside the 1980-1984 time period) are remarkably similar across all the models.

All the models exhibited substantially similar patterns in recruitment, with 22.02 (high) and 22.06d (low) bracketing the other estimates (Figures 4, 5). The similarity in estimates between the models that started in 1948 and those that started in 1982 is rather striking. This is true for other population trends as well, including mature biomass at the time of mating (Figures 6, 7) and biomass at the beginning of the crab year (July 1; Figures 8, 9). Although the population biomass estimates for models initialized in 1982 start out slightly below the models initialized in 1948, the trends converge for all the models (excluding 22.02) substantially converge within a few years (Figures 6, 8).

Estimated fully-selected catchability, retention curves, and selectivity curves in the directed fishery are shown in Figures 10-13. The models that start in 1948 all estimated a large spike in catchability around 1977, while all the models exhibited similar trends after 1982. Retention curves are similar for all models, as are selectivity curves in most years, although the annual estimates for males in 1995 exhibit variability not seen across models in other years in the size at 50% selected. Estimated fully-selected catchability and selectivity for bycatch in the snow crab fishery are shown in Figures 14-16. The selectivity curves for males are consistent across models, while most are consistent for females as well, the exception being 20.03 in the pre-1997 and post-2004 periods. The differences in female selectivity in 20.03 were reflected by opposing changes in the mean level of catchability for females relative to the other models during these time periods. Estimated fully-selected catchability and selectivity for bycatch in the BBRKC fishery are shown in Figures 17-19. Estimated catchability for males was very consistent across all models, as were the selectivity curves. Conversely, size-at-50% selected varied substantially for females across models in the 1997-2004 and 2005-2021 time blocks varied to a fair degree. Similar figures for catchability and selectivity in the groundfish fisheries are shown in Figures 20-22. The selectivity curves estimated for male bycatch in the 1987-1996 time frame exhibit substantial variability in size-at-50% selectivity across the models.

Survey capture probability, incorporating survey selectivity and fully-selected catchability in the same plot, is compared across models in Figures 23 and 24 for females and males, respectively. Curves for Model 22.03 stand apart from curves for the other models as outliers, exhibiting selection curves that are almost independent of size.

Fits to survey biomass are shown in Figure 25, with fit diagnostics for the NMFS survey data shown in Figure 26. The models that start in 1982 (22.05's, 22.06's) do somewhat better at fitting the survey data in the early 1980s than those that start in 1948 (21.22a, 22.02, 22.03). However, all the models show residual patterns with a cyclic nature of over- and under-prediction. Based on the MAD, MARE, and RMSE summary statistics, the 22.05's and 22.06's perform somewhat better than the other models, and Model 22.03 appears to have the worst performance of all.

Fits to retained catch biomass in the directed fishery, as well as diagnostics, are show in Figure 27. The z-scores suggest very similar performance in fitting the data for all the models, but the diagnostics suggest the 22.05's and 22.06's perform much better. This is partly because these models do not include the foreign fleet data in the early part of the time series, but the statistics have been calculated over the full time interval for each model.

Fits to total catch biomass in the directed fishery are shown in Figure 28. Most of the models fit total catch biomass by sex, but Model 20.03 aggregates across sex before fitting to the aggregated data. Fits to the bycatch fleets are shown in Figures 29-31. For the directed fishery, the z-scores for fitting to male biomass and fitting to total biomass are almost identical. This is not the case when fitting to bycatch in the snow crab and BBRKC fisheries (Figures 29 and 30), although more so for the former than the latter. For the directed and BBRKC fisheries, the trends in male and female catch biomass are relatively similar (or the trends for females are simply less than the perceived level of uncertainty reflected by the confidence intervals) while the trends in the snow crab fishery are not, resulting in the models selecting parameter values that "split the difference"—note that the sex-specific z-scores are equal and opposite for bycatch in the snow crab fishery and the MAD, MARE, and RMSE diagnostics all suggest the fit to the aggregated data is much better than those to the sex-specific data. The comparison of fits to bycatch in the groundfish fisheries is much simpler than for the other fisheries considered here because the fits in all the models are to aggregated catch data (Figure 31). In this case, the MARE diagnostic is a bit deceiving because the 20.05's and 20.06's models do not include the time period of high bycatch in the mid-1970s.

Time-averaged observed and predicted size comps are compared across all models considered successful in Figures 32-38 for the NMFS EBS shelf survey (Figures 32, 33), retained catch in the directed fishery (Figure 34), and total catch in the directed fishery, the snow crab fishery, the BBRKC fishery, and the groundfish fisheries (Figures 35-38). All appear to be fairly similar, except for those for total catch size comps from Model 20.03 in the directed, snow crab, and BBRKC fisheries, but this is due to a programming problem (to be corrected in the future) in the software used to make the plots.

Summary

Of the models that passed the first gauntlet of convergence checks, the model which incorporated the bootstrapped sample sizes (20.02) seems to be the most divergent of the ones considered here. This model fits survey biomass time series somewhat more poorly than the other models, but the improvement in fits to the survey size comps are slight, at best. The default input sample sizes appear to perform adequately well. The other models do not really appear to exhibit any remarkable strengths or weaknesses to recommend or prohibit them. Fitting sex-aggregated time series for catches (20.03) appears to be a modest improvement to fitting sex-specific data, at least when using lognormal likelihoods. It does, however, require one to fit size comp data normalized to 1 over both sexes simultaneously (rather than normalizing over each sex separately) or have some other information on sex ratio. Initializing the model in 1982 (or at some other time in the more recent past) has the advantage that historical catch estimates of uncertain quality can be eliminated from consideration, but at the cost of increasing the number of estimated parameters, which may have an impact on overall model stability.

Proposed models for the September 2022 Assessment

Models with at least one of the following are suggested as alternatives to be included for the September assessment:

- fits to fishery catch biomass time series aggregated across sexes
- model initialization in 1982

The following models are thus proposed to be evaluated for the September 2022 assessment:

- 21.22a, with updated data for 2021/22
- 22.03: 21.22a + fits to fishery catch biomass time series aggregated across sexes
- 22.06b: model initialized in 1982, with logistic-scale parameterization and a relatively small smoothing penalty
- 22.07: a (new) combination of 22.03 and 22.06b

Finally, the author requests guidance on how best to judge model fits when the data that goes into the fit undergoes different levels of aggregation in different models prior to being fit, or when only subsets of the available data are fit. Should data/predictions be aggregated to the highest common level of aggregation prior to comparison in order to better compare "apples to apples"? A consideration is that this may obscure problems in models that fit more disaggregated data, but including these fits leads to a proliferation of analyses. The considerations regarding models using different time frames in the fitting process are of a similar nature.

References

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Tables

Figures

Tables

Table 1. Model configurations evaluated for this report. Model 22.04b had no model runs converge out of 400 runs started with jittered parameter values. Model 22.04a had one run out 400 started with initially-jittered values that appeared to converge and for which uncertainty estimates were obtained, but with five parameters at bounds it was not judged to be successful. It was not possible to invert the model hessian matrix to obtain parameter uncertainty estimates for Models 22.05a and 22.05b.

model configuration	parent	changes	number of parameters	jitter runs	number at bounds	objective function value	max gradient	invertible for std. devs?
21.22a	--	--	346	--	0	3014.12	5.92E-04	yes
No Corner Stations	21.22a	survey biomass time series and size compositions calculated using NMFS trawl survey hauls with the "corner" stations removed for all years	346	--	0	3023.45	7.58E-05	yes
22.01	21.22a	using updated bycatch estimates for the groundfish fisheries used in place of old versions	346	--	0	3014.11	5.83E-04	yes
22.02	21.22a	using input sample sizes for survey size compositions based on effective sample sizes from bootstrapping in place of default value of 200	346	--	2	3785.04	3.82E-04	yes
22.03	21.22a	fits to fishery catch data changed from sex-specific to aggregated, corresponding fits to size composition data changed to extended versions	346	--	0	2982.62	2.06E-05	yes
22.04a	21.22a	using directed fishery data by ADFG management areas from 2005 on + changes to selectivity functions for directed fishery and snow crab fishery	350	400		no converged runs		
22.04b	21.22a	fishery biomass likelihoods change from lognormal to normal	350	400		no converged runs		
22.05a	21.22a	Starting model in 1982, estimating initial population size using individual parameters on log scale, no smoothing on parameters, all data prior to 1982 dropped	403	--	3	2701.50	1.79E-03	no
22.05b	22.05a	smoothing weight = 0.1	403	--	2	2727.16	3.62E-04	yes
22.05c	22.05a	smoothing weight = 1.0	403	--	2	2899.22	5.41E-04	yes
22.05d	22.05a	smoothing weight = 10.0	403	--	2	4128.05	3.55E-04	yes
22.06a	21.22a	Starting model in 1982, estimating initial population size using individual parameters on logistic scale, no smoothing on parameters, all data prior to 1982 dropped	404	--	7	2719.84	1.59E-04	no
22.06b	22.06a	smoothing weight = 0.1	404	400	2	2766.73	1.04E-03	yes
22.06c	22.06a	smoothing weight = 1.0	404	--	3	3004.20	1.24E-03	yes
22.06d	22.06a	smoothing weight = 10.0	404	--	2	4216.40	1.00E-03	yes

Table 2. Population-related processes included in the 2021 assessment model (21.22a).

process	time blocks	21.22a description
Population rates and quantities		
Population built from annual recruitment		
Recruitment	1949-1974	ln-scale mean + annual devs constrained as AR1 process
	1975+	ln-scale mean + annual devs
	1949+	sigma-R fixed
Growth	1949+	sex-specific
		mean post-molt size: power function of pre-molt size
		post-molt size: gamma distribution conditioned on pre-molt size
Maturity	1949+	sex-specific
		size-specific probability of terminal molt
		logit-scale parameterization
Natural mortalty	1949-1979,	estimated sex/maturity state-specific multipliers on base rate
	1985+	priors on multipliers based on uncertainty in max age
	1980-1984	estimated "enhanced mortality" period multipliers

Table 3. Surveys and survey-related processes included in the 2021 assessment model (21.22a).

process	time blocks	21.22a description
Surveys		
NMFS EBS trawl survey		
male survey q	1975-1981	ln-scale
	1982+	ln-scale w/ prior based on Somerton's underbag experiment
female survey q	1975-1981	ln-scale
	1982+	ln-scale w/ prior based on Somerton's underbag experiment
male selectivity	1975-1981	ascending logistic
	1982+	ascending logistic
female selectivity	1975-1981	ascending normal, estimated fully-selected size
	1982+	ascending normal, fixed asymptote
BSFRF SBS trawl surveys		
male catchability	2016-2017	fixed at 1 for all sizes
male availability	2016-2017	empirically-determined outside the model
female catchability	2016-2017	fixed at 1 for all sizes
female availability	2016-2017	empirically-determined outside the model

Table 4. Fisheries and fishery-related processes included in the 2021 assessment model (21.22a).

Fishery/process	time blocks	21.22a description
TCF	directed Tanner crab fishery	
capture rates	pre-1965	male nominal rate
	1965+	male ln-scale mean + annual devs
	1949+	ln-scale female offset
male selectivity	1949-1990	ascending logistic
	1991-1996	annually-varying ascending logistic
	2005+	annually-varying ascending logistic
female selectivity	1949+	ascending logistic
male retention	1949-1990, 1991-1996, 2005-2009, 2013-2015, 2017, 2018	ascending logistic
% retained	pre-1988	fixed at 100%
	1991-1996	fixed at 100%
	2005-2009	fixed at 100%
	2013+	fixed at 100%
SCF	bycatch in snow crab fishery	
capture rates	pre-1978	nominal rate on males
	1979-1991	extrapolated from effort
	1992+	male ln-scale mean + annual devs
	1949+	ln-scale female offset
male selectivity	1949-1996	dome-shaped (double normal)
	1997-2004	dome-shaped (double normal)
	2005+	dome-shaped (double normal)
female selectivity	1949-1996	ascending logistic
	1997-2004	ascending logistic
	2005+	ascending logistic
RKF	bycatch in BBRKC fishery	
capture rates	pre-1952	nominal rate on males
	1953-1991	extrapolated from effort
	1992+	male ln-scale mean + annual devs
	1949+	ln-scale female offset
male selectivity	1949-1996	ascending normal, asymptote fixed
	1997-2004	ascending normal, asymptote fixed
	2005+	ascending normal, asymptote fixed
female selectivity	1949-1996	ascending normal
	1997-2004	ascending normal
	2005+	ascending normal
GTF	bycatch in groundfish fisheries	
capture rates	pre-1973	male ln-scale mean from 1973+
	1973+	male ln-scale mean + annual devs
	1973+	ln-scale female offset
male selectivity	1949-1986	ascending logistic
	1987-1996	ascending logistic
	1997+	ascending logistic
female selectivity	1949-1986	ascending logistic
	1987-1996	ascending logistic
	1997+	ascending logistic

Table 5. Likelihood components in the 2021 assessment model (21.22a).

Model	Component	Type	included in optimization	Likelihood	21.22a distribution
221.22a	TCF: retained catch	biomass	yes	males only	lognormal
		size comp.s	yes	males only	multinomial
	TCF: total catch	biomass	yes	by sex	lognormal
		size comp.s	yes	by sex	multinomial
	SCF: total catch	biomass	yes	by sex	lognormal
		size comp.s	yes	by sex	multinomial
	RKF: total catch	biomass	yes	by sex	lognormal
		size comp.s	yes	by sex	multinomial
	GF All: total catch	abundance	yes	by sex	lognormal
		biomass	yes	by sex	lognormal
		size comp.s	yes	by sex	multinomial
	NMFS "M" survey (males only, no maturity)	biomass	yes	all males	lognormal
		size comp.s	yes	all males	multinomial
	NMFS "F" survey (females only, w/ maturity)	biomass	yes	by maturity classification	lognormal
		size comp.s	yes	by maturity classification	multinomial
	BSFRF "M" survey (males only, no maturity)	biomass	yes	all males	lognormal
		size comp.s	yes	all males	D-M
	BSFRF "F" survey (females only, w/ maturity)	biomass	yes	by maturity classification	lognormal
		size comp.s	yes	by maturity classification	D-M
	growth data	EBS only	yes	by sex	gamma
	male maturity ogive data	EBS only	yes	males only	binomial

Table 6. Data coverage in the assessment model (color shading highlights different model time periods and data components, x's denote new data in 2021).

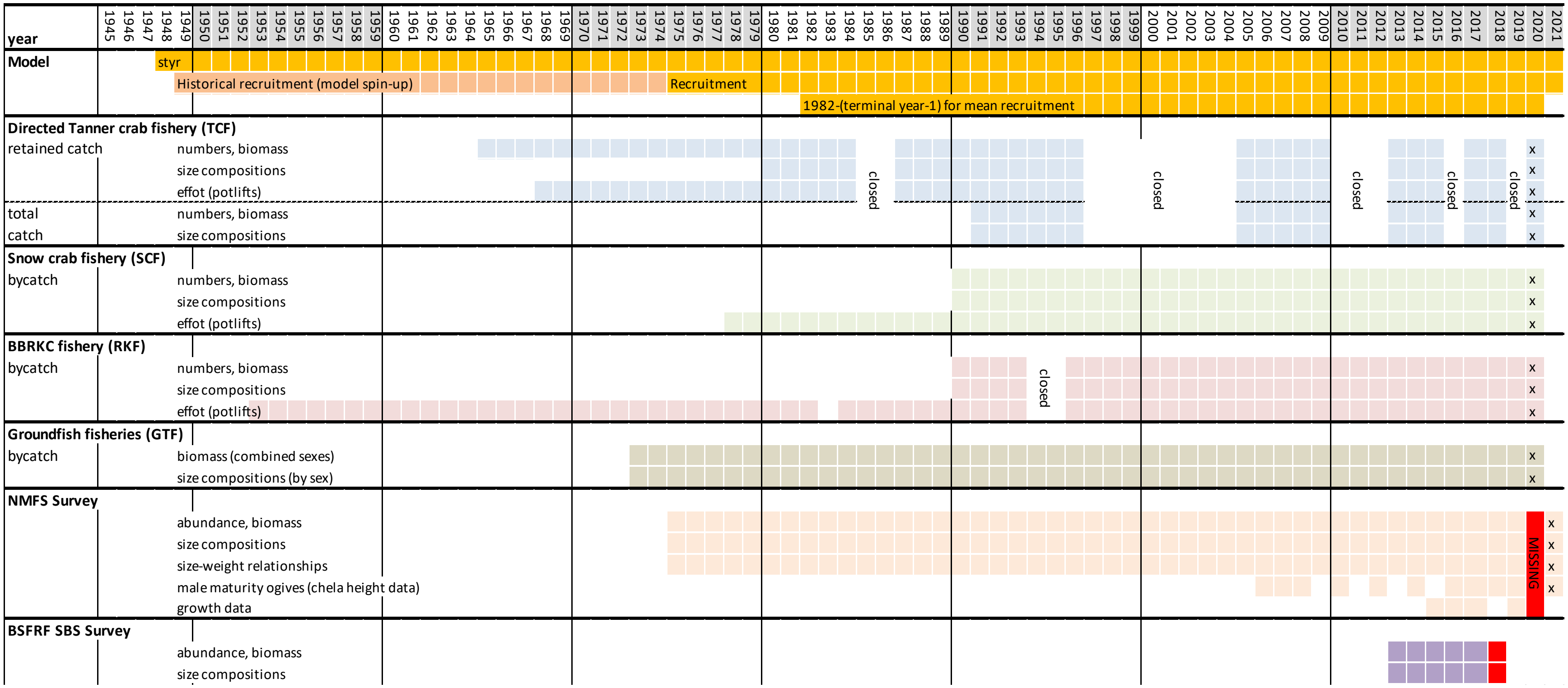

Table 7. Comparison of management-related results from the models that were considered successful.

case	objective function value	max. gradient	avg. recruitment	B100	Bmsy	current MMB	Fmsy	MSY	Fofl	OFL	projected MMB
21.22a	3014.12	5.92E-04	396.90	103.63	36.27	82.27	1.19	16.84	1.19	27.20	42.78
22.01	3014.11	5.83E-04	396.99	103.64	36.27	82.25	1.19	16.84	1.19	27.19	42.76
22.02	3785.04	3.82E-04	463.21	116.39	40.74	94.44	1.30	19.53	1.30	31.97	47.95
22.03	2982.62	2.40E-05	391.11	101.70	35.59	80.44	1.20	16.57	1.20	26.57	41.76
22.05b	2727.16	3.62E-04	419.09	106.06	37.12	80.98	1.30	17.19	1.30	26.98	41.98
22.05c	2899.22	5.40E-04	395.19	106.98	37.44	82.74	1.26	17.07	1.26	27.43	43.22
22.05d	4128.05	3.55E-04	355.90	107.33	37.57	86.25	1.20	16.72	1.20	28.46	45.48
22.06b	2766.73	1.04E-03	390.14	107.60	37.66	83.65	1.23	17.16	1.23	27.67	43.72
22.06c	3004.20	1.24E-03	365.61	108.34	37.92	85.79	1.22	16.98	1.22	28.37	45.08
22.06d	4216.40	1.00E-03	347.91	104.42	36.55	85.94	1.21	16.66	1.21	28.62	44.73

Table 8. Summary table for parameters estimated at upper or lower bounds. The sign indicates whether a parameter is at its upper (positive) or lower (negative) bound. For a parameter vector, the value indicates the number of elements at a bound in the vector.

category	name	21.22a	22.01	22.02	22.03	22.04a	22.05a	22.05b	22.05c	22.05d	22.06a	22.06b	22.06c	22.06d	description
Initial numbers at size	pLnBaseInitN[1]	--	--	--	--	--	-1	--	--	--	--	--	--	--	base class initial N at Z
	pvLnInitNatZ	--	--	--	--	--	--	--	--	--	-3	--	--	--	males immature new shell
		--	--	--	--	--	--	--	--	--	-1	--	--	--	males mature new shell
		--	--	--	--	--	--	--	--	--	-1	--	--	--	males mature old shell
selectivity	pS1[10]	--	--	--	--	1	--	--	--	--	--	--	--	--	ascending z-at-1 for SCF selectivity (females, 2005+)
	pS1[15]	--	--	--	--	--	--	--	--	--	--	--	1	--	z50 for GF.AllGear selectivity (males, 1987-1996)
	pS2[1]	--	--	--	--	--	--	--	--	1	--	--	1	1	width for NMFS survey selectivity (males, 1982+)
	pS2[23]	--	--	--	--	-1	--	--	--	--	--	--	--	--	width for TCF allEBS retention (males, pre-1997)
	pS2[3]	--	--	--	--	--	1	1	1	1	1	1	1	1	slope for TCF retention (pre-1991)
	pS2[4]	--	--	--	--	--	1	1	1	--	1	1	--	--	slope for TCF retention (1997+)
		--	--	1	--	--	--	--	--	--	--	--	--	--	width for NMFS survey selectivity (females, 1982+)
	pS2[6]	--	--	1	--	--	--	--	--	--	--	--	--	--	slope for TCF retention (1997+)
	pS4[5]	--	--	--	--	1	--	--	--	--	--	--	--	--	descending width for SCF selectivity (females, 1997-2004)
	pS4[6]	--	--	--	--	-1	--	--	--	--	--	--	--	--	descending width for SCF selectivity (females, 2005+)
	pS4[8]	--	--	--	--	-1	--	--	--	--	--	--	--	--	descending width for TCF West166 selectivity (females, 2005+)

Table 9. Comparison of survey-related constituents of the objective function among the models considered successful.

objective function value (total)			case									
fleet	catch.type	data.type	21.22a	'22.01	'22.02	'22.03	22.05b	22.05c	22.05d	22.06b	22.06c	22.06d
⊟ NMFS F	⊟ index catch	biomass	164.7	164.7	183.8	161.9	126.4	123.9	121.2	125.7	118.9	117.9
		n.at.z	293.2	293.2	625.1	294.5	238.9	242.0	284.0	242.5	268.8	322.3
⊟ NMFS M	⊟ index catch	biomass	61.4	61.3	96.6	59.7	60.1	64.1	85.9	61.6	71.8	73.4
		n.at.z	405.9	405.8	719.3	407.4	290.2	293.5	324.7	283.9	303.9	364.9
⊟ SBS BSFRF females	⊟ index catch	biomass	-1.9	-1.9	7.7	-2.3	-1.6	-2.7	-4.4	-3.1	-4.2	-4.4
		n.at.z	231.5	231.5	233.9	231.6	229.8	231.3	234.5	231.9	234.6	235.7
⊟ SBS BSFRF males	⊟ index catch	biomass	-1.1	-1.1	0.4	-1.3	-1.6	-1.5	-1.5	-1.4	-1.4	-1.6
		n.at.z	290.3	290.3	289.9	290.9	286.5	287.7	290.3	288.4	290.3	291.5

Table 10. Comparison of differences relative to the base model, 21.22a, for survey-related constituents of the objective function for the models considered successful.

objective function value (total)			Change from base model (21.22a): positive values indicate better fit								
fleet	catch.type	data.type	'22.01	'22.02	'22.03	22.05b	22.05c	22.05d	22.06b	22.06c	22.06d
NMFS F	index catch	biomass	0.0	-19.1	2.8	38.3	40.8	43.5	39.0	45.8	46.8
		n.at.z	0.0	-332.0	-1.3	54.3	51.1	9.1	50.7	24.4	-29.2
NMFS M	index catch	biomass	0.0	-35.2	1.7	1.3	-2.7	-24.6	-0.3	-10.5	-12.0
		n.at.z	0.0	-313.5	-1.5	115.6	112.4	81.1	121.9	101.9	40.9
SBS BSFRF females	index catch	biomass	0.0	-9.6	0.4	-0.3	0.8	2.5	1.2	2.3	2.4
		n.at.z	0.0	-2.5	-0.1	1.7	0.1	-3.0	-0.5	-3.1	-4.3
SBS BSFRF males	index catch	biomass	0.0	-1.5	0.2	0.5	0.4	0.4	0.2	0.3	0.5
		n.at.z	0.0	0.4	-0.6	3.9	2.7	0.0	2.0	0.0	-1.2

Table 11. Comparison of fishery-related constituents of the objective function among the models considered successful.

objective function value (total)				case									
fleet	**catch.type**	**data.type**	**sex**	**21.22a**	**'22.01**	**'22.02**	**'22.03**	**22.05b**	**22.05c**	**22.05d**	**22.06b**	**22.06c**	**22.06d**
GF All	**total catch**	abundance	all sexes	-36.2	-36.2	-35.9	-36.2	-36.9	-36.9	-36.3	-36.6	-37.6	-36.8
		biomass	all sexes	-67.5	-67.5	-67.0	-67.6	-53.7	-53.7	-53.2	-53.4	-54.2	-53.7
		n.at.z	female	222.8	222.6	236.4	222.3	202.5	205.2	222.9	205.8	212.8	228.0
			male	287.4	287.6	305.3	285.9	247.4	246.0	264.8	255.7	257.2	293.7
RKF	**total catch**	abundance	all sexes				0.0						
			female	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
			male	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
		biomass	all sexes				-37.5						
			female	17.2	17.2	17.5		17.2	17.4	17.2	17.3	17.5	17.2
			male	-40.2	-40.2	-39.9		-39.7	-39.6	-39.9	-39.6	-39.6	-39.9
		n.at.z	female	2.2	2.2	2.2	6.9	2.3	2.5	2.7	2.4	2.6	2.8
			male	33.9	33.9	34.3	31.5	35.2	34.9	34.4	34.9	34.6	34.0
SCF	**total catch**	abundance	all sexes				0.0						
			female	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
			male	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
		biomass	all sexes				-50.7						
			female	11.0	11.0	10.9		10.7	10.6	10.3	10.7	10.7	10.5
			male	-21.5	-21.5	-20.8		-21.1	-21.1	-21.2	-21.1	-21.1	-21.1
		n.at.z	female	17.5	17.5	17.1	52.1	16.9	16.9	16.6	16.8	16.6	16.6
			male	86.1	86.1	85.3	78.8	86.2	86.1	85.5	86.8	86.6	85.9
TCF	**retained catch**	abundance	female	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			male	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		biomass	female	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			male	-137.4	-137.4	-136.3	-138.4	-95.4	-95.6	-96.0	-95.6	-95.8	-96.0
		n.at.z	male	54.9	54.9	57.7	55.4	41.1	50.3	74.9	42.5	53.2	86.3
	total catch	abundance	all sexes				0.0						
			female	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
			male	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
		biomass	all sexes				8.6						
			female	66.9	66.9	60.4		64.7	64.7	63.7	64.7	64.5	64.0
			male	9.1	9.1	10.6		10.5	10.5	11.1	10.5	10.8	10.8
		n.at.z	female	12.7	12.7	12.1	87.4	12.5	12.4	12.2	12.4	12.2	12.2
			male	76.8	76.8	69.7	67.6	69.5	69.5	67.7	70.9	69.4	68.1

Table 12. Comparison of differences relative to the base model, 21.22a, for fishery-related constituents of the objective function for the models considered successful.

objective function value (total)				Change from base model (21.22a): positive values indicate better fit										
fleet	**catch.type**	**data.type**	**sex**	**'22.01**	**'22.02**	**'22.03**	**22.05b**	**22.05c**	**22.05d**	**22.06b**	**22.06c**	**22.06d**	**0.000**	**0.000**
GF All	**total catch**	abundance	all sexes	0.0	-0.3	0.1	0.7	0.7	0.1	0.4	1.5	0.6	-36.2	-36.2
		biomass	all sexes	0.0	-0.6	0.0	-13.8	-13.9	-14.4	-14.1	-13.3	-13.9	-67.5	-67.5
		n.at.z	female	0.2	-13.6	0.5	20.3	17.6	0.0	17.1	10.0	-5.2	222.8	222.8
			male	-0.2	-17.9	1.5	40.0	41.4	22.6	31.7	30.2	-6.3	287.4	287.4
RKF	**total catch**	abundance	all sexes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			female	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			male	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		biomass	all sexes	0.0	0.0	37.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			female	0.0	-0.3	17.2	0.0	-0.1	0.0	-0.1	-0.3	0.0	17.2	17.2
			male	0.0	-0.3	-40.2	-0.5	-0.5	-0.2	-0.6	-0.6	-0.3	-40.2	-40.2
		n.at.z	female	0.0	0.1	-4.7	-0.1	-0.2	-0.4	-0.1	-0.4	-0.5	2.2	2.2
			male	0.0	-0.5	2.4	-1.4	-1.1	-0.5	-1.0	-0.8	-0.1	33.9	33.9
SCF	**total catch**	abundance	all sexes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			female	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			male	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		biomass	all sexes	0.0	0.0	50.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			female	0.0	0.1	11.0	0.3	0.4	0.7	0.3	0.3	0.5	11.0	11.0
			male	0.0	-0.7	-21.5	-0.4	-0.4	-0.2	-0.4	-0.4	-0.4	-21.5	-21.5
		n.at.z	female	0.0	0.4	-34.6	0.6	0.6	0.9	0.7	0.9	0.9	17.5	17.5
			male	0.0	0.8	7.4	-0.1	0.0	0.7	-0.7	-0.5	0.3	86.1	86.1
TCF	**retained catch**	abundance	female	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			male	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		biomass	female	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			male	0.0	-1.1	1.0	-42.0	-41.8	-41.4	-41.7	-41.5	-41.3	-137.4	-137.4
		n.at.z	male	0.0	-2.8	-0.5	13.8	4.6	-20.0	12.4	1.7	-31.4	54.9	54.9
	total catch	abundance	all sexes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			female	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			male	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		biomass	all sexes	0.0	0.0	-8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			female	0.0	6.5	66.9	2.2	2.2	3.2	2.2	2.4	2.9	66.9	66.9
			male	0.0	-1.5	9.1	-1.4	-1.5	-2.0	-1.4	-1.7	-1.8	9.1	9.1
		n.at.z	female	0.0	0.5	-74.7	0.1	0.3	0.5	0.2	0.4	0.5	12.7	12.7
			male	0.0	7.1	9.1	7.2	7.3	9.0	5.9	7.4	8.7	76.8	76.8

Table 13. Comparison of other data-related constituents of the objective function among the models considered successful.

objective function value (total)		case									
data.type	**sex**	**21.22a**	**'22.01**	**'22.02**	**'22.03**	**22.05b**	**22.05c**	**22.05d**	**22.06b**	**22.06c**	**22.06d**
EBS_mature_male_ratios	male	206.5	206.5	209.3	206.2	203.3	203.9	204.8	204.0	203.4	203.4
EBS_molt_increment_data	female	246.9	246.9	250.1	247.5	242.9	247.2	259.2	248.1	253.3	271.5
	male	282.5	282.4	273.5	282.8	277.0	278.3	282.9	281.4	282.0	287.0

Table 14. Comparison of differences relative to the base model, 21.22a, for other data-related constituents of the objective function for the models considered successful.

objective function value (total)		Change from base model (21.22a): positive values indicate better fit								
data.type	**sex**	**'22.01**	**'22.02**	**'22.03**	**22.05b**	**22.05c**	**22.05d**	**22.06b**	**22.06c**	**22.06d**
EBS_mature_male_ratios	male	0.0	-2.8	0.3	3.2	2.6	1.7	2.5	3.1	3.1
EBS_molt_increment_data	female	0.0	-3.1	-0.6	4.0	-0.2	-12.2	-1.1	-6.3	-24.5
	male	0.0	8.9	-0.3	5.5	4.2	-0.5	1.1	0.5	-4.5

Table 15. Comparison of non data-related constituents of the objective function among the models considered successful.

Values for non-data components to the objective function case												
category	**type**	**element**	**21.22a**	**22.01**	**22.02**	**22.03**	**22.05b**	**22.05c**	**22.05d**	**22.06b**	**22.06c**	**22.06d**
components	**recruitment**	recDevs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
penalties	**devsSumSq**	pDevsLnC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pDevsLnR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pDevsS1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	F-devs	fisheries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	growth	negativeGrowth	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	maturity	nondecreasing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		smoothness	1.9	1.9	2.0	2.0	2.0	2.1	2.0	2.0	1.9	1.8
	nonParSelFcns		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
priors	**fisheries**	pDC2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pDevsLnC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pLnC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	growth	pGrA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pGrB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pGrBeta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	initNs	pLnBaseInitN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pvLnInitNatZ	0.0	0.0	0.0	0.0	23.3	171.3	1231.8	38.9	202.3	1190.3
	maturity	pvLgtPrM2M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	natural mortality	pDM1	34.7	34.7	38.8	35.9	37.7	35.2	33.4	35.8	34.2	37.7
		pDM2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	recruitment	pDevsLnR	110.9	110.9	110.3	111.1	51.2	51.3	51.5	51.5	51.6	51.5
		pLnR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pRa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pRb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pRCV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pRX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	selectivity functior	pDevsS1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pS1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pS2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pS3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pS4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pvNPSel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	surveys	pQ	91.0	91.1	124.4	88.7	91.0	91.6	90.4	90.6	92.2	90.6

Table 16. Comparison of differences relative to the base model, 21.22a, for other data-related constituents of the objective function for the models considered successful.

Changes, compared with the base model 21.22a, in non-data components to the objective function: positive values indicate better fit											
category	**type**	**element**	**22.01**	**22.02**	**22.03**	**22.05b**	**22.05c**	**22.05d**	**22.06b**	**22.06c**	**22.06d**
components	**recruitment**	recDevs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
penalties	**devsSumSq**	pDevsLnC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pDevsLnR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pDevsS1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	F-devs	fisheries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	growth	negativeGrowth	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	maturity	nondecreasing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		smoothness	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0	-0.1
	nonParSelFcns		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
priors	**fisheries**	pDC2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pDevsLnC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pLnC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	growth	pGrA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pGrB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pGrBeta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	initNs	pLnBaseInitN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pvLnInitNatZ	0.0	0.0	0.0	23.3	171.3	1231.8	38.9	202.3	1190.3
	maturity	pvLgtPrM2M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	natural mortality	pDM1	0.0	4.1	1.3	3.0	0.5	-1.2	1.2	-0.5	3.0
		pDM2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	recruitment	pDevsLnR	0.0	-0.7	0.2	-59.8	-59.6	-59.5	-59.4	-59.3	-59.4
		pLnR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pRa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pRb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pRCV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pRX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	selectivity functions	pDevsS1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pS1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pS2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pS3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pS4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		pvNPSel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	surveys	pQ	0.0	33.4	-2.3	0.0	0.5	-0.6	-0.4	1.1	-0.4

Table 17. Parameter values for successful models. NA indicates the parameter was fixed, not estimated. "—" indicates the parameter was not included in the indicated model.

		21.22a		22.01		22.02		22.03		22.05b		22.05c		22.05d		22.06b		22.06c		22.06d		
process	name	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	label
recruitment	pLnR[1]	--	--	--	--	--	--	--	--	5.68	0.07	5.62	0.07	5.51	0.06	5.60	0.07	5.53	0.06	5.49	0.06	current recruitment period
		6.72	0.59	6.72	0.59	6.73	0.58	6.71	0.59	--	--	--	--	--	--	--	--	--	--	--	--	historical recruitment period
	pLnR[2]	5.76	0.07	5.76	0.07	5.91	0.06	5.75	0.07	--	--	--	--	--	--	--	--	--	--	--	--	current recruitment period
	pRa[1]	2.24	0.03	2.24	0.03	2.26	0.02	2.24	0.03	2.19	0.03	2.22	0.03	2.28	0.03	2.23	0.03	2.28	0.03	2.30	0.03	fixed value
	pRb[1]	1.39	0.08	1.39	0.08	1.42	0.06	1.39	0.08	1.29	0.08	1.34	0.08	1.47	0.07	1.38	0.07	1.46	0.07	1.50	0.07	fixed value
	pRCV[1]	-0.70	NA	-0.70	NA	-0.70	NA	-0.70	NA	-0.69	NA	-0.69	NA	-0.69	NA	-0.69	NA	-0.69	NA	-0.69	NA	full model period
	pRX[1]	0.00	NA	0.00	NA	0.00	NA	0.00	NA	0.00	NA	0.00	NA	0.00	NA	0.00	NA	0.00	NA	0.00	NA	full model period
natural mortality	pDM1[1]	1.02	0.05	1.02	0.05	0.99	0.04	1.02	0.05	1.02	0.05	1.00	0.05	0.98	0.04	1.00	0.05	0.97	0.04	0.98	0.04	multiplier for immature crab
	pDM1[2]	1.30	0.04	1.30	0.04	1.35	0.04	1.31	0.04	1.30	0.04	1.28	0.04	1.24	0.04	1.27	0.04	1.25	0.04	1.27	0.04	multiplier for mature males
	pDM1[3]	1.34	0.04	1.34	0.04	1.32	0.04	1.34	0.04	1.36	0.04	1.36	0.04	1.38	0.04	1.37	0.04	1.37	0.04	1.38	0.04	multiplier for mature females
	pDM2[1]	2.35	0.25	2.35	0.25	1.86	0.20	2.38	0.25	--	--	--	--	--	--	--	--	--	--	--	--	1980-1984 multiplier for mature males
	pDM2[2]	1.96	0.17	1.96	0.17	1.68	0.15	1.93	0.17	--	--	--	--	--	--	--	--	--	--	--	--	1980-1984 multiplier for mature females
	pM[1]	-1.47	NA	-1.47	NA	-1.47	NA	-1.47	NA	-1.47	NA	-1.47	NA	-1.47	NA	-1.47	NA	-1.47	NA	-1.47	NA	base ln-scale M
growth	pGrA[1]	32.45	0.26	32.45	0.26	32.47	0.24	32.38	0.25	32.49	0.25	32.71	0.28	33.42	0.33	32.76	0.29	33.12	0.31	33.89	0.35	males
	pGrA[2]	33.63	0.31	33.63	0.31	33.97	0.30	33.67	0.31	33.54	0.31	33.71	0.33	34.27	0.40	33.69	0.34	33.98	0.36	34.96	0.45	females
	pGrB[1]	166.30	0.76	166.30	0.76	164.70	0.68	166.50	0.76	165.00	0.76	165.00	0.75	164.60	0.77	165.40	0.75	165.00	0.75	164.60	0.81	males
	pGrB[2]	115.00	0.61	115.00	0.61	115.20	0.54	115.00	0.62	114.90	0.61	114.80	0.64	114.40	0.71	114.90	0.64	114.40	0.67	113.60	0.78	females
	pGrBeta[1]	0.85	0.10	0.85	0.10	0.80	0.10	0.85	0.10	0.77	0.10	0.85	0.11	1.07	0.15	0.87	0.11	0.97	0.13	1.33	0.18	both sexes

Table 18. Parameter values for recruitment devs in the "historical" time period (prior to 1975) for successful models. Note that 22.05 and 22.06 models start in 1982. NA indicates the parameter was fixed, not estimated. "—" indicates the parameter was not included in the indicated model.

				21.22a		22.01		22.02		22.03		22.05b		22.05c		22.05d		22.06b		22.06c		22.06d	
			index	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.
recruitment	pDevsLnR	historical recruitment period	1	−0.49592	1.7780	−0.49596	1.7780	−0.535205	1.7685	−0.49063	1.7789	–	–	–	–	–	–	–	–	–	–	–	–
			2	−0.49509	1.6452	−0.49512	1.6452	−0.534254	1.6351	−0.48981	1.6461	–	–	–	–	–	–	–	–	–	–	–	–
			3	−0.49315	1.5158	−0.49319	1.5158	−0.532044	1.5053	−0.48791	1.5167	–	–	–	–	–	–	–	–	–	–	–	–
			4	−0.48977	1.3909	−0.48982	1.3908	−0.528173	1.3801	−0.48459	1.3917	–	–	–	–	–	–	–	–	–	–	–	–
			5	−0.48451	1.2718	−0.48455	1.2718	−0.522113	1.2611	−0.47940	1.2725	–	–	–	–	–	–	–	–	–	–	–	–
			6	−0.47676	1.1603	−0.47681	1.1603	−0.513174	1.1499	−0.47179	1.1609	–	–	–	–	–	–	–	–	–	–	–	–
			7	−0.46579	1.0587	−0.46584	1.0587	−0.500453	1.0490	−0.46099	1.0592	–	–	–	–	–	–	–	–	–	–	–	–
			8	−0.45060	0.9698	−0.45065	0.9698	−0.482779	0.9609	−0.44604	0.9701	–	–	–	–	–	–	–	–	–	–	–	–
			9	−0.42995	0.8969	−0.43001	0.8969	−0.458641	0.8890	−0.42571	0.8969	–	–	–	–	–	–	–	–	–	–	–	–
			10	−0.40226	0.8435	−0.40232	0.8435	−0.426120	0.8363	−0.39844	0.8433	–	–	–	–	–	–	–	–	–	–	–	–
			11	−0.36557	0.8126	−0.36562	0.8126	−0.382799	0.8055	−0.36231	0.8124	–	–	–	–	–	–	–	–	–	–	–	–
			12	−0.31730	0.8061	−0.31735	0.8061	−0.325436	0.7982	−0.31479	0.8059	–	–	–	–	–	–	–	–	–	–	–	–
			13	−0.25349	0.8232	−0.25352	0.8232	−0.248889	0.8137	−0.25193	0.8233	–	–	–	–	–	–	–	–	–	–	–	–
			14	−0.16755	0.8594	−0.16755	0.8593	−0.144445	0.8478	−0.16720	0.8598	–	–	–	–	–	–	–	–	–	–	–	–
			15	−0.04833	0.9041	−0.04829	0.9041	0.003127	0.8914	−0.04949	0.9047	–	–	–	–	–	–	–	–	–	–	–	–
			16	0.12444	0.9386	0.12455	0.9386	0.221803	0.9284	0.12163	0.9388	–	–	–	–	–	–	–	–	–	–	–	–
			17	0.39022	0.9368	0.39047	0.9368	0.558825	0.9377	0.38634	0.9364	–	–	–	–	–	–	–	–	–	–	–	–
			18	0.80303	0.8819	0.80345	0.8819	1.035939	0.9092	0.80009	0.8814	–	–	–	–	–	–	–	–	–	–	–	–
			19	1.35730	0.7867	1.35784	0.7867	1.529494	0.7749	1.35639	0.7852	–	–	–	–	–	–	–	–	–	–	–	–
			20	1.67168	0.6671	1.67184	0.6670	1.646109	0.6570	1.66451	0.6664	–	–	–	–	–	–	–	–	–	–	–	–
			21	1.21092	0.6788	1.21027	0.6788	1.089186	0.6869	1.19044	0.6799	–	–	–	–	–	–	–	–	–	–	–	–
			22	0.66147	0.6779	0.66082	0.6778	0.536578	0.6726	0.64441	0.6789	–	–	–	–	–	–	–	–	–	–	–	–
			23	0.36427	0.6566	0.36409	0.6566	0.364993	0.6462	0.36150	0.6570	–	–	–	–	–	–	–	–	–	–	–	–
			24	−0.09311	0.6611	−0.09323	0.6611	−0.009213	0.6471	−0.09212	0.6615	–	–	–	–	–	–	–	–	–	–	–	–
			25	−0.48210	0.6613	−0.48198	0.6613	−0.516085	0.6529	−0.47919	0.6617	–	–	–	–	–	–	–	–	–	–	–	–
			26	−0.17208	0.7021	−0.17154	0.7020	−0.326231	0.7006	−0.17299	0.7029	–	–	–	–	–	–	–	–	–	–	–	–

Table 19. Parameter values for recruitment devs in the “current” time period successful models. NA indicates the parameter was fixed, not estimated. “—” indicates the parameter was not included in the indicated model. For models starting in 1948, the “current” time period starts in 1975. For the other models, the “current” time period starts in 1982.

				21.22a		22.01		22.02		22.03		22.05b		22.05c		22.05d		22.06b		22.06c		22.06d	
			index	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.
recruitment	pDevsLnR	current recruitment period	1	1.34374	0.31402	1.34379	0.31413	1.25527	0.25378	1.33796	0.31972	1.25978	0.11186	1.29088	0.10196	1.29348	0.09461	1.32931	0.10372	1.2838	0.09709	1.241262	0.09194
			2	1.95233	0.19762	1.95269	0.19764	1.54495	0.19949	1.95902	0.19863	1.01815	0.16247	0.92257	0.16866	0.67224	0.18670	0.89696	0.17469	0.7328	0.18594	0.594795	0.18694
			3	1.58569	0.22807	1.58601	0.22808	1.83537	0.15177	1.59046	0.22906	1.08026	0.16477	1.12714	0.15739	1.21192	0.14093	1.16237	0.15536	1.2250	0.14533	1.266764	0.13113
			4	0.65974	0.40538	0.65925	0.40563	0.80547	0.29140	0.64183	0.41310	1.11084	0.14777	1.08981	0.15196	1.05010	0.15762	1.08873	0.15554	1.1419	0.15254	1.068616	0.15546
			5	−0.17736	0.55445	−0.17664	0.55431	−0.66814	0.57333	−0.17101	0.55296	0.91866	0.15605	0.93053	0.15801	0.92340	0.16691	0.93219	0.16186	0.8583	0.17834	0.888174	0.17415
			6	−0.17714	0.40939	−0.17681	0.40940	−0.42067	0.35847	−0.17687	0.40970	0.38654	0.21437	0.48387	0.20568	0.72112	0.17887	0.51778	0.20399	0.7194	0.17897	0.862111	0.15949
			7	−0.01713	0.29742	−0.01673	0.29739	0.08939	0.18724	−0.02103	0.29767	−0.35115	0.26437	−0.34517	0.27040	−0.29833	0.27811	−0.34353	0.27675	−0.4072	0.29469	−0.269624	0.27603
			8	−0.15650	0.28750	−0.15634	0.28752	−0.45474	0.22792	−0.16627	0.28820	−0.73531	0.29134	−0.72865	0.29460	−0.71367	0.30292	−0.73470	0.30102	−0.6972	0.28842	−0.711574	0.30315
			9	1.08265	0.11734	1.08291	0.11734	1.21065	0.09158	1.07453	0.11721	−1.26187	0.33908	−1.20568	0.33169	−1.07332	0.31092	−1.18010	0.33089	−1.1017	0.31188	−0.986865	0.29081
			10	0.78270	0.17062	0.78291	0.17062	0.73379	0.14333	0.76513	0.17178	−1.18334	0.25965	−1.19328	0.26285	−1.20954	0.26713	−1.18900	0.26513	−1.1856	0.26421	−1.212352	0.26609
			11	0.94362	0.16442	0.94349	0.16444	0.83001	0.14170	0.93060	0.16536	−1.15270	0.25554	−1.18000	0.25881	−1.25744	0.26621	−1.20776	0.26538	−1.2328	0.26856	−1.285277	0.26396
			12	0.95506	0.15599	0.95512	0.15598	0.89114	0.13231	0.95996	0.15679	−0.98478	0.24008	−0.99300	0.23965	−1.01118	0.23410	−0.99770	0.24105	−0.9841	0.23598	−1.030374	0.22757
			13	0.78670	0.16605	0.78662	0.16605	0.73440	0.13335	0.80201	0.16864	−0.48957	0.17785	−0.50995	0.17906	−0.56811	0.17987	−0.51899	0.18042	−0.5419	0.17908	−0.619166	0.17835
			14	0.34809	0.21201	0.34750	0.21206	0.23069	0.16938	0.42575	0.20652	−0.70428	0.22846	−0.71705	0.22879	−0.74602	0.22621	−0.73056	0.23199	−0.8003	0.23619	−0.769448	0.22019
			15	−0.43508	0.27252	−0.43498	0.27245	−0.32283	0.18854	−0.35956	0.26206	0.18866	0.11858	0.19334	0.11733	0.19469	0.11396	0.19945	0.11720	0.2187	0.11355	0.179046	0.11119
			16	−0.89838	0.31276	−0.89865	0.31277	−0.99475	0.25868	−1.06773	0.35350	−0.78555	0.24160	−0.79536	0.23976	−0.81300	0.23307	−0.80717	0.24192	−0.8201	0.23852	−0.829159	0.22670
			17	−1.32027	0.33282	−1.32082	0.33286	−1.21598	0.23114	−1.35451	0.32653	0.74952	0.09971	0.73339	0.10039	0.68044	0.10140	0.72771	0.10073	0.7030	0.10127	0.629177	0.10119
			18	−1.29114	0.26296	−1.29125	0.26294	−1.00318	0.16028	−1.26803	0.25687	−0.37396	0.27608	−0.36182	0.27022	−0.33157	0.25309	−0.37090	0.27267	−0.3469	0.26189	−0.312193	0.23900
			19	−1.33088	0.26996	−1.33085	0.26994	−1.31335	0.19447	−1.32556	0.27072	1.11922	0.10176	1.11914	0.10083	1.10474	0.09911	1.12309	0.10093	1.1217	0.09976	1.078791	0.09795
			20	−1.11002	0.24409	−1.11003	0.24410	−1.12118	0.17613	−1.10311	0.24483	−0.06268	0.27913	−0.09297	0.28044	−0.12815	0.27513	−0.11547	0.28614	−0.1229	0.28168	−0.129771	0.26531
			21	−0.62715	0.18151	−0.62706	0.18151	−0.70322	0.14391	−0.62328	0.18198	1.21363	0.10658	1.21642	0.10657	1.19922	0.10863	1.21849	0.10750	1.2075	0.10916	1.174961	0.10988
			22	−0.85127	0.23729	−0.85132	0.23731	−0.89434	0.19045	−0.85201	0.23837	0.64535	0.15124	0.69582	0.14712	0.82501	0.13602	0.72027	0.14612	0.8040	0.13914	0.903456	0.12895
			23	0.07983	0.11839	0.07987	0.11840	0.07331	0.09656	0.08273	0.11850	−0.41844	0.26720	−0.41589	0.26922	−0.39881	0.27110	−0.42679	0.27546	−0.4177	0.27688	−0.384782	0.26946
			24	−0.93610	0.24755	−0.93607	0.24757	−0.90990	0.18700	−0.93567	0.24845	−0.92877	0.36882	−0.90385	0.36390	−0.83494	0.34902	−0.89727	0.36544	−0.8618	0.35778	−0.774835	0.33224
			25	0.61543	0.10031	0.61560	0.10031	0.64166	0.08565	0.62174	0.10028	−0.37022	0.26607	−0.38767	0.26385	−0.43314	0.25840	−0.38734	0.26342	−0.4061	0.25937	−0.473178	0.25618
			26	−0.51012	0.28166	−0.51022	0.28171	−0.51644	0.22345	−0.50958	0.28301	0.24879	0.26354	0.10182	0.26878	−0.18939	0.26982	0.03163	0.26996	−0.1274	0.27025	−0.313266	0.26594
			27	1.00971	0.10116	1.00982	0.10117	1.01465	0.08825	1.01316	0.10148	1.52380	0.09951	1.53747	0.09448	1.51088	0.09414	1.54513	0.09395	1.5296	0.09356	1.454649	0.09712
			28	−0.24117	0.29403	−0.24085	0.29402	−0.26761	0.26861	−0.22348	0.29342	0.48053	0.19555	0.56705	0.18999	0.81170	0.16357	0.60276	0.18886	0.7426	0.17267	0.954181	0.14573
			29	1.09959	0.10849	1.09973	0.10849	1.11311	0.09240	1.11186	0.10772	−0.21182	0.20385	−0.17191	0.20203	−0.07034	0.19919	−0.15268	0.20315	−0.1000	0.20165	−0.005579	0.19586
			30	0.60042	0.14973	0.60052	0.14973	0.81744	0.10694	0.56779	0.15245	−1.44010	0.37749	−1.45537	0.38310	−1.46977	0.39198	−1.46528	0.39014	−1.4817	0.39512	−1.464102	0.39062
			31	−0.57916	0.28467	−0.57896	0.28467	−0.47346	0.22473	−0.59640	0.28483	−0.52809	0.15712	−0.50651	0.15557	−0.46406	0.15256	−0.49517	0.15589	−0.4754	0.15436	−0.447746	0.15029
			32	−1.04070	0.36952	−1.04070	0.36957	−0.91638	0.27021	−1.03995	0.36765	−1.05524	0.22417	−1.03953	0.22216	−0.99667	0.21576	−1.02759	0.22298	−1.0012	0.21862	−0.980514	0.21015
			33	−0.48887	0.26209	−0.48838	0.26209	−0.31862	0.16885	−0.48821	0.26188	−0.78077	0.19673	−0.80896	0.19729	−0.86933	0.19827	−0.82622	0.19966	−0.8630	0.20034	−0.904053	0.19630
			34	−0.07782	0.27419	−0.07692	0.27419	−0.32290	0.18425	−0.08755	0.27474	−0.63533	0.21244	−0.67048	0.21154	−0.74222	0.20759	−0.68169	0.21169	−0.7249	0.20884	−0.791124	0.20424
			35	1.44627	0.09403	1.44682	0.09404	1.31199	0.07290	1.44575	0.09478	1.16628	0.08480	1.15640	0.08517	1.11811	0.08611	1.15152	0.08548	1.1275	0.08612	1.080626	0.08629
			36	0.43978	0.19955	0.44020	0.19952	0.54025	0.13943	0.47209	0.19652	0.31502	0.19761	0.33436	0.19478	0.39053	0.18638	0.34407	0.19497	0.3810	0.18965	0.420747	0.17964
			37	−0.28533	0.20591	−0.28502	0.20591	−0.35722	0.15879	−0.26981	0.20710	0.88984	0.14747	0.88976	0.14620	0.89432	0.14268	0.88977	0.14648	0.8919	0.14416	0.895760	0.14010
			38	−1.58460	0.39100	−1.58522	0.39109	−1.57537	0.29478	−1.57989	0.39277	−1.13715	0.63664	−1.16567	0.63411	−1.21268	0.62934	−1.18121	0.63397	−1.2239	0.63012	−1.205512	0.62703
			39	−0.62306	0.15758	−0.62350	0.15759	−0.50297	0.10896	−0.61834	0.15794	1.27624	0.17486	1.25902	0.17389	1.22979	0.17039	1.25590	0.17356	1.2352	0.17068	1.207378	0.16952
			40	−1.15008	0.22630	−1.15037	0.22629	−0.86028	0.13056	−1.14670	0.22666	–	–	–	–	–	–	–	–	–	–	–	–
			41	−0.95307	0.20307	−0.95352	0.20307	−0.93839	0.13233	−0.95375	0.20340	–	–	–	–	–	–	–	–	–	–	–	–
			42	−0.78508	0.21293	−0.78596	0.21296	−0.70224	0.14031	−0.78896	0.21335	–	–	–	–	–	–	–	–	–	–	–	–
			43	1.03531	0.08603	1.03484	0.08603	1.00531	0.07527	1.03607	0.08615	–	–	–	–	–	–	–	–	–	–	–	–
			44	0.23456	0.19838	0.23410	0.19840	0.35446	0.14703	0.23990	0.19858	–	–	–	–	–	–	–	–	–	–	–	–
			45	0.76742	0.14863	0.76690	0.14864	0.94726	0.11262	0.76889	0.14880	–	–	–	–	–	–	–	–	–	–	–	–
			46	−1.26293	0.62572	−1.26288	0.62571	−1.36110	0.61977	−1.26464	0.62592	–	–	–	–	–	–	–	–	–	–	–	–
			47	1.14171	0.17475	1.14141	0.17476	1.15470	0.17220	1.14468	0.17477	–	–	–	–	–	–	–	–	–	–	–	–

Table 20. Final parameter values related to the size-specific probability of undergoing the molt to maturity for successful models. The indices refer to indices to size bins. NA indicates the parameter was fixed, not estimated. "—" indicates the parameter was not included in the indicated model.

				21.22a		22.01		22.02		22.03		22.05b		22.05c		22.05d		22.06b		22.06c		22.06d	
		label	index	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.
maturity	pvLgtPrM2M	females 50-105 mmCW (entire model period)	1	−5.34142	1.21490	−5.34234	1.21510	−5.84764	1.11770	−5.35699	1.21730	−5.29778	1.34700	−5.34748	1.35650	−5.46916	1.40460	−5.32018	1.35980	−5.33513	1.37090	−5.54855	1.42400
			2	−4.10929	0.56933	−4.10976	0.56947	−4.51267	0.46856	−4.11350	0.57118	−4.21290	0.62013	−4.23475	0.62656	−4.30389	0.65205	−4.21579	0.62684	−4.21819	0.63354	−4.35917	0.66385
			3	−2.91568	0.25027	−2.91570	0.25028	−3.20538	0.20679	−2.90980	0.25021	−3.10495	0.27599	−3.10279	0.27590	−3.11875	0.27714	−3.08963	0.27558	−3.08099	0.27608	−3.15113	0.27870
			4	−1.71361	0.14724	−1.71333	0.14723	−1.86530	0.10236	−1.70416	0.14704	−1.87387	0.17415	−1.86329	0.17331	−1.84082	0.17203	−1.84939	0.17337	−1.83314	0.17352	−1.85888	0.17193
			5	−0.57842	0.09229	−0.57820	0.09229	−0.73460	0.06096	−0.57466	0.09256	−0.75421	0.10987	−0.74388	0.10990	−0.69989	0.11002	−0.72610	0.10977	−0.70049	0.10996	−0.70079	0.10990
			6	0.25956	0.09191	0.25952	0.09191	0.21984	0.06219	0.26129	0.09223	0.19844	0.10494	0.21455	0.10553	0.26711	0.10670	0.23642	0.10562	0.26977	0.10629	0.27224	0.10725
			7	0.57081	0.10367	0.57083	0.10368	0.61048	0.07415	0.57286	0.10419	0.63161	0.11856	0.64215	0.11919	0.69355	0.12167	0.66299	0.11977	0.68603	0.12075	0.68525	0.12291
			8	1.07017	0.13746	1.07031	0.13746	1.09176	0.10093	1.06539	0.13788	1.06585	0.15182	1.07426	0.15355	1.15832	0.16056	1.10076	0.15504	1.12695	0.15664	1.15324	0.16257
			9	1.95964	0.22847	1.95977	0.22847	2.12834	0.19733	1.96656	0.22964	2.01714	0.25114	2.06956	0.25914	2.19078	0.27466	2.08269	0.25921	2.11915	0.26506	2.15786	0.27986
			10	2.86654	0.42636	2.86694	0.42641	2.86438	0.36204	2.93288	0.45260	3.07761	0.51707	3.21044	0.54887	3.37080	0.59408	3.18937	0.54596	3.26105	0.56348	3.33761	0.59681
			11	3.80481	0.97449	3.80563	0.97450	3.56525	0.87726	3.95102	1.02230	4.18332	1.11580	4.39889	1.16720	4.58878	1.24310	4.33918	1.16420	4.44926	1.19020	4.56391	1.23680
		males 60-150 mmCW (entire model period)	1	−2.91297	0.21518	−2.91280	0.21515	−2.99959	0.19526	−2.91033	0.21501	−2.93815	0.22456	−2.96965	0.22738	−3.03214	0.23620	−2.98876	0.23014	−3.01457	0.23267	−3.02858	0.24357
			2	−3.45450	0.29159	−3.45463	0.29161	−3.53340	0.26862	−3.46424	0.29328	−3.54213	0.31163	−3.53783	0.31074	−3.51885	0.30748	−3.53297	0.31109	−3.51799	0.30885	−3.49014	0.30698
			3	−2.91186	0.23918	−2.91213	0.23920	−2.97989	0.21166	−2.91942	0.24140	−3.01856	0.26611	−3.00959	0.26476	−2.98315	0.26106	−3.00320	0.26485	−2.98727	0.26225	−2.95846	0.26165
			4	−2.15567	0.13337	−2.15571	0.13336	−2.15693	0.11437	−2.15076	0.13343	−2.17023	0.13957	−2.18246	0.14010	−2.21393	0.14248	−2.19705	0.14152	−2.19888	0.14143	−2.21396	0.14535
			5	−1.49020	0.11826	−1.49006	0.11825	−1.54908	0.09923	−1.48557	0.11868	−1.48224	0.12721	−1.49682	0.12825	−1.54376	0.13217	−1.51093	0.12974	−1.52073	0.13036	−1.55565	0.13642
			6	−1.29688	0.10527	−1.29686	0.10527	−1.30403	0.08733	−1.30353	0.10600	−1.28321	0.11209	−1.28531	0.11243	−1.28080	0.11272	−1.28237	0.11291	−1.27327	0.11256	−1.26014	0.11391
			7	−0.76915	0.09783	−0.76922	0.09782	−0.80802	0.08063	−0.77801	0.09859	−0.79366	0.10417	−0.78912	0.10532	−0.76857	0.10663	−0.77845	0.10581	−0.76553	0.10594	−0.74040	0.10841
			8	−0.33395	0.08828	−0.33411	0.08827	−0.35527	0.07343	−0.32314	0.08864	−0.29677	0.09326	−0.30035	0.09420	−0.31075	0.09623	−0.31184	0.09498	−0.30490	0.09560	−0.30130	0.09865
			9	−0.29102	0.08975	−0.29119	0.08974	−0.26974	0.07575	−0.28228	0.09017	−0.25869	0.09432	−0.26102	0.09517	−0.26083	0.09724	−0.27565	0.09583	−0.25809	0.09633	−0.24621	0.09985
			10	0.01495	0.08980	0.01489	0.08980	0.06225	0.07848	0.01833	0.09009	0.02511	0.09366	0.02453	0.09444	0.01892	0.09605	0.02675	0.09505	0.03079	0.09559	0.02007	0.09836
			11	0.43636	0.09508	0.43633	0.09508	0.47694	0.08635	0.43712	0.09545	0.45440	0.09804	0.45035	0.09911	0.43375	0.10115	0.44807	0.09961	0.45227	0.10068	0.43094	0.10355
			12	0.95404	0.12212	0.95367	0.12207	0.91085	0.10511	0.93688	0.12233	0.99920	0.12188	1.01140	0.12508	1.05794	0.13318	1.05322	0.12918	1.04913	0.12982	1.10350	0.13972
			13	1.69878	0.15390	1.69846	0.15386	1.64110	0.14232	1.68818	0.15484	1.68950	0.15167	1.70128	0.15298	1.74276	0.15681	1.74360	0.15612	1.73579	0.15553	1.78478	0.16172
			14	2.72566	0.26754	2.72555	0.26753	2.61050	0.25433	2.70997	0.26905	2.66747	0.26891	2.72503	0.27420	2.77536	0.28118	2.72600	0.27292	2.73816	0.27618	2.75514	0.28175
			15	3.09124	0.28259	3.09126	0.28259	3.04122	0.27232	3.06662	0.28833	3.06028	0.28447	3.11380	0.28698	3.16869	0.28719	3.11151	0.28683	3.12805	0.28609	3.15476	0.28427
			16	3.68702	0.48607	3.68682	0.48602	3.69094	0.48639	3.58773	0.47083	3.67467	0.48558	3.72284	0.48775	3.83509	0.49865	3.70872	0.48668	3.76562	0.49275	3.87720	0.50749
			17	4.85579	1.04720	4.85534	1.04720	4.86317	1.06410	4.67463	1.03400	4.82200	1.06350	4.88049	1.05870	5.05113	1.06770	4.85129	1.05990	4.94627	1.06570	5.12815	1.08570

Table 21. Final parameter values related to fisheries, surveys, and size composition likelihoods for successful models. NA indicates the parameter was fixed, not estimated. "—" indicates the parameter was not included in the indicated model.

			21.22a		22.01		22.02		22.03		22.05b		22.05c		22.05d		22.06b		22.06c		22.06d	
process	name	label	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.
fisheries	pDC2[1]	TCF: female offset	− 2.5050	0.20801	− 2.5051	0.20805	− 2.6789	0.20224	− 2.6755	0.21049	− 2.574	0.22874	− 2.5354	0.22279	− 2.4434	0.21543	− 2.4884	0.22523	− 2.4365	0.21857	− 2.5051	0.20811
	pDC2[2]	SCF: female offset	− 2.0173	0.28214	− 2.0173	0.28216	− 2.1105	0.27342	− 2.6405	0.33054	− 2.000	0.28073	− 1.9703	0.27738	− 1.8980	0.27331	− 1.9383	0.27937	− 1.9014	0.27692	− 1.9627	0.27000
	pDC2[3]	GTF: female offset	− 0.9898	0.09264	− 0.9900	0.09267	− 1.0050	0.08672	− 1.0138	0.09273	− 1.339	0.12137	− 1.2223	0.11883	− 0.8669	0.09976	− 1.1063	0.11274	− 0.8957	0.11525	− 0.9965	0.09162
	pDC2[4]	RKF: female offset	− 2.4803	0.63574	− 2.4804	0.63579	− 2.6104	0.63307	− 2.4392	0.84151	− 2.801	0.57728	− 2.9340	0.51835	− 2.9912	0.47588	− 2.7969	0.55049	− 2.9502	0.48528	− 3.1652	0.45952
	pHM[1]	handling mortality for pot fisheries	0.3210	NA	0.3210	NA	0.3210	NA	0.3210	NA	0.321	NA	0.3210	NA	0.3210	NA	0.3210	NA	0.3210	NA	0.3210	NA
	pHM[2]	handling mortality for groundfish trawl fisheries	0.8000	NA	0.8000	NA	0.8000	NA	0.8000	NA	0.800	NA	0.8000	NA	0.8000	NA	0.8000	NA	0.8000	NA	0.8000	NA
	pLgtRet[1]	TCF: logit-scale max retention (pre-1997)	14.9000	NA	14.9000	NA	14.9000	NA	14.9000	NA	14.900	NA	14.9000	NA	14.9000	NA	14.9000	NA	14.9000	NA	14.9000	NA
	pLgtRet[2]	TCF: logit-scale max retention (2005-2009)	14.9000	NA	14.9000	NA	14.9000	NA	14.9000	NA	14.900	NA	14.9000	NA	14.9000	NA	14.9000	NA	14.9000	NA	14.9000	NA
	pLgtRet[3]	TCF: logit-scale max retention (2013+)	14.9000	NA	14.9000	NA	14.9000	NA	14.9000	NA	14.900	NA	14.9000	NA	14.9000	NA	14.9000	NA	14.9000	NA	14.9000	NA
	pLnC[1]	TCF: base capture rate, ALL YEARS	–	–	–	–	–	–	–	–	− 2.035	0.06074	− 2.1165	0.05915	− 2.2447	0.05588	− 2.0822	0.06144	− 2.1693	0.05757	− 2.2335	0.05537
		TCF: base capture rate, pre-1965 (=0.05)	− 2.9957	NA	− 2.9957	NA	− 2.9957	NA	− 2.9957	NA	–	–	–	–	–	–	–	–	–	–	–	–
	pLnC[2]	SCF: base capture rate, ALL YEARS	–	–	–	–	–	–	–	–	− 3.673	0.07293	− 3.6818	0.07296	− 3.6950	0.07124	− 3.6841	0.07317	− 3.6953	0.07243	− 3.6609	0.07055
		TCF: base capture rate, 1965+	− 1.3265	0.12814	− 1.3265	0.12816	− 1.4192	0.12039	− 1.3243	0.12809	–	–	–	–	–	–	–	–	–	–	–	–
	pLnC[3]	GTF: base capture rate, ALL YEARS	–	–	–	–	–	–	–	–	− 4.956	0.06902	− 4.9906	0.06825	− 5.0712	0.06263	− 5.0252	0.06846	− 4.9544	0.06026	− 5.0124	0.06157
		SCF: base capture rate, pre-1978 (=0.01)	− 4.6052	NA	− 4.6052	NA	− 4.6052	NA	− 4.6052	NA	–	–	–	–	–	–	–	–	–	–	–	–
	pLnC[4]	RKF: base capture rate, ALL YEARS	–	–	–	–	–	–	–	–	− 4.650	0.10174	− 4.6680	0.10184	− 4.6737	0.10143	− 4.6906	0.10199	− 4.6888	0.10129	− 4.6464	0.10124
		SCF: base capture rate, 1992+	− 3.6507	0.07028	− 3.6509	0.07028	− 3.8242	0.07003	− 3.6092	0.07253	–	–	–	–	–	–	–	–	–	–	–	–
	pLnC[5]	DUMMY CAPTURE RATE	− 4.1807	NA	− 4.1807	NA	− 4.1807	NA	− 4.1807	NA	–	–	–	–	–	–	–	–	–	–	–	–
	pLnC[6]	GTF: base capture rate, ALL YEARS	− 4.9165	0.05861	− 4.9147	0.05862	− 5.0700	0.05653	− 4.8907	0.05830	–	–	–	–	–	–	–	–	–	–	–	–
	pLnC[7]	RKF: base capture rate, pre-1953 (=0.02)	− 3.9120	NA	− 3.9120	NA	− 3.9120	NA	− 3.9120	NA	–	–	–	–	–	–	–	–	–	–	–	–
	pLnC[8]	RKF: base capture rate, 1992+	− 4.7478	0.09941	− 4.7478	0.09941	− 4.8552	0.10004	− 4.7255	0.10881	–	–	–	–	–	–	–	–	–	–	–	–
surveys	pQ[1]	NMFS trawl survey: males, 1975-1981	− 0.6549	0.10728	− 0.6551	0.10731	− 0.7139	0.09187	− 0.6365	0.10643	–	–	–	–	–	–	–	–	–	–	–	–
		NMFS trawl survey: males, 1982+	–	–	–	–	–	–	–	–	− 0.618	0.05302	− 0.6443	0.05351	− 0.6852	0.04892	− 0.6561	0.05396	− 0.6860	0.05001	− 0.6506	0.04812
	pQ[2]	NMFS trawl survey: females, 1982+	–	–	–	–	–	–	–	–	− 1.272	0.07650	− 1.2514	0.07527	− 1.1902	0.07170	− 1.2242	0.07432	− 1.2142	0.07353	− 1.2304	0.06974
		NMFS trawl survey: males, 1982+	− 0.6343	0.05031	− 0.6345	0.05032	− 0.8035	0.05019	− 0.6102	0.04981	–	–	–	–	–	–	–	–	–	–	–	–
	pQ[3]	BSFRF SBS	–	–	–	–	–	–	–	–	0.000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA
		NMFS trawl survey: females, 1975-1981	− 0.9880	0.13293	− 0.9883	0.13294	− 1.1021	0.11453	− 0.9835	0.13252	–	–	–	–	–	–	–	–	–	–	–	–
	pQ[4]	NMFS trawl survey: females, 1982+	− 1.2543	0.07538	− 1.2546	0.07538	− 1.5862	0.05849	− 1.2462	0.07540	–	–	–	–	–	–	–	–	–	–	–	–
	pQ[5]	BSFRF SBS	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA	–	–	–	–	–	–	–	–	–	–	–	–
Dirichlet-Multinomial	pLnDirMul[1]	ln(theta) parameter for NMFS M	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA
	pLnDirMul[10]	ln(theta) parameter for RKF total male catch	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA
	pLnDirMul[11]	ln(theta) parameter for RKF total female catch	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA
	pLnDirMul[12]	ln(theta) parameter for GF All total male+female catch	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA
	pLnDirMul[2]	ln(theta) parameter for NMFS F	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA
	pLnDirMul[3]	ln(theta) parameter for BSFRF SBS M	0.9448	0.24815	0.9446	0.24812	0.9272	0.24665	0.9335	0.24746	1.002	0.25243	0.9861	0.25047	0.9535	0.24659	0.9780	0.24969	0.9493	0.24663	0.9361	0.24504
	pLnDirMul[4]	ln(theta) parameter for BSFRF SBS F	2.5297	0.24481	2.5296	0.24481	2.5199	0.24458	2.5291	0.24479	2.538	0.24498	2.5311	0.24480	2.5181	0.24447	2.5288	0.24475	2.5173	0.24446	2.5124	0.24432
	pLnDirMul[5]	ln(theta) parameter for TCF retained catch	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA
	pLnDirMul[6]	ln(theta) parameter for TCF total male catch	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA
	pLnDirMul[7]	ln(theta) parameter for TCF total female catch	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA
	pLnDirMul[8]	ln(theta) parameter for SCF total male catch	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA
	pLnDirMul[9]	ln(theta) parameter for SCF total female catch	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA	0.0000	NA

Table 22. Final parameter values for fishing mortality “devs” in the directed fishery for successful models that started in 1948. NA indicates the parameter was fixed, not estimated. “—” indicates the parameter was not included in the indicated model.

	21.22a		22.01		22.02		22.03		22.05b		22.05c		22.05d		22.06b		22.06c		22.06d	
index	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.
1	−1.458652	0.8675	−1.458498	0.8676	−1.2372	0.8777	−1.4726	0.8684	–	–	–	–	–	–	–	–	–	–	–	–
2	−1.249296	0.7182	−1.249136	0.7182	−1.0296	0.7324	−1.2629	0.7188	–	–	–	–	–	–	–	–	–	–	–	–
3	0.592145	0.6597	0.592322	0.6597	0.8224	0.6883	0.5784	0.6598	–	–	–	–	–	–	–	–	–	–	–	–
4	1.170177	0.6431	1.170380	0.6432	1.4216	0.6916	1.1558	0.6427	–	–	–	–	–	–	–	–	–	–	–	–
5	2.333972	0.9293	2.334275	0.9295	2.6935	1.1694	2.3178	0.9287	–	–	–	–	–	–	–	–	–	–	–	–
6	4.121946	0.7829	4.122182	0.7827	4.2513	0.5939	4.1395	0.7934	–	–	–	–	–	–	–	–	–	–	–	–
7	4.734865	0.6810	4.734702	0.6813	3.0643	2.0349	4.7539	0.7053	–	–	–	–	–	–	–	–	–	–	–	–
8	2.116776	1.2425	2.116428	1.2430	0.8446	0.8794	2.0850	1.2593	–	–	–	–	–	–	–	–	–	–	–	–
9	−0.001303	0.3380	−0.001435	0.3380	−0.2503	0.3714	−0.0169	0.3378	–	–	–	–	–	–	–	–	–	–	–	–
10	−0.344289	0.2172	−0.344374	0.2172	−0.3682	0.2054	−0.3515	0.2172	–	–	–	–	–	–	–	–	–	–	–	–
11	−0.215492	0.1837	−0.215505	0.1838	−0.1507	0.1705	−0.2189	0.1839	–	–	–	–	–	–	–	–	–	–	–	–
12	0.534756	0.1800	0.534777	0.1800	0.6415	0.1690	0.5319	0.1800	–	–	–	–	–	–	–	–	–	–	–	–
13	1.287688	0.2078	1.287611	0.2079	1.3845	0.1805	1.2830	0.2073	–	–	–	–	–	–	–	–	–	–	–	–
14	1.565886	0.2923	1.565438	0.2924	1.7852	0.2334	1.5569	0.2899	–	–	–	–	–	–	–	–	–	–	–	–
15	2.054475	0.3957	2.053509	0.3957	2.7042	0.3990	2.0441	0.3907	–	–	–	–	–	–	–	–	–	–	–	–
16	1.776460	0.2686	1.776376	0.2687	2.5000	0.3469	1.7881	0.2691	–	–	–	–	–	–	–	–	–	–	–	–
17	0.089783	0.1531	0.090033	0.1531	0.3980	0.1489	0.1002	0.1532	–	–	–	–	–	–	–	–	–	–	–	–
18	−1.027157	0.1355	−1.027102	0.1355	−0.9961	0.1246	−1.0190	0.1356	–	–	–	–	–	–	–	–	–	–	–	–
19	−2.447669	0.1371	−2.447703	0.1371	−2.6271	0.1239	−2.4374	0.1372	–	–	–	–	–	–	–	–	–	–	–	–
20	−1.143152	0.1495	−1.143149	0.1495	−1.4312	0.1326	−1.1276	0.1497	–	–	–	–	–	–	–	–	–	–	–	–
21	−1.532399	0.1310	−1.532383	0.1310	−1.5748	0.1225	−1.5249	0.1310	–	–	–	–	–	–	–	–	–	–	–	–
22	−0.586882	0.1305	−0.586754	0.1305	−0.5992	0.1221	−0.5764	0.1305	–	–	–	–	–	–	–	–	–	–	–	–
23	0.593532	0.1318	0.593610	0.1318	0.5668	0.1226	0.6118	0.1320	–	–	–	–	–	–	–	–	–	–	–	–
24	1.331416	0.1377	1.331524	0.1377	1.2887	0.1272	1.3803	0.1390	–	–	–	–	–	–	–	–	–	–	–	–
25	1.590444	0.1649	1.590688	0.1649	1.6398	0.1620	1.6896	0.1647	–	–	–	–	–	–	–	–	–	–	–	–
26	1.925011	0.1639	1.925187	0.1639	1.8747	0.1557	2.0746	0.1776	–	–	–	–	–	–	–	–	–	–	–	–
27	1.621890	0.1732	1.622136	0.1732	1.5906	0.1683	1.6545	0.1741	–	–	–	–	–	–	–	–	–	–	–	–
28	0.995611	0.1881	0.995828	0.1881	1.0119	0.1881	0.9018	0.1828	–	–	–	–	–	–	–	–	–	–	–	–
29	0.485739	0.2141	0.485919	0.2141	0.5795	0.2376	0.3128	0.1758	–	–	–	–	–	–	–	–	–	–	–	–
30	−0.159819	0.1727	−0.159714	0.1727	−0.2725	0.1683	0.2347	0.2273	–	–	–	–	–	–	–	–	–	–	–	–
31	−2.453514	0.1375	−2.453308	0.1375	−2.4387	0.1302	−2.5188	0.1326	–	–	–	–	–	–	–	–	–	–	–	–
32	−1.837678	0.1375	−1.837465	0.1375	−1.8179	0.1302	−1.8994	0.1326	–	–	–	–	–	–	–	–	–	–	–	–
33	−2.004581	0.1373	−2.004460	0.1373	−1.9907	0.1299	−2.0773	0.1323	–	–	–	–	–	–	–	–	–	–	–	–
34	−2.147043	0.1380	−2.146864	0.1380	−2.1227	0.1308	−2.2343	0.1324	–	–	–	–	–	–	–	–	–	–	–	–
35	−1.935934	0.1780	−1.935635	0.1780	−1.8751	0.1764	−2.2406	0.1540	–	–	–	–	–	–	–	–	–	–	–	–
36	−2.136240	0.1357	−2.136304	0.1357	−2.1361	0.1284	−2.1220	0.1349	–	–	–	–	–	–	–	–	–	–	–	–
37	−0.875653	0.1319	−0.875839	0.1319	−0.8166	0.1248	−0.8429	0.1323	–	–	–	–	–	–	–	–	–	–	–	–
38	−0.569367	0.1310	−0.569842	0.1310	−0.5286	0.1240	−0.5355	0.1313	–	–	–	–	–	–	–	–	–	–	–	–
39	−2.285763	0.1313	−2.286294	0.1313	−2.2655	0.1245	−2.2611	0.1314	–	–	–	–	–	–	–	–	–	–	–	–
40	−2.137527	0.1316	−2.137923	0.1316	−2.1323	0.1250	−2.1106	0.1319	–	–	–	–	–	–	–	–	–	–	–	–
41	−2.373162	0.1333	−2.373236	0.1333	−2.4017	0.1263	−2.3441	0.1336	–	–	–	–	–	–	–	–	–	–	–	–

Table 23. Final parameter values for fishing mortality “devs” in the directed fishery for successful models. NA indicates the parameter was fixed, not estimated. “—” indicates the parameter was not included in the indicated model.

	21.22a		22.01		22.02		22.03		22.05b		22.05c		22.05d		22.06b		22.06c		22.06d	
index	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.
1	0.84278	0.1574	0.84284	0.1574	0.80211	0.1577	1.41348	0.2032	0.82674	0.1567	0.82898	0.1563	0.83412	0.1556	0.82744	0.1565	0.83719	0.1563	0.82698	0.1553
2	1.11756	0.1579	1.11766	0.1579	1.08229	0.1585	1.66842	0.2076	1.10224	0.1569	1.10275	0.1567	1.10488	0.1561	1.10103	0.1566	1.10614	0.1565	1.10234	0.1558
3	0.69245	0.1584	0.69258	0.1584	0.66073	0.1595	0.67004	0.2055	0.69127	0.1580	0.69133	0.1579	0.69204	0.1577	0.68914	0.1578	0.69430	0.1580	0.69345	0.1575
4	1.40492	0.1592	1.40510	0.1592	1.36568	0.1598	1.06661	0.1970	1.41366	0.1592	1.41157	0.1591	1.40723	0.1588	1.40842	0.1588	1.41164	0.1592	1.41288	0.1587
5	0.85947	0.1588	0.85964	0.1588	0.82201	0.1602	0.49434	0.1954	0.87053	0.1587	0.86878	0.1587	0.86822	0.1586	0.86739	0.1584	0.87163	0.1588	0.88015	0.1584
6	0.69750	0.1578	0.69769	0.1578	0.65351	0.1593	0.41707	0.1971	0.70948	0.1578	0.70847	0.1579	0.71032	0.1580	0.70839	0.1576	0.71409	0.1581	0.72622	0.1578
7	1.24079	0.1581	1.24102	0.1581	1.18230	0.1595	1.26087	0.2064	1.25811	0.1583	1.25575	0.1585	1.25592	0.1585	1.25562	0.1582	1.26009	0.1586	1.27386	0.1585
8	0.71183	0.1801	0.71205	0.1801	0.69254	0.1804	1.04947	0.2064	0.67492	0.1803	0.68261	0.1798	0.70221	0.1792	0.68244	0.1797	0.68808	0.1794	0.72360	0.1793
9	0.20166	0.1794	0.20186	0.1794	0.18644	0.1798	0.10588	0.1946	0.16718	0.1796	0.17355	0.1790	0.18958	0.1784	0.17467	0.1790	0.17708	0.1786	0.21005	0.1785
10	−1.52264	0.2070	−1.52246	0.2070	−1.51891	0.2074	−1.50820	0.2111	−1.55415	0.2075	−1.55226	0.2071	−1.54482	0.2066	−1.54931	0.2071	−1.55162	0.2068	−1.52566	0.2066
11	−0.75457	0.2117	−0.75436	0.2117	−0.72970	0.2117	−0.76428	0.2145	−0.77497	0.2125	−0.77437	0.2120	−0.77563	0.2114	−0.77317	0.2120	−0.77510	0.2117	−0.76813	0.2113
12	−0.40303	0.2023	−0.40281	0.2023	−0.37710	0.2019	−0.31169	0.2116	−0.41715	0.2032	−0.41768	0.2027	−0.42162	0.2021	−0.41807	0.2026	−0.41978	0.2023	−0.41775	0.2021
13	−1.60559	0.2096	−1.60541	0.2096	−1.58302	0.2089	−1.59943	0.2126	−1.61369	0.2104	−1.61352	0.2100	−1.61726	0.2097	−1.61502	0.2100	−1.61819	0.2098	−1.61746	0.2096
14	−2.73443	0.2148	−2.73426	0.2148	−2.71594	0.2140	−2.71688	0.2424	−2.74003	0.2158	−2.73923	0.2154	−2.73875	0.2150	−2.74024	0.2154	−2.74022	0.2151	−2.74065	0.2148
15	−1.70721	0.1885	−1.70711	0.1885	−1.70675	0.1879	−2.02768	0.1910	−1.71930	0.1891	−1.71793	0.1888	−1.72103	0.1885	−1.71934	0.1888	−1.72047	0.1886	−1.72017	0.1884
16	−0.07628	0.1893	−0.07612	0.1893	−0.05308	0.1890	−0.06695	0.1984	−0.06374	0.1896	−0.06678	0.1895	−0.07248	0.1894	−0.06901	0.1894	−0.07353	0.1895	−0.08710	0.1895
17	0.62838	0.1555	0.62845	0.1555	0.64646	0.1551	0.08020	0.1914	0.63703	0.1558	0.63822	0.1557	0.64162	0.1554	0.63854	0.1556	0.63888	0.1555	0.63186	0.1555
18	0.35747	0.1552	0.35752	0.1552	0.36803	0.1549	0.11329	0.1950	0.36997	0.1555	0.36897	0.1553	0.36486	0.1552	0.36763	0.1553	0.36456	0.1553	0.34701	0.1553
19	−0.43950	0.1799	−0.43948	0.1800	−0.44998	0.1797	−0.51425	0.1967	−0.43189	0.1802	−0.43014	0.1801	−0.42610	0.1799	−0.42987	0.1800	−0.42923	0.1799	−0.43974	0.1799
20	−0.16265	0.1891	−0.16273	0.1891	−0.20205	0.1890	−0.12933	0.1985	−0.16274	0.1894	−0.15493	0.1893	−0.13614	0.1890	−0.15024	0.1893	−0.14344	0.1892	−0.13764	0.1891
21	−0.06158	0.1945	−0.06171	0.1945	−0.11272	0.1944	−0.03281	0.1993	−0.06695	0.1948	−0.05847	0.1947	−0.03766	0.1944	−0.05133	0.1946	−0.04446	0.1945	−0.03316	0.1945
22	0.43934	0.1903	0.43921	0.1903	0.39508	0.1901	0.50679	0.1980	0.43707	0.1907	0.44155	0.1906	0.45478	0.1904	0.44736	0.1905	0.45049	0.1905	0.45996	0.1906
23	0.15278	0.1921	0.15266	0.1921	0.15031	0.1915	0.19509	0.1975	0.15956	0.1925	0.15910	0.1923	0.15143	0.1922	0.15933	0.1923	0.15298	0.1923	0.13907	0.1923
24	0.05179	0.1876	0.05163	0.1876	0.11565	0.1868	0.11204	0.1971	0.07249	0.1880	0.06583	0.1879	0.04485	0.1878	0.06088	0.1879	0.05110	0.1879	0.02037	0.1878
25	0.72923	0.1525	0.72883	0.1525	0.79835	0.1516	0.94727	0.1916	0.74736	0.1530	0.74666	0.1528	0.74285	0.1524	0.74492	0.1527	0.74554	0.1526	0.72833	0.1523
26	0.62285	0.1834	0.62218	0.1834	0.67569	0.1827	0.74329	0.1931	0.63691	0.1841	0.63991	0.1840	0.64409	0.1837	0.64054	0.1839	0.64417	0.1838	0.63603	0.1836
27	0.47841	0.1857	0.47779	0.1856	0.52888	0.1854	0.56399	0.1956	0.48868	0.1862	0.49153	0.1861	0.49727	0.1860	0.49358	0.1860	0.49676	0.1861	0.49664	0.1859
28	−0.08018	0.1954	−0.08059	0.1954	−0.03651	0.1953	−0.06767	0.1987	−0.07261	0.1957	−0.07450	0.1957	−0.07784	0.1956	−0.07237	0.1956	−0.07496	0.1956	−0.07682	0.1956
29	−0.08838	0.1952	−0.08864	0.1952	−0.06545	0.1950	−0.07744	0.1993	−0.08117	0.1955	−0.08667	0.1955	−0.09475	0.1954	−0.08513	0.1954	−0.09063	0.1955	−0.08920	0.1954
30	0.20047	0.1907	0.20037	0.1907	0.20631	0.1903	0.21478	0.1988	0.20806	0.1910	0.20154	0.1909	0.19144	0.1908	0.20285	0.1909	0.19666	0.1909	0.19767	0.1909
31	−1.79364	0.2001	−1.79340	0.2001	−1.78116	0.1996	−1.80630	0.2134	−1.77288	0.2002	−1.79062	0.2001	−1.83361	0.2000	−1.79706	0.2001	−1.81976	0.2000	−1.85299	0.2001

Table 24. Final parameter values for fishing mortality “devs” in the snow crab fishery for successful models. NA indicates the parameter was fixed, not estimated. “—” indicates the parameter was not included in the indicated model.

	21.22a		22.01		22.02		22.03		22.05b		22.05c		22.05d		22.06b		22.06c		22.06d	
index	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.
1	0.84278	0.1574	0.84284	0.1574	0.80211	0.1577	1.41348	0.2032	0.82674	0.1567	0.82898	0.1563	0.83412	0.1556	0.82744	0.1565	0.83719	0.1563	0.82698	0.1553
2	1.11756	0.1579	1.11766	0.1579	1.08229	0.1585	1.66842	0.2076	1.10224	0.1569	1.10275	0.1567	1.10488	0.1561	1.10103	0.1566	1.10614	0.1565	1.10234	0.1558
3	0.69245	0.1584	0.69258	0.1584	0.66073	0.1595	0.67004	0.2055	0.69127	0.1580	0.69133	0.1579	0.69204	0.1577	0.68914	0.1578	0.69430	0.1580	0.69345	0.1575
4	1.40492	0.1592	1.40510	0.1592	1.36568	0.1598	1.06661	0.1970	1.41366	0.1592	1.41157	0.1591	1.40723	0.1588	1.40842	0.1588	1.41164	0.1592	1.41288	0.1587
5	0.85947	0.1588	0.85964	0.1588	0.82201	0.1602	0.49434	0.1954	0.87053	0.1587	0.86878	0.1587	0.86822	0.1586	0.86739	0.1584	0.87163	0.1588	0.88015	0.1584
6	0.69750	0.1578	0.69769	0.1578	0.65351	0.1593	0.41707	0.1971	0.70948	0.1578	0.70847	0.1579	0.71032	0.1580	0.70839	0.1576	0.71409	0.1581	0.72622	0.1578
7	1.24079	0.1581	1.24102	0.1581	1.18230	0.1595	1.26087	0.2064	1.25811	0.1583	1.25575	0.1585	1.25592	0.1585	1.25562	0.1582	1.26009	0.1586	1.27386	0.1585
8	0.71183	0.1801	0.71205	0.1801	0.69254	0.1804	1.04947	0.2064	0.67492	0.1803	0.68261	0.1798	0.70221	0.1792	0.68244	0.1797	0.68808	0.1794	0.72360	0.1793
9	0.20166	0.1794	0.20186	0.1794	0.18644	0.1798	0.10588	0.1946	0.16718	0.1796	0.17355	0.1790	0.18958	0.1784	0.17467	0.1790	0.17708	0.1786	0.21005	0.1785
10	−1.52264	0.2070	−1.52246	0.2070	−1.51891	0.2074	−1.50820	0.2111	−1.55415	0.2075	−1.55226	0.2071	−1.54482	0.2066	−1.54931	0.2071	−1.55162	0.2068	−1.52566	0.2066
11	−0.75457	0.2117	−0.75436	0.2117	−0.72970	0.2117	−0.76428	0.2145	−0.77497	0.2125	−0.77437	0.2120	−0.77563	0.2114	−0.77317	0.2120	−0.77510	0.2117	−0.76813	0.2113
12	−0.40303	0.2023	−0.40281	0.2023	−0.37710	0.2019	−0.31169	0.2116	−0.41715	0.2032	−0.41768	0.2027	−0.42162	0.2021	−0.41807	0.2026	−0.41978	0.2023	−0.41775	0.2021
13	−1.60559	0.2096	−1.60541	0.2096	−1.58302	0.2089	−1.59943	0.2126	−1.61369	0.2104	−1.61352	0.2100	−1.61726	0.2097	−1.61502	0.2100	−1.61819	0.2098	−1.61746	0.2096
14	−2.73443	0.2148	−2.73426	0.2148	−2.71594	0.2140	−2.71688	0.2424	−2.74003	0.2158	−2.73923	0.2154	−2.73875	0.2150	−2.74024	0.2154	−2.74022	0.2151	−2.74065	0.2148
15	−1.70721	0.1885	−1.70711	0.1885	−1.70675	0.1879	−2.02768	0.1910	−1.71930	0.1891	−1.71793	0.1888	−1.72103	0.1885	−1.71934	0.1888	−1.72047	0.1886	−1.72017	0.1884
16	−0.07628	0.1893	−0.07612	0.1893	−0.05308	0.1890	−0.06695	0.1984	−0.06374	0.1896	−0.06678	0.1895	−0.07248	0.1894	−0.06901	0.1894	−0.07353	0.1895	−0.08710	0.1895
17	0.62838	0.1555	0.62845	0.1555	0.64646	0.1551	0.08020	0.1914	0.63703	0.1558	0.63822	0.1557	0.64162	0.1554	0.63854	0.1556	0.63888	0.1555	0.63186	0.1555
18	0.35747	0.1552	0.35752	0.1552	0.36803	0.1549	0.11329	0.1950	0.36997	0.1555	0.36897	0.1553	0.36486	0.1552	0.36763	0.1553	0.36456	0.1553	0.34701	0.1553
19	−0.43950	0.1799	−0.43948	0.1800	−0.44998	0.1797	−0.51425	0.1967	−0.43189	0.1802	−0.43014	0.1801	−0.42610	0.1799	−0.42987	0.1800	−0.42923	0.1799	−0.43974	0.1799
20	−0.16265	0.1891	−0.16273	0.1891	−0.20205	0.1890	−0.12933	0.1985	−0.16274	0.1894	−0.15493	0.1893	−0.13614	0.1890	−0.15024	0.1893	−0.14344	0.1892	−0.13764	0.1891
21	−0.06158	0.1945	−0.06171	0.1945	−0.11272	0.1944	−0.03281	0.1993	−0.06695	0.1948	−0.05847	0.1947	−0.03766	0.1944	−0.05133	0.1946	−0.04446	0.1945	−0.03316	0.1945
22	0.43934	0.1903	0.43921	0.1903	0.39508	0.1901	0.50679	0.1980	0.43707	0.1907	0.44155	0.1906	0.45478	0.1904	0.44736	0.1905	0.45049	0.1905	0.45996	0.1906
23	0.15278	0.1921	0.15266	0.1921	0.15031	0.1915	0.19509	0.1975	0.15956	0.1925	0.15910	0.1923	0.15143	0.1922	0.15933	0.1923	0.15298	0.1923	0.13907	0.1923
24	0.05179	0.1876	0.05163	0.1876	0.11565	0.1868	0.11204	0.1971	0.07249	0.1880	0.06583	0.1879	0.04485	0.1878	0.06088	0.1879	0.05110	0.1879	0.02037	0.1878
25	0.72923	0.1525	0.72883	0.1525	0.79835	0.1516	0.94727	0.1916	0.74736	0.1530	0.74666	0.1528	0.74285	0.1524	0.74492	0.1527	0.74554	0.1526	0.72833	0.1523
26	0.62285	0.1834	0.62218	0.1834	0.67569	0.1827	0.74329	0.1931	0.63691	0.1841	0.63991	0.1840	0.64409	0.1837	0.64054	0.1839	0.64417	0.1838	0.63603	0.1836
27	0.47841	0.1857	0.47779	0.1856	0.52888	0.1854	0.56399	0.1956	0.48868	0.1862	0.49153	0.1861	0.49727	0.1860	0.49358	0.1860	0.49676	0.1861	0.49664	0.1859
28	−0.08018	0.1954	−0.08059	0.1954	−0.03651	0.1953	−0.06767	0.1987	−0.07261	0.1957	−0.07450	0.1957	−0.07784	0.1956	−0.07237	0.1956	−0.07496	0.1956	−0.07682	0.1956
29	−0.08838	0.1952	−0.08864	0.1952	−0.06545	0.1950	−0.07744	0.1993	−0.08117	0.1955	−0.08667	0.1955	−0.09475	0.1954	−0.08513	0.1954	−0.09063	0.1955	−0.08920	0.1954
30	0.20047	0.1907	0.20037	0.1907	0.20631	0.1903	0.21478	0.1988	0.20806	0.1910	0.20154	0.1909	0.19144	0.1908	0.20285	0.1909	0.19666	0.1909	0.19767	0.1909
31	−1.79364	0.2001	−1.79340	0.2001	−1.78116	0.1996	−1.80630	0.2134	−1.77288	0.2002	−1.79062	0.2001	−1.83361	0.2000	−1.79706	0.2001	−1.81976	0.2000	−1.85299	0.2001

Table 25. Final parameter values for fishing mortality “devs” in the BBRKC fishery for successful models. NA indicates the parameter was fixed, not estimated. “—” indicates the parameter was not included in the indicated model.

	21.22a		22.01		22.02		22.03		22.05b		22.05c		22.05d		22.06b		22.06c		22.06d	
index	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.
1	3.66550	0.2077	3.66555	0.2077	3.58104	0.2066	3.81771	0.2292	3.62117	0.2073	3.58900	0.2067	3.50373	0.2074	3.63205	0.2073	3.58829	0.2072	3.50485	0.2083
2	3.36857	0.2219	3.36870	0.2219	3.29872	0.2206	3.51500	0.2437	3.35176	0.2218	3.32960	0.2213	3.27968	0.2220	3.34814	0.2214	3.31418	0.2210	3.28698	0.2228
3	3.23784	0.2336	3.23797	0.2336	3.14226	0.2309	3.39428	0.2539	3.26254	0.2369	3.25616	0.2368	3.25528	0.2392	3.26074	0.2365	3.25453	0.2370	3.28027	0.2411
4	4.61607	0.2106	4.61624	0.2107	4.51915	0.2092	4.38354	0.2422	4.66618	0.2148	4.66814	0.2148	4.67810	0.2184	4.67369	0.2148	4.67602	0.2152	4.71122	0.2212
5	2.35186	0.2362	2.35191	0.2362	2.23015	0.2353	2.34253	0.2448	2.40122	0.2392	2.41052	0.2398	2.45424	0.2427	2.41552	0.2396	2.43426	0.2408	2.48871	0.2432
6	1.00828	0.2527	1.00836	0.2527	0.88872	0.2497	1.01049	0.2629	0.99373	0.2584	1.00259	0.2590	1.02534	0.2614	1.00525	0.2585	1.01746	0.2600	1.04640	0.2613
7	0.74615	0.2476	0.74629	0.2476	0.63506	0.2449	0.74816	0.2631	0.73003	0.2523	0.73835	0.2529	0.76066	0.2554	0.74173	0.2525	0.74991	0.2539	0.77772	0.2551
8	0.31183	0.2440	0.31202	0.2440	0.24130	0.2423	0.31749	0.2731	0.29887	0.2480	0.30515	0.2484	0.32106	0.2504	0.30742	0.2480	0.31022	0.2490	0.33059	0.2499
9	0.08943	0.2412	0.08965	0.2412	0.06853	0.2409	0.08706	0.2794	0.07865	0.2444	0.08488	0.2449	0.09921	0.2468	0.08655	0.2445	0.09267	0.2454	0.10313	0.2467
10	−0.51681	0.2672	−0.51656	0.2672	−0.50352	0.2682	−0.51971	0.3430	−0.51886	0.2699	−0.51632	0.2702	−0.51595	0.2716	−0.51851	0.2698	−0.51472	0.2706	−0.52609	0.2712
11	−0.33189	0.2365	−0.33165	0.2365	−0.30590	0.2385	−0.33334	0.2804	−0.33332	0.2392	−0.33199	0.2393	−0.33191	0.2405	−0.33501	0.2389	−0.33155	0.2396	−0.34284	0.2401
12	−0.63723	0.2355	−0.63701	0.2355	−0.61323	0.2378	−0.63605	0.2875	−0.63297	0.2380	−0.63257	0.2382	−0.63544	0.2392	−0.63784	0.2377	−0.63751	0.2383	−0.64933	0.2389
13	−0.95741	0.2352	−0.95722	0.2352	−0.93564	0.2375	−0.95742	0.2974	−0.95736	0.2377	−0.95548	0.2377	−0.95153	0.2386	−0.95913	0.2372	−0.95429	0.2377	−0.96278	0.2384
14	−1.32758	0.2473	−1.32739	0.2473	−1.27351	0.2471	−1.34151	0.3302	−1.32486	0.2480	−1.32480	0.2480	−1.32927	0.2484	−1.33278	0.2479	−1.33332	0.2481	−1.34762	0.2484
15	−1.82759	0.3301	−1.82741	0.3301	−1.77087	0.3299	−1.83894	0.4331	−1.82456	0.3308	−1.82542	0.3308	−1.82669	0.3311	−1.83315	0.3307	−1.83206	0.3309	−1.84094	0.3312
16	−1.27146	0.2116	−1.27135	0.2116	−1.21851	0.2115	−1.29217	0.2615	−1.27061	0.2124	−1.26759	0.2125	−1.26377	0.2130	−1.27424	0.2124	−1.27108	0.2126	−1.27904	0.2130
17	0.11382	0.2108	0.11392	0.2108	0.15428	0.2108	0.08896	0.2172	0.11878	0.2117	0.11790	0.2118	0.11269	0.2122	0.10981	0.2116	0.10911	0.2118	0.09076	0.2122
18	−0.35976	0.2104	−0.35976	0.2104	−0.35390	0.2103	−0.38074	0.2203	−0.36450	0.2112	−0.35979	0.2113	−0.35028	0.2117	−0.36298	0.2112	−0.35759	0.2113	−0.36102	0.2116
19	−2.03274	0.3078	−2.03286	0.3078	−2.05549	0.3076	−2.04731	0.4154	−2.04692	0.3084	−2.03640	0.3085	−2.01322	0.3088	−2.03452	0.3084	−2.02408	0.3085	−2.01127	0.3089
20	−2.48616	0.5200	−2.48630	0.5200	−2.51425	0.5200	−2.49586	0.6943	−2.50252	0.5205	−2.49285	0.5206	−2.47133	0.5209	−2.49002	0.5206	−2.48125	0.5208	−2.46499	0.5211
21	−1.46369	0.2428	−1.46382	0.2428	−1.47373	0.2423	−1.46708	0.3230	−1.47718	0.2434	−1.47185	0.2435	−1.46092	0.2440	−1.47138	0.2435	−1.46757	0.2437	−1.45984	0.2441
22	−0.43627	0.2116	−0.43635	0.2116	−0.37912	0.2109	−0.44780	0.2272	−0.43043	0.2123	−0.43410	0.2124	−0.45138	0.2129	−0.44321	0.2123	−0.45090	0.2125	−0.47217	0.2130
23	0.21493	0.2117	0.21475	0.2117	0.32498	0.2114	0.20779	0.2187	0.22817	0.2127	0.22102	0.2127	0.20146	0.2130	0.20940	0.2125	0.20399	0.2127	0.17862	0.2129
24	−0.18815	0.2093	−0.18857	0.2093	−0.08948	0.2092	−0.20143	0.2161	−0.18207	0.2102	−0.18098	0.2102	−0.18129	0.2106	−0.18766	0.2101	−0.18328	0.2103	−0.19192	0.2105
25	−0.22713	0.2093	−0.22767	0.2093	−0.14879	0.2091	−0.24147	0.2179	−0.22643	0.2102	−0.22215	0.2102	−0.21532	0.2106	−0.22510	0.2101	−0.21907	0.2103	−0.21675	0.2107
26	−0.02109	0.2101	−0.02157	0.2101	0.05206	0.2099	−0.03753	0.2201	−0.02272	0.2109	−0.01997	0.2110	−0.01484	0.2114	−0.02164	0.2109	−0.01796	0.2111	−0.01125	0.2115
27	−0.73153	0.2107	−0.73188	0.2107	−0.66855	0.2105	−0.75138	0.2501	−0.73179	0.2115	−0.73446	0.2116	−0.73880	0.2120	−0.73733	0.2115	−0.73899	0.2117	−0.73367	0.2120
28	−1.99089	0.5083	−1.99109	0.5083	−1.94804	0.5081	−1.99975	0.6810	−1.99100	0.5089	−1.99599	0.5090	−2.00304	0.5093	−1.99949	0.5089	−2.00257	0.5091	−1.99352	0.5094
29	−2.91690	1.0891	−2.91688	1.0891	−2.88371	1.0884	−2.92354	1.3168	−2.91298	1.0910	−2.92062	1.0917	−2.93647	1.0927	−2.92632	1.0913	−2.93285	1.0924	−2.93421	1.0930

Table 26. Final parameter values for fishing mortality “devs” in the groundfish fisheries for successful models starting in 1948. NA indicates the parameter was fixed, not estimated. “—” indicates the parameter was not included in the indicated model.

	21.22a		22.01		22.02		22.03		22.05b		22.05c		22.05d		22.06b		22.06c		22.06d	
index	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.
1	1.52303	0.2225	1.52100	0.2226	1.48544	0.2243	1.51556	0.2227	–	–	–	–	–	–	–	–	–	–	–	–
2	1.85199	0.2124	1.85000	0.2124	1.87709	0.2098	1.84644	0.2123	–	–	–	–	–	–	–	–	–	–	–	–
3	1.00674	0.2103	1.00477	0.2103	1.06255	0.2074	1.00209	0.2102	–	–	–	–	–	–	–	–	–	–	–	–
4	0.47352	0.2085	0.47153	0.2085	0.54290	0.2053	0.46898	0.2084	–	–	–	–	–	–	–	–	–	–	–	–
5	0.14544	0.2083	0.14341	0.2084	0.22430	0.2044	0.14170	0.2082	–	–	–	–	–	–	–	–	–	–	–	–
6	−0.13689	0.2090	−0.13894	0.2090	−0.03341	0.2044	−0.13946	0.2089	–	–	–	–	–	–	–	–	–	–	–	–
7	0.45922	0.2129	0.45712	0.2129	0.61317	0.2085	0.45724	0.2126	–	–	–	–	–	–	–	–	–	–	–	–
8	0.09274	0.2100	0.09067	0.2100	0.19873	0.2093	0.09312	0.2098	–	–	–	–	–	–	–	–	–	–	–	–
9	−0.08779	0.2038	−0.08983	0.2038	−0.10263	0.2038	−0.08578	0.2037	–	–	–	–	–	–	–	–	–	–	–	–
10	−1.02951	0.2018	−1.03154	0.2018	−1.15577	0.2008	−1.02595	0.2018	–	–	–	–	–	–	–	–	–	–	–	–
11	−0.30435	0.2036	−0.30635	0.2036	−0.50783	0.2011	−0.29799	0.2036	–	–	–	–	–	–	–	–	–	–	–	–
12	−0.03618	0.2082	−0.03812	0.2082	−0.27399	0.2049	−0.02633	0.2083	–	–	–	–	–	–	–	–	–	–	–	–
13	−0.52876	0.2044	−0.53069	0.2044	−0.71560	0.2029	−0.51873	0.2044	–	–	–	–	–	–	–	–	–	–	–	–
14	−0.26820	0.1987	−0.27013	0.1988	−0.38950	0.1983	−0.25858	0.1988	–	–	–	–	–	–	–	–	–	–	–	–
15	−0.40843	0.2031	−0.41029	0.2031	−0.49168	0.2027	−0.39075	0.2029	–	–	–	–	–	–	–	–	–	–	–	–
16	−0.90554	0.2026	−0.90740	0.2026	−0.95775	0.2022	−0.88908	0.2025	–	–	–	–	–	–	–	–	–	–	–	–
17	−0.61868	0.2015	−0.62052	0.2015	−0.64635	0.2011	−0.60343	0.2016	–	–	–	–	–	–	–	–	–	–	–	–
18	−0.24752	0.2017	−0.24934	0.2017	−0.26430	0.2011	−0.23029	0.2019	–	–	–	–	–	–	–	–	–	–	–	–
19	0.59753	0.1508	0.59575	0.1508	0.58595	0.1500	0.60989	0.1509	–	–	–	–	–	–	–	–	–	–	–	–
20	0.86531	0.1513	0.86354	0.1513	0.84210	0.1504	0.87623	0.1513	–	–	–	–	–	–	–	–	–	–	–	–
21	0.54359	0.1511	0.54182	0.1511	0.51154	0.1505	0.55017	0.1510	–	–	–	–	–	–	–	–	–	–	–	–
22	1.02084	0.1520	1.01908	0.1520	0.97833	0.1514	1.02727	0.1519	–	–	–	–	–	–	–	–	–	–	–	–
23	0.92520	0.1517	0.92344	0.1517	0.87721	0.1513	0.93855	0.1519	–	–	–	–	–	–	–	–	–	–	–	–
24	1.09785	0.1533	1.09610	0.1533	1.04251	0.1526	1.11473	0.1537	–	–	–	–	–	–	–	–	–	–	–	–
25	1.55831	0.1492	1.55793	0.1492	1.55215	0.1484	1.56007	0.1494	–	–	–	–	–	–	–	–	–	–	–	–
26	1.41470	0.1477	1.41437	0.1477	1.41778	0.1466	1.41498	0.1477	–	–	–	–	–	–	–	–	–	–	–	–
27	0.88414	0.1468	0.88382	0.1469	0.90538	0.1459	0.88238	0.1469	–	–	–	–	–	–	–	–	–	–	–	–
28	0.92321	0.1470	0.92290	0.1470	0.96083	0.1462	0.91963	0.1470	–	–	–	–	–	–	–	–	–	–	–	–
29	1.14678	0.1472	1.14648	0.1472	1.18742	0.1464	1.14133	0.1471	–	–	–	–	–	–	–	–	–	–	–	–
30	0.44174	0.1470	0.44142	0.1470	0.48148	0.1462	0.43462	0.1469	–	–	–	–	–	–	–	–	–	–	–	–
31	−0.10832	0.1467	−0.10868	0.1467	−0.07237	0.1459	−0.11710	0.1466	–	–	–	–	–	–	–	–	–	–	–	–
32	0.18586	0.1466	0.18547	0.1466	0.21701	0.1458	0.17605	0.1464	–	–	–	–	–	–	–	–	–	–	–	–
33	−0.14466	0.1466	−0.14510	0.1466	−0.11364	0.1458	−0.15526	0.1464	–	–	–	–	–	–	–	–	–	–	–	–
34	−0.17067	0.1467	−0.17118	0.1467	−0.14389	0.1459	−0.18346	0.1465	–	–	–	–	–	–	–	–	–	–	–	–
35	−0.08202	0.1466	−0.08263	0.1466	−0.06746	0.1458	−0.09548	0.1464	–	–	–	–	–	–	–	–	–	–	–	–
36	−0.42518	0.1461	−0.42595	0.1461	−0.42778	0.1454	−0.43518	0.1460	–	–	–	–	–	–	–	–	–	–	–	–
37	−0.80739	0.1452	−0.80831	0.1452	−0.82146	0.1445	−0.81320	0.1452	–	–	–	–	–	–	–	–	–	–	–	–
38	−1.15736	0.1449	−1.15828	0.1449	−1.17270	0.1442	−1.16140	0.1449	–	–	–	–	–	–	–	–	–	–	–	–
39	−0.85102	0.1451	−0.85184	0.1451	−0.84549	0.1443	−0.85414	0.1451	–	–	–	–	–	–	–	–	–	–	–	–
40	−1.34157	0.1457	−1.34229	0.1457	−1.29642	0.1448	−1.34492	0.1457	–	–	–	–	–	–	–	–	–	–	–	–
41	−0.78090	0.1459	−0.78173	0.1460	−0.70047	0.1451	−0.78510	0.1460	–	–	–	–	–	–	–	–	–	–	–	–
42	−0.69723	0.1454	−0.69831	0.1454	−0.61092	0.1447	−0.70279	0.1454	–	–	–	–	–	–	–	–	–	–	–	–
43	−0.83484	0.1450	−0.83610	0.1450	−0.76003	0.1444	−0.84187	0.1450	–	–	–	–	–	–	–	–	–	–	–	–
44	−0.76493	0.1451	−0.74785	0.1451	−0.70111	0.1445	−0.77260	0.1450	–	–	–	–	–	–	–	–	–	–	–	–
45	−1.34806	0.1450	−1.32986	0.1450	−1.29486	0.1446	−1.35484	0.1450	–	–	–	–	–	–	–	–	–	–	–	–
46	−1.05480	0.1455	−1.04432	0.1455	−1.01887	0.1451	−1.06062	0.1455	–	–	–	–	–	–	–	–	–	–	–	–
47	−0.95725	0.1463	−0.94873	0.1463	−0.93778	0.1458	−0.96231	0.1463	–	–	–	–	–	–	–	–	–	–	–	–
48	−1.05971	0.1482	−1.05631	0.1482	−1.03981	0.1475	−1.06441	0.1482	–	–	–	–	–	–	–	–	–	–	–	–

Table 27. Final parameter values for fishing mortality “devs” in the groundfish fisheries for successful models starting in 1982. NA indicates the parameter was fixed, not estimated. “—” indicates the parameter was not included in the indicated model.

	21.22a		22.01		22.02		22.03		22.05b		22.05c		22.05d		22.06b		22.06c		22.06d	
index	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.
1	–	–	–	–	–	–	–	–	−0.61014	0.2086	−0.682769	0.2065	−0.79366	0.2048	−0.779408	0.2053	−0.87819	0.2052	−0.76793	0.2045
2	–	–	–	–	–	–	–	–	−0.15643	0.2052	−0.184358	0.2047	−0.29485	0.2040	−0.211187	0.2048	−0.36220	0.2046	−0.25887	0.2039
3	–	–	–	–	–	–	–	–	−0.07666	0.2048	−0.083345	0.2041	−0.15186	0.2034	−0.066694	0.2047	−0.22669	0.2040	−0.09258	0.2033
4	–	–	–	–	–	–	–	–	−0.55943	0.2030	−0.543147	0.2022	−0.54818	0.2016	−0.502727	0.2034	−0.63179	0.2026	−0.47765	0.2014
5	–	–	–	–	–	–	–	–	−0.22928	0.2002	−0.199937	0.1994	−0.16050	0.1985	−0.156523	0.2006	−0.25364	0.1996	−0.10719	0.1982
6	–	–	–	–	–	–	–	–	−0.14376	0.2091	−0.162873	0.2082	−0.26924	0.2040	−0.181823	0.2068	0.07335	0.1993	−0.20451	0.2032
7	–	–	–	–	–	–	–	–	−0.64459	0.2083	−0.662802	0.2077	−0.76128	0.2040	−0.694502	0.2062	−0.43787	0.1997	−0.71253	0.2037
8	–	–	–	–	–	–	–	–	−0.36782	0.2071	−0.385987	0.2066	−0.48108	0.2033	−0.419712	0.2053	−0.17085	0.1990	−0.44528	0.2033
9	–	–	–	–	–	–	–	–	0.00233	0.2076	−0.020095	0.2071	−0.12366	0.2035	−0.054364	0.2058	0.18333	0.1992	−0.09350	0.2037
10	–	–	–	–	–	–	–	–	0.87217	0.1594	0.844099	0.1590	0.71872	0.1546	0.802602	0.1572	1.06127	0.1482	0.75845	0.1546
11	–	–	–	–	–	–	–	–	1.14087	0.1603	1.111789	0.1598	0.98616	0.1549	1.071055	0.1578	1.32130	0.1490	1.02840	0.1552
12	–	–	–	–	–	–	–	–	0.81917	0.1603	0.789307	0.1598	0.66525	0.1546	0.749785	0.1576	0.99427	0.1492	0.71164	0.1549
13	–	–	–	–	–	–	–	–	1.29686	0.1612	1.266808	0.1606	1.14542	0.1555	1.228843	0.1584	1.46979	0.1505	1.19795	0.1558
14	–	–	–	–	–	–	–	–	1.19850	0.1605	1.169476	0.1600	1.05323	0.1552	1.133646	0.1579	1.37106	0.1505	1.11108	0.1555
15	–	–	–	–	–	–	–	–	1.37440	0.1616	1.344971	0.1613	1.22870	0.1569	1.310039	0.1593	1.55477	0.1518	1.29211	0.1570
16	–	–	–	–	–	–	–	–	1.62056	0.1483	1.635691	0.1482	1.70463	0.1475	1.651942	0.1481	1.57638	0.1465	1.69477	0.1476
17	–	–	–	–	–	–	–	–	1.48043	0.1466	1.494678	0.1465	1.56125	0.1459	1.511852	0.1464	1.43461	0.1448	1.54876	0.1459
18	–	–	–	–	–	–	–	–	0.95582	0.1457	0.969372	0.1456	1.03248	0.1449	0.986482	0.1455	0.90911	0.1440	1.01597	0.1450
19	–	–	–	–	–	–	–	–	1.00102	0.1459	1.013703	0.1458	1.07274	0.1451	1.030108	0.1457	0.95351	0.1441	1.04921	0.1451
20	–	–	–	–	–	–	–	–	1.23111	0.1461	1.242246	0.1459	1.29702	0.1452	1.257141	0.1458	1.17877	0.1442	1.26946	0.1452
21	–	–	–	–	–	–	–	–	0.52826	0.1459	0.540222	0.1458	0.59674	0.1449	0.554956	0.1456	0.47755	0.1439	0.56643	0.1449
22	–	–	–	–	–	–	–	–	−0.01936	0.1457	−0.007195	0.1455	0.05011	0.1447	0.007178	0.1453	−0.06950	0.1437	0.01797	0.1446
23	–	–	–	–	–	–	–	–	0.27690	0.1457	0.289169	0.1455	0.34499	0.1446	0.303260	0.1452	0.22569	0.1436	0.30847	0.1445
24	–	–	–	–	–	–	–	–	−0.05231	0.1457	−0.039488	0.1456	0.01758	0.1447	−0.025509	0.1453	−0.10228	0.1436	−0.02101	0.1446
25	–	–	–	–	–	–	–	–	−0.07870	0.1459	−0.064251	0.1457	−0.00399	0.1448	−0.049831	0.1455	−0.12458	0.1437	−0.04335	0.1447
26	–	–	–	–	–	–	–	–	0.01112	0.1458	0.026237	0.1457	0.08705	0.1448	0.040613	0.1454	−0.03356	0.1437	0.04611	0.1447
27	–	–	–	–	–	–	–	–	−0.33677	0.1454	−0.317957	0.1453	−0.24878	0.1444	−0.301294	0.1451	−0.37172	0.1433	−0.28392	0.1442
28	–	–	–	–	–	–	–	–	−0.72299	0.1447	−0.701641	0.1445	−0.62516	0.1436	−0.682393	0.1444	−0.75077	0.1425	−0.65026	0.1435
29	–	–	–	–	–	–	–	–	−1.07460	0.1444	−1.054665	0.1442	−0.98285	0.1432	−1.034625	0.1441	−1.10641	0.1422	−1.00788	0.1432
30	–	–	–	–	–	–	–	–	−0.76547	0.1444	−0.749466	0.1442	−0.68747	0.1433	−0.731065	0.1441	−0.80706	0.1422	−0.71797	0.1432
31	–	–	–	–	–	–	–	–	−1.24800	0.1448	−1.236141	0.1447	−1.18570	0.1439	−1.221562	0.1445	−1.30081	0.1428	−1.22649	0.1439
32	–	–	–	–	–	–	–	–	−0.68111	0.1452	−0.670634	0.1451	−0.62332	0.1443	−0.658534	0.1449	−0.73695	0.1433	−0.66837	0.1442
33	–	–	–	–	–	–	–	–	−0.59949	0.1449	−0.585757	0.1447	−0.53017	0.1439	−0.572120	0.1446	−0.64612	0.1429	−0.56987	0.1436
34	–	–	–	–	–	–	–	–	−0.73975	0.1445	−0.723655	0.1444	−0.66238	0.1435	−0.707953	0.1443	−0.78037	0.1425	−0.69447	0.1434
35	–	–	–	–	–	–	–	–	−0.67085	0.1444	−0.655462	0.1443	−0.59431	0.1435	−0.638802	0.1443	−0.71242	0.1425	−0.62054	0.1435
36	–	–	–	–	–	–	–	–	−1.25409	0.1443	−1.241974	0.1442	−1.18642	0.1434	−1.225536	0.1441	−1.30279	0.1424	−1.20950	0.1434
37	–	–	–	–	–	–	–	–	−0.96010	0.1447	−0.951770	0.1446	−0.90334	0.1438	−0.936129	0.1444	−1.01738	0.1428	−0.92674	0.1438
38	–	–	–	–	–	–	–	–	−0.86088	0.1454	−0.856192	0.1453	−0.81680	0.1445	−0.842000	0.1451	−0.92737	0.1435	−0.84667	0.1445
39	–	–	–	–	–	–	–	–	−0.95694	0.1472	−0.956209	0.1471	−0.92708	0.1464	−0.945210	0.1468	−1.03346	0.1453	−0.96972	0.1464

Table 28. Final parameter values for selectivity parameter pS1 for successful models. NA indicates the parameter was fixed, not estimated. "—" indicates the parameter was not included in the indicated model.

		21.22a		22.01		22.02		22.03		22.05b		22.05c		22.05d		22.06b		22.06c		22.06d	
name	label	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.
pS1[01]	size at 1 for NMFS survey selectivity (males, 1982+)	–	–	–	–	–	–	–	–	179.000	NA	179.000	NA	179.000	NA	179.000	NA	179.000	NA	179.000	NA
	size at 1 for NMFS survey selectivity (males, pre-1982)	179.000	NA	179.000	NA	179.000	NA	179.000	NA	–	–	–	–	–	–	–	–	–	–	–	–
pS1[02]	size at 1 for NMFS survey selectivity (females, 1982+)	–	–	–	–	–	–	–	–	129.900	NA	129.900	NA	129.900	NA	129.900	NA	129.900	NA	129.900	NA
	size at 1 for NMFS survey selectivity (males, 1982+)	179.000	NA	179.000	NA	179.000	NA	179.000	NA	–	–	–	–	–	–	–	–	–	–	–	–
pS1[03]	size at 1 for NMFS survey selectivity (females, pre-1982)	129.900	NA	129.900	NA	129.900	NA	129.900	NA	–	–	–	–	–	–	–	–	–	–	–	–
	z50 for TCF retention (pre-1991)	–	–	–	–	–	–	–	–	138.214	0.250390	138.031	0.246180	137.790	0.253900	138.186	0.246800	137.989	0.247410	137.773	0.253490
pS1[04]	size at 1 for NMFS survey selectivity (females, 1982+)	129.900	NA	129.900	NA	129.900	NA	129.900	NA	–	–	–	–	–	–	–	–	–	–	–	–
	z50 for TCF retention (1991-1996)	–	–	–	–	–	–	–	–	137.737	0.115050	137.737	0.124150	137.735	0.146560	137.737	0.108920	137.737	0.129570	137.742	0.163490
pS1[05]	DUMMY VALUE	–	–	–	–	–	–	–	–	4.500	NA	4.500	NA	4.500	NA	4.500	NA	4.500	NA	4.500	NA
	z50 for TCF retention (pre-1991)	138.671	0.777610	138.672	0.777410	138.822	0.747420	138.663	0.794530	–	–	–	–	–	–	–	–	–	–	–	–
pS1[06]	ln(z50) for TCF selectivity (males)	–	–	–	–	–	–	–	–	4.865	0.007233	4.863	0.007167	4.861	0.007015	4.862	0.007245	4.861	0.007134	4.859	0.006966
	z50 for TCF retention (1991-1996)	137.746	0.199750	137.747	0.200080	137.684	0.101390	138.544	1.257800	–	–	–	–	–	–	–	–	–	–	–	–
pS1[07]	DUMMY VALUE	4.500	NA	4.500	NA	4.500	NA	4.500	NA	–	–	–	–	–	–	–	–	–	–	–	–
	z50 for TCF selectivity (females)	–	–	–	–	–	–	–	–	94.671	2.760000	94.492	2.678800	94.424	2.572200	94.620	2.708000	94.566	2.599300	94.094	2.492900
pS1[08]	ascending z-at-1 for SCF selectivity (males, pre-1997)	–	–	–	–	–	–	–	–	160.647	2.288700	160.461	2.390200	160.285	2.536900	160.645	2.315200	160.362	2.501100	160.510	2.276700
	ln(z50) for TCF selectivity (males)	4.856	0.007486	4.856	0.007487	4.869	0.007674	4.854	0.006863	–	–	–	–	–	–	–	–	–	–	–	–
pS1[09]	ascending z-at-1 for SCF selectivity (males, 1997-2004)	–	–	–	–	–	–	–	–	118.666	6.869900	118.558	6.906700	118.124	7.083000	118.323	6.945900	118.507	7.012000	118.156	7.080800
	z50 for TCF selectivity (females)	93.923	2.545900	93.925	2.546500	94.074	2.566300	92.943	2.296900	–	–	–	–	–	–	–	–	–	–	–	–
pS1[10]	ascending z-at-1 for SCF selectivity (males, 2005+)	–	–	–	–	–	–	–	–	124.814	1.303200	124.718	1.301500	124.580	1.308600	124.648	1.299900	124.670	1.301800	124.505	1.311400
	ascending z-at-1 for SCF selectivity (males, pre-1997)	160.095	2.850900	160.095	2.850600	159.897	4.215300	159.388	5.937500	–	–	–	–	–	–	–	–	–	–	–	–
pS1[11]	ascending z-at-1 for SCF selectivity (males, 1997-2004)	118.179	6.689500	118.179	6.688900	118.074	6.605400	118.380	6.921500	–	–	–	–	–	–	–	–	–	–	–	–
	ascending z50 for SCF selectivity (females, pre-1997)	–	–	–	–	–	–	–	–	93.898	8.133700	93.526	8.147100	92.733	8.141300	93.664	8.106500	93.371	8.113800	92.696	8.354400
pS1[12]	ascending z-at-1 for SCF selectivity (males, 2005+)	124.476	1.277200	124.475	1.277100	124.817	1.274100	124.481	1.279100	–	–	–	–	–	–	–	–	–	–	–	–
	ascending z50 for SCF selectivity (females, 1997-2004)	–	–	–	–	–	–	–	–	71.867	5.240400	71.697	5.200400	71.562	5.139300	71.872	5.205200	71.792	5.150800	71.214	5.145400
pS1[13]	ascending z50 for SCF selectivity (females, 2005+)	–	–	–	–	–	–	–	–	108.211	7.036900	108.213	7.020400	108.226	7.000800	108.320	7.041000	107.933	6.961900	107.779	7.053800
	ascending z50 for SCF selectivity (females, pre-1997)	92.344	8.019100	92.345	8.019600	90.870	8.455100	80.647	6.639600	–	–	–	–	–	–	–	–	–	–	–	–
pS1[14]	ascending z50 for SCF selectivity (females, 1997-2004)	72.036	5.061000	72.038	5.060500	71.534	5.243700	72.673	4.354700	–	–	–	–	–	–	–	–	–	–	–	–
	z50 for GF.AllGear selectivity (males, pre-1987)	–	–	–	–	–	–	–	–	63.297	3.605200	61.776	3.261800	57.594	2.564700	62.008	4.770000	57.720	2.955000	58.839	2.395600
pS1[15]	ascending z50 for SCF selectivity (females, 2005+)	107.784	7.131000	107.785	7.131000	109.592	7.433800	101.371	8.541900	–	–	–	–	–	–	–	–	–	–	–	–
	z50 for GF.AllGear selectivity (males, 1987-1996)	–	–	–	–	–	–	–	–	95.483	12.397000	87.862	11.447000	65.852	7.581300	80.996	10.405000	120.000	0.047278	71.818	7.961000
pS1[16]	z50 for GF.AllGear selectivity (males, 1997+)	–	–	–	–	–	–	–	–	100.676	2.792500	99.679	2.836100	98.207	2.969500	98.585	2.803400	98.656	2.903700	98.046	2.975100
	z50 for GF.AllGear selectivity (males, pre-1987)	59.813	3.067000	59.823	3.068700	58.155	2.674400	60.110	3.106500	–	–	–	–	–	–	–	–	–	–	–	–
pS1[17]	z50 for GF.AllGear selectivity (females, pre-1987)	–	–	–	–	–	–	–	–	42.786	2.275500	43.456	2.294400	46.314	2.207200	43.959	2.281300	46.248	2.584200	46.169	2.156700
	z50 for GF.AllGear selectivity (males, 1987-1996)	68.694	6.715100	68.707	6.717200	66.338	6.627200	70.059	6.625400	–	–	–	–	–	–	–	–	–	–	–	–
pS1[18]	z50 for GF.AllGear selectivity (females, 1987-1996)	–	–	–	–	–	–	–	–	39.141	2.049700	39.231	2.100500	40.108	2.334500	39.472	2.164700	70.187	14.302000	39.336	2.232200
	z50 for GF.AllGear selectivity (males, 1997+)	97.271	2.553400	97.334	2.553500	99.123	2.581800	97.203	2.522800	–	–	–	–	–	–	–	–	–	–	–	–
pS1[19]	z50 for GF.AllGear selectivity (females, 1997+)	–	–	–	–	–	–	–	–	78.704	3.678700	80.749	3.764200	89.450	3.759900	83.198	3.640700	88.838	4.197400	86.304	3.649000
	z50 for GF.AllGear selectivity (females, pre-1987)	43.726	1.858100	43.727	1.858200	41.831	1.666700	43.456	1.842300	–	–	–	–	–	–	–	–	–	–	–	–
pS1[20]	size at 1 for RKF selectivity (males, pre-1997)	–	–	–	–	–	–	–	–	179.900	NA	179.900	NA	179.900	NA	179.900	NA	179.900	NA	179.900	NA
	z50 for GF.AllGear selectivity (females, 1987-1996)	39.897	2.162800	39.895	2.162400	37.948	1.830000	40.177	2.194000	–	–	–	–	–	–	–	–	–	–	–	–
pS1[21]	size at 1 for RKF selectivity (males, 1997-2004)	–	–	–	–	–	–	–	–	179.900	NA	179.900	NA	179.900	NA	179.900	NA	179.900	NA	179.900	NA
	z50 for GF.AllGear selectivity (females, 1997+)	87.373	3.172800	87.460	3.176900	91.254	3.476200	86.918	3.167100	–	–	–	–	–	–	–	–	–	–	–	–
pS1[22]	size at 1 for RKF selectivity (males, 2005+)	–	–	–	–	–	–	–	–	179.900	NA	179.900	NA	179.900	NA	179.900	NA	179.900	NA	179.900	NA
	size at 1 for RKF selectivity (males, pre-1997)	179.900	NA	179.900	NA	179.900	NA	179.900	NA	–	–	–	–	–	–	–	–	–	–	–	–
pS1[23]	size at 1 for RKF selectivity (females, pre-1997)	–	–	–	–	–	–	–	–	139.900	NA	139.900	NA	139.900	NA	139.900	NA	139.900	NA	139.900	NA
	size at 1 for RKF selectivity (males, 1997-2004)	179.900	NA	179.900	NA	179.900	NA	179.900	NA	–	–	–	–	–	–	–	–	–	–	–	–
pS1[24]	size at 1 for RKF selectivity (females, 1997-2004)	–	–	–	–	–	–	–	–	122.094	24.185000	119.184	23.115000	116.809	22.911000	120.556	23.668000	117.129	22.115000	114.691	22.287000
	size at 1 for RKF selectivity (males, 2005+)	179.900	NA	179.900	NA	179.900	NA	179.900	NA	–	–	–	–	–	–	–	–	–	–	–	–
pS1[25]	size at 1 for RKF selectivity (females, 2005+)	–	–	–	–	–	–	–	–	122.541	14.106000	120.162	13.273000	118.321	12.405000	121.298	13.826000	118.487	12.435000	116.560	12.721000
	size at 1 for RKF selectivity (females, pre-1997)	139.900	NA	139.900	NA	139.900	NA	139.900	NA	–	–	–	–	–	–	–	–	–	–	–	–
pS1[26]	size at 1 for RKF selectivity (females, 1997-2004)	126.015	25.857000	126.016	25.855000	126.806	26.635000	135.403	39.158000	–	–	–	–	–	–	–	–	–	–	–	–
	z50 for TCF retention (2005-2009)	–	–	–	–	–	–	–	–	139.932	0.971730	139.892	0.974220	139.818	0.977220	139.911	0.975950	139.881	0.974930	139.825	0.977700
pS1[27]	size at 1 for RKF selectivity (females, 2005+)	126.159	15.816000	126.160	15.816000	128.084	16.477000	132.725	22.071000	–	–	–	–	–	–	–	–	–	–	–	–
	z50 for TCF retention (2013+)	–	–	–	–	–	–	–	–	125.238	0.683910	125.216	0.680920	125.200	0.676570	125.173	0.681140	125.186	0.678760	125.209	0.675480
pS1[28]	z50 for TCF retention (2005-2009)	139.725	1.002100	139.725	1.002100	139.624	1.008300	137.633	0.304640	–	–	–	–	–	–	–	–	–	–	–	–
pS1[29]	z50 for TCF retention (2013+)	125.060	0.678340	125.061	0.678410	125.191	0.666580	125.483	0.725320	–	–	–	–	–	–	–	–	–	–	–	–

Table 29. Final parameter values for selectivity parameter pS2 for successful models. NA indicates the parameter was fixed, not estimated. "—" indicates the parameter was not included in the indicated model.

		21.22a		22.01		22.02		22.03		22.05b		22.05c		22.05d		22.06b		22.06c		22.06d	
name	label	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.
pS2[01]	width for NMFS survey selectivity (males, 1982+)	–	–	–	–	–	–	–	–	88.58081	2.937200	92.60366	3.314500	100.00000	1.795e − 04	94.16529	3.456300	100.00000	1.755e − 03	100.00000	1.275e − 04
	width for NMFS survey selectivity (males, pre-1982)	66.89242	2.558500	66.88594	2.558000	68.64232	2.335800	66.79032	2.548500	–	–	–	–	–	–	–	–	–	–	–	–
pS2[02]	width for NMFS survey selectivity (females, 1982+)	–	–	–	–	–	–	–	–	76.95710	5.758400	80.34584	6.423300	87.50409	7.405e + 00	79.53586	6.180100	84.97572	6.998e + 00	97.92564	1.000e + 01
	width for NMFS survey selectivity (males, 1982+)	90.86617	3.089800	90.85996	3.089200	91.49206	2.555400	90.31683	3.027300	–	–	–	–	–	–	–	–	–	–	–	–
pS2[03]	slope for TCF retention (pre-1991)	–	–	–	–	–	–	–	–	1.00000	0.001691	1.00000	0.001092	1.00000	6.431e − 04	1.00000	0.001789	1.00000	9.633e − 04	1.00000	5.854e − 04
	width for NMFS survey selectivity (females, pre-1982)	41.33826	2.217500	41.33719	2.217300	41.23306	1.737800	41.52302	2.244700	–	–	–	–	–	–	–	–	–	–	–	–
pS2[04]	slope for TCF retention (1997+)	–	–	–	–	–	–	–	–	1.99987	0.180800	1.99984	0.220150	1.99977	3.054e − 01	1.99990	0.150400	1.99982	2.418e − 01	1.99974	3.598e − 01
	width for NMFS survey selectivity (females, 1982+)	78.99429	6.103500	79.00083	6.105000	100.00000	0.001662	79.57399	6.226200	–	–	–	–	–	–	–	–	–	–	–	–
pS2[05]	slope for TCF retention (pre-1991)	0.78671	0.301310	0.78658	0.301080	0.77523	0.259610	0.79247	0.312840	–	–	–	–	–	–	–	–	–	–	–	–
	slope for TCF selectivity (males, pre-1997)	–	–	–	–	–	–	–	–	0.12204	0.006795	0.12292	0.006908	0.12454	7.026e − 03	0.12152	0.006878	0.12339	6.996e − 03	0.12616	7.126e − 03
pS2[06]	slope for TCF retention (1997+)	1.99965	0.472120	1.99965	0.473110	1.99991	0.118430	1.01386	0.772240	–	–	–	–	–	–	–	–	–	–	–	–
	slope for TCF selectivity (males, 1997+)	–	–	–	–	–	–	–	–	0.15625	0.006969	0.15619	0.007004	0.15522	6.984e − 03	0.15602	0.007072	0.15566	7.036e − 03	0.15511	6.995e − 03
pS2[07]	slope for TCF selectivity (females)	–	–	–	–	–	–	–	–	0.17619	0.021835	0.17703	0.021740	0.17820	2.141e − 02	0.17698	0.021727	0.17871	2.142e − 02	0.17881	2.147e − 02
	slope for TCF selectivity (males, pre-1997)	0.11792	0.007139	0.11791	0.007139	0.10654	0.006066	0.12095	0.006812	–	–	–	–	–	–	–	–	–	–	–	–
pS2[08]	ascending width for SCF selectivity (males, pre-1997)	–	–	–	–	–	–	–	–	32.98789	1.527100	33.12272	1.562700	33.51719	1.626e + 00	33.24579	1.560400	33.29107	1.601e + 00	33.59683	1.576e + 00
	slope for TCF selectivity (males, 1997+)	0.16071	0.007370	0.16071	0.007370	0.15987	0.007082	0.16359	0.007594	–	–	–	–	–	–	–	–	–	–	–	–
pS2[09]	ascending width for SCF selectivity (males, 1997-2004)	–	–	–	–	–	–	–	–	15.73589	3.555100	15.76729	3.597800	15.72961	3.740e + 00	15.70106	3.631400	15.84346	3.678e + 00	15.72404	3.744e + 00
	slope for TCF selectivity (females)	0.18040	0.022065	0.18039	0.022064	0.17460	0.021464	0.19625	0.025916	–	–	–	–	–	–	–	–	–	–	–	–
pS2[10]	ascending width for SCF selectivity (males, 2005+)	–	–	–	–	–	–	–	–	14.52976	0.711450	14.55557	0.716180	14.63147	7.278e − 01	14.57743	0.718660	14.62686	7.224e − 01	14.61399	7.296e − 01
	ascending width for SCF selectivity (males, pre-1997)	33.18869	1.656400	33.18807	1.656200	33.67259	2.047600	32.77599	2.461200	–	–	–	–	–	–	–	–	–	–	–	–
pS2[11]	ascending width for SCF selectivity (males, 1997-2004)	15.52980	3.493300	15.52937	3.493000	15.52846	3.450300	15.59118	3.573400	–	–	–	–	–	–	–	–	–	–	–	–
	slope for SCF selectivity (females, pre-1997)	–	–	–	–	–	–	–	–	0.08019	0.022282	0.08036	0.022835	0.08165	2.410e − 02	0.08068	0.022678	0.08164	2.349e − 02	0.07956	2.419e − 02
pS2[12]	ascending width for SCF selectivity (males, 2005+)	14.45919	0.707270	14.45826	0.707220	14.55015	0.702660	14.44445	0.707430	–	–	–	–	–	–	–	–	–	–	–	–
	slope for SCF selectivity (females, 1997-2004)	–	–	–	–	–	–	–	–	0.32518	0.302740	0.33392	0.325220	0.34448	3.542e − 01	0.32772	0.308530	0.33492	3.243e − 01	0.35881	4.063e − 01
pS2[13]	slope for SCF selectivity (females, 2005+)	–	–	–	–	–	–	–	–	0.08041	0.013842	0.08006	0.013876	0.07995	1.402e − 02	0.08027	0.013889	0.08107	1.415e − 02	0.07939	1.421e − 02
	slope for SCF selectivity (females, pre-1997)	0.08447	0.024245	0.08446	0.024243	0.07970	0.024425	0.13818	0.066682	–	–	–	–	–	–	–	–	–	–	–	–
pS2[14]	slope for GF.AllGear selectivity (males, pre-1987)	–	–	–	–	–	–	–	–	0.09374	0.012380	0.09600	0.011988	0.10698	1.268e − 02	0.08902	0.015670	0.10385	1.397e − 02	0.10715	1.128e − 02
	slope for SCF selectivity (females, 1997-2004)	0.33273	0.305130	0.33270	0.305010	0.33552	0.342700	0.31793	0.242180	–	–	–	–	–	–	–	–	–	–	–	–
pS2[15]	slope for GF.AllGear selectivity (males, 1987-1996)	–	–	–	–	–	–	–	–	0.03057	0.004578	0.03218	0.005195	0.04410	9.372e − 03	0.03423	0.005850	0.02423	1.737e − 03	0.03942	7.185e − 03
	slope for SCF selectivity (females, 2005+)	0.08079	0.014043	0.08079	0.014043	0.07587	0.013402	0.09650	0.022957	–	–	–	–	–	–	–	–	–	–	–	–
pS2[16]	slope for GF.AllGear selectivity (males, 1997+)	–	–	–	–	–	–	–	–	0.05682	0.002441	0.05632	0.002504	0.05499	2.602e − 03	0.05675	0.002549	0.05524	2.554e − 03	0.05477	2.609e − 03
	slope for GF.AllGear selectivity (males, pre-1987)	0.09069	0.010723	0.09066	0.010721	0.09405	0.010650	0.09001	0.010650	–	–	–	–	–	–	–	–	–	–	–	–
pS2[17]	slope for GF.AllGear selectivity (females, pre-1987)	–	–	–	–	–	–	–	–	0.15266	0.030965	0.14822	0.028758	0.13825	2.181e − 02	0.14488	0.027474	0.13005	2.330e − 02	0.13797	2.122e − 02
	slope for GF.AllGear selectivity (males, 1987-1996)	0.04587	0.008112	0.04586	0.008107	0.04592	0.008729	0.04580	0.007685	–	–	–	–	–	–	–	–	–	–	–	–
pS2[18]	slope for GF.AllGear selectivity (females, 1987-1996)	–	–	–	–	–	–	–	–	0.18622	0.062369	0.18065	0.060791	0.15837	5.406e − 02	0.17386	0.058980	0.02931	8.522e − 03	0.16752	5.795e − 02
	slope for GF.AllGear selectivity (males, 1997+)	0.05913	0.002525	0.05911	0.002522	0.05807	0.002411	0.05941	0.002516	–	–	–	–	–	–	–	–	–	–	–	–
pS2[19]	slope for GF.AllGear selectivity (females, 1997+)	–	–	–	–	–	–	–	–	0.07225	0.005741	0.06906	0.005383	0.06027	4.155e − 03	0.06680	0.004959	0.06147	4.432e − 03	0.06098	4.409e − 03
	slope for GF.AllGear selectivity (females, pre-1987)	0.13438	0.019629	0.13437	0.019628	0.14279	0.021489	0.13565	0.019947	–	–	–	–	–	–	–	–	–	–	–	–
pS2[20]	slope for GF.AllGear selectivity (females, 1987-1996)	0.17126	0.056272	0.17129	0.056289	0.20953	0.073013	0.16828	0.054766	–	–	–	–	–	–	–	–	–	–	–	–
	width for RKF selectivity (males, pre-1997)	–	–	–	–	–	–	–	–	19.27929	0.759270	19.34671	0.765860	19.33843	7.772e − 01	19.37137	0.768310	19.39467	7.712e − 01	19.28699	7.775e − 01
pS2[21]	slope for GF.AllGear selectivity (females, 1997+)	0.06395	0.004224	0.06387	0.004218	0.05820	0.003802	0.06417	0.004264	–	–	–	–	–	–	–	–	–	–	–	–
	width for RKF selectivity (males, 1997-2004)	–	–	–	–	–	–	–	–	27.26440	2.075500	27.29805	2.090300	27.24482	2.112e + 00	27.41397	2.108700	27.31029	2.103e + 00	27.28101	2.115e + 00
pS2[22]	width for RKF selectivity (males, 2005+)	–	–	–	–	–	–	–	–	27.04329	0.961060	27.10893	0.970030	27.12208	9.817e − 01	27.26429	0.981750	27.19544	9.808e − 01	27.17592	9.862e − 01
	width for RKF selectivity (males, pre-1997)	19.71234	0.794840	19.71170	0.794790	19.71910	0.806480	19.64831	0.794450	–	–	–	–	–	–	–	–	–	–	–	–
pS2[23]	width for RKF selectivity (males, 1997-2004)	27.93039	2.149600	27.92927	2.149400	27.81233	2.136100	27.99221	2.154500	–	–	–	–	–	–	–	–	–	–	–	–
	width for RKF selectivity (males, pre-1997)	–	–	–	–	–	–	–	–	18.02538	1.971700	18.54616	1.968200	19.01753	1.996e + 00	18.25285	1.964800	18.81665	1.947e + 00	19.29379	2.038e + 00
pS2[24]	width for RKF selectivity (males, 1997-2004)	–	–	–	–	–	–	–	–	15.77316	10.731000	15.08118	10.581000	14.43591	1.068e + 01	15.38492	10.649000	14.46725	1.028e + 01	13.93569	1.062e + 01
	width for RKF selectivity (males, 2005+)	27.68538	1.001300	27.68399	1.001200	27.13618	0.955850	27.81108	1.006100	–	–	–	–	–	–	–	–	–	–	–	–
pS2[25]	width for RKF selectivity (males, 2005+)	–	–	–	–	–	–	–	–	15.29523	5.267000	14.76439	5.156200	14.28399	4.972e + 00	15.00306	5.245500	14.27311	4.938e + 00	13.92666	5.183e + 00
	width for RKF selectivity (males, pre-1997)	17.65114	2.029600	17.65053	2.029500	17.85745	2.107600	18.03264	2.359900	–	–	–	–	–	–	–	–	–	–	–	–
pS2[26]	slope for TCF retention (2005-2009)	–	–	–	–	–	–	–	–	0.59395	0.204550	0.59888	0.208220	0.60895	2.153e − 01	0.59444	0.206450	0.59914	2.090e − 01	0.60765	2.146e − 01
	width for RKF selectivity (males, 1997-2004)	16.77483	11.039000	16.77448	11.038000	17.08502	11.445000	18.78009	14.963000	–	–	–	–	–	–	–	–	–	–	–	–
pS2[27]	slope for TCF retention (2013+)	–	–	–	–	–	–	–	–	0.56401	0.238570	0.56990	0.240500	0.57737	2.425e − 01	0.57537	0.243390	0.57650	2.432e − 01	0.57704	2.415e − 01
	width for RKF selectivity (males, 2005+)	16.26298	5.626000	16.26304	5.625800	16.82869	5.865400	17.52958	7.860100	–	–	–	–	–	–	–	–	–	–	–	–
pS2[28]	slope for TCF retention (2005-2009)	0.62043	0.228510	0.62048	0.228530	0.64345	0.243280	1.99970	0.405050	–	–	–	–	–	–	–	–	–	–	–	–
pS2[29]	slope for TCF retention (2013+)	0.59625	0.248760	0.59598	0.248700	0.59148	0.245430	0.50922	0.218480	–	–	–	–	–	–	–	–	–	–	–	–

Table 30. Final parameter values for selectivity parameters pS3 and pS4 for successful models. NA indicates the parameter was fixed, not estimated. "—" indicates the parameter was not included in the indicated model.

		21.22a		22.01		22.02		22.03		22.05b		22.05c		22.05d		22.06b		22.06c		22.06d	
name	label	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.
pS3[01]	scaled increment for descending z-at-1 for SCF selectivity (males, pre-1997)	0.001	*NA*	0.001	*NA*	0.001	*NA*	0.001	*NA*	0.001	*NA*	0.001	*NA*	0.001	*NA*	0.001	*NA*	0.001	*NA*	0.001	*NA*
pS3[02]	scaled increment for descending z-at-1 for SCF selectivity (males, 1997-2004)	0.001	*NA*	0.001	*NA*	0.001	*NA*	0.001	*NA*	0.001	*NA*	0.001	*NA*	0.001	*NA*	0.001	*NA*	0.001	*NA*	0.001	*NA*
pS3[03]	scaled increment for descending z-at-1 for SCF selectivity (males, 2005+)	0.001	*NA*	0.001	*NA*	0.001	*NA*	0.001	*NA*	0.001	*NA*	0.001	*NA*	0.001	*NA*	0.001	*NA*	0.001	*NA*	0.001	*NA*
pS4[01]	descending width for SCF selectivity (males, pre-1997)	1.100	*NA*	1.100	*NA*	1.100	*NA*	1.100	*NA*	1.100	*NA*	1.100	*NA*	1.100	*NA*	1.100	*NA*	1.100	*NA*	1.100	*NA*
pS4[02]	descending width for SCF selectivity (males, 1997-2004)	19.376	8.294	19.377	8.295	19.593	8.413	20.293	9.097	19.772	9.039	19.695	8.933	19.942	9.047	19.805	8.936	19.633	8.922	19.751	8.889
pS4[03]	descending width for SCF selectivity (males, 2005+)	13.255	1.277	13.257	1.277	13.338	1.320	13.226	1.272	13.327	1.341	13.330	1.331	13.379	1.330	13.299	1.319	13.294	1.321	13.423	1.330

Table 31. Final parameter values for selectivity “devs” parameters pDevsS1 for successful models. These are applied to time-varying selectivity in the directed fishery after 1990. NA indicates the parameter was fixed, not estimated. “—” indicates the parameter was not included in the indicated model.

	21.22a		22.01		22.02		22.03		22.05b		22.05c		22.05d		22.06b		22.06c		22.06d	
index	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.	estimate	std. dev.
1	0.08749	0.01766	0.08750	0.01766	0.10285	0.01813	0.08889	0.01462	0.08275	0.01692	0.07880	0.01697	0.06861	0.01703	0.08181	0.01708	0.07501	0.01705	0.06600	0.01686
2	0.06337	0.01589	0.06336	0.01589	0.07299	0.01646	0.06717	0.01411	0.05844	0.01539	0.05658	0.01536	0.05258	0.01536	0.05822	0.01546	0.05468	0.01536	0.05218	0.01533
3	0.11006	0.01541	0.11006	0.01541	0.12071	0.01642	0.10682	0.01298	0.10692	0.01459	0.10610	0.01461	0.10443	0.01465	0.10763	0.01476	0.10563	0.01466	0.10240	0.01463
4	0.12025	0.01991	0.12027	0.01991	0.13689	0.02057	0.10832	0.01824	0.12272	0.01841	0.12209	0.01844	0.12217	0.01836	0.12310	0.01858	0.12123	0.01849	0.11914	0.01843
5	0.11242	0.02942	0.11245	0.02942	0.14453	0.02997	0.08340	0.02112	0.12160	0.02640	0.12069	0.02643	0.12242	0.02607	0.12193	0.02650	0.12069	0.02619	0.11794	0.02622
6	0.12889	0.01735	0.12889	0.01735	0.12651	0.01878	0.18684	0.02023	0.12311	0.01639	0.12354	0.01631	0.12322	0.01609	0.12470	0.01645	0.12384	0.01621	0.12278	0.01599
7	−0.05155	0.01480	−0.05155	0.01480	−0.05934	0.01477	−0.04689	0.01432	−0.05037	0.01451	−0.04953	0.01460	−0.04832	0.01480	−0.05038	0.01467	−0.04889	0.01471	−0.04764	0.01488
8	−0.05073	0.01517	−0.05072	0.01517	−0.05673	0.01511	−0.03131	0.01416	−0.04677	0.01502	−0.04712	0.01511	−0.04704	0.01527	−0.04845	0.01516	−0.04735	0.01517	−0.04649	0.01529
9	−0.09736	0.01421	−0.09736	0.01421	−0.10367	0.01407	−0.09848	0.01373	−0.09717	0.01399	−0.09631	0.01406	−0.09452	0.01418	−0.09708	0.01412	−0.09530	0.01413	−0.09269	0.01419
10	0.03028	0.01245	0.03029	0.01245	0.02538	0.01244	0.01998	0.01178	0.03256	0.01226	0.03333	0.01232	0.03499	0.01247	0.03210	0.01239	0.03368	0.01241	0.03556	0.01248
11	0.17226	0.01356	0.17227	0.01356	0.16640	0.01347	0.13999	0.01199	0.17514	0.01343	0.17733	0.01354	0.18209	0.01377	0.17592	0.01352	0.17901	0.01363	0.18273	0.01381
12	−0.02214	0.01504	−0.02214	0.01504	−0.03450	0.01522	−0.02648	0.01443	−0.02169	0.01490	−0.02064	0.01497	−0.01854	0.01512	−0.02111	0.01502	−0.01960	0.01506	−0.01676	0.01514
13	−0.08221	0.01308	−0.08220	0.01308	−0.08944	0.01301	−0.08337	0.01270	−0.08284	0.01281	−0.08302	0.01291	−0.08397	0.01310	−0.08431	0.01301	−0.08396	0.01304	−0.08350	0.01316
14	−0.12057	0.01466	−0.12056	0.01466	−0.12665	0.01451	−0.12068	0.01432	−0.12113	0.01436	−0.12108	0.01447	−0.12145	0.01468	−0.12228	0.01457	−0.12141	0.01460	−0.12082	0.01476
15	−0.08746	0.01714	−0.08748	0.01714	−0.09496	0.01696	−0.08509	0.01632	−0.08631	0.01679	−0.08551	0.01688	−0.08395	0.01706	−0.08608	0.01694	−0.08446	0.01696	−0.08255	0.01709
16	−0.13241	0.01541	−0.13243	0.01541	−0.13923	0.01521	−0.13020	0.01476	−0.13322	0.01511	−0.13274	0.01521	−0.13245	0.01544	−0.13352	0.01531	−0.13241	0.01534	−0.13155	0.01549
17	−0.18047	0.01707	−0.18052	0.01707	−0.19148	0.01711	−0.17877	0.01648	−0.18386	0.01698	−0.18255	0.01705	−0.18014	0.01719	−0.18232	0.01707	−0.18039	0.01711	−0.17655	0.01708

Table 32. Estimated values for natural mortality (*M*) from successful models. The period 1980-1984 is hypothesized to be a period of high M on mature Tanner crab, and separate values are estimated for this period of “elevated” mortality for models initialized in 1948. For models initialized in 1982, the estimates of M apply to the entire model time period.

	immature	mature			
	all	female		male	
case	typical	typical	elevated	typical	elevated
21.22a	0.235	0.307	0.601	0.300	0.705
22.01	0.235	0.307	0.601	0.300	0.705
22.02	0.229	0.303	0.508	0.311	0.580
22.03	0.234	0.308	0.595	0.301	0.716
22.05b	0.235	0.313	–	0.299	–
22.05c	0.230	0.313	–	0.293	–
22.05d	0.225	0.317	–	0.285	–
22.06b	0.229	0.315	–	0.293	–
22.06c	0.223	0.316	–	0.287	–
22.06d	0.226	0.318	–	0.292	–

Table 33. Estimated values for fully-selected catchability in the NMFS survey. For models initialized in 1948, catchability is estimated in two time periods (1975-1981 and 1982+, corresponding to changes in survey gear in 1982).

	NMFS F female		NMFS M male	
case	1975	1982	1975	1982
21.22a	0.37	0.29	0.52	0.53
22.01	0.37	0.29	0.52	0.53
22.02	0.33	0.20	0.49	0.45
22.03	0.37	0.29	0.53	0.54
22.05b	–	0.28	–	0.54
22.05c	–	0.29	–	0.53
22.05d	–	0.30	–	0.50
22.06b	–	0.29	–	0.52
22.06c	–	0.30	–	0.50
22.06d	–	0.29	–	0.52

Figures

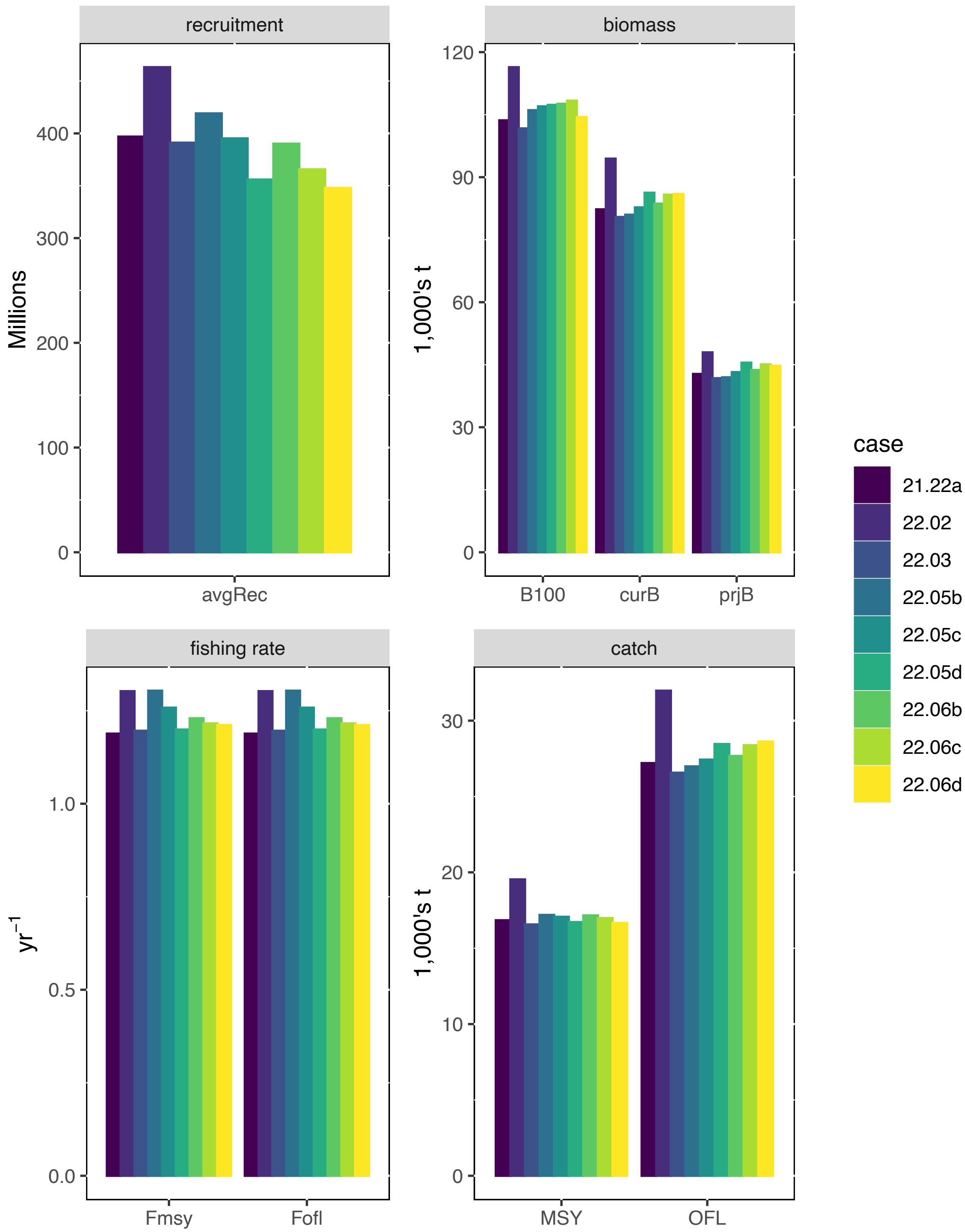

Figure 1. Comparison of management-related quantities from the models regarded as successful. avgRec: average recruitment; curb: current mature biomass; prjB: MMB projected ahead one year assuming the OFL is taken.

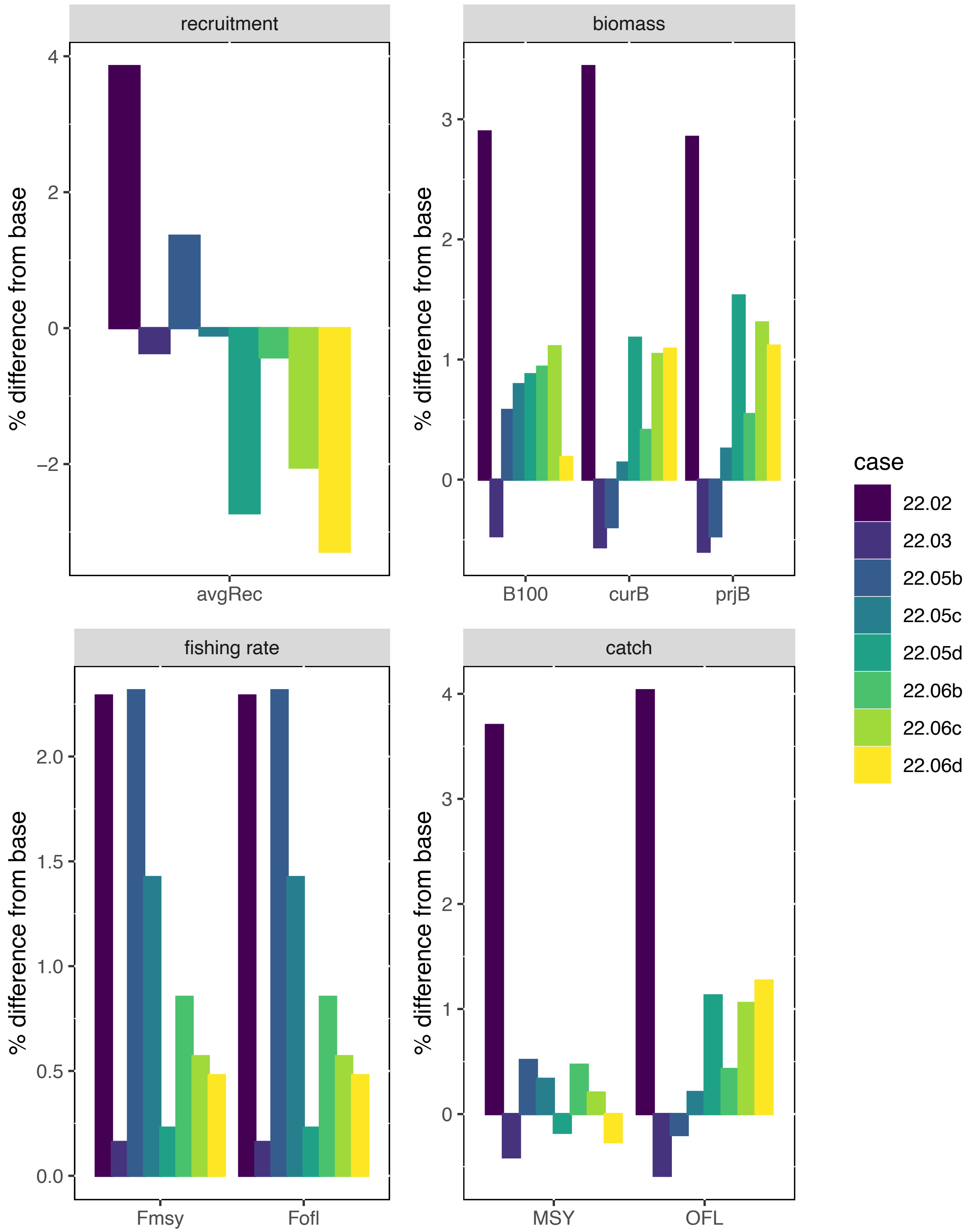

Figure 2. Differences in management-related quantities, relative to 21.22a, from the models regarded as successful. avgRec: average recruitment; curb: current mature biomass; prjB: MMB projected ahead one year assuming the OFL is taken.

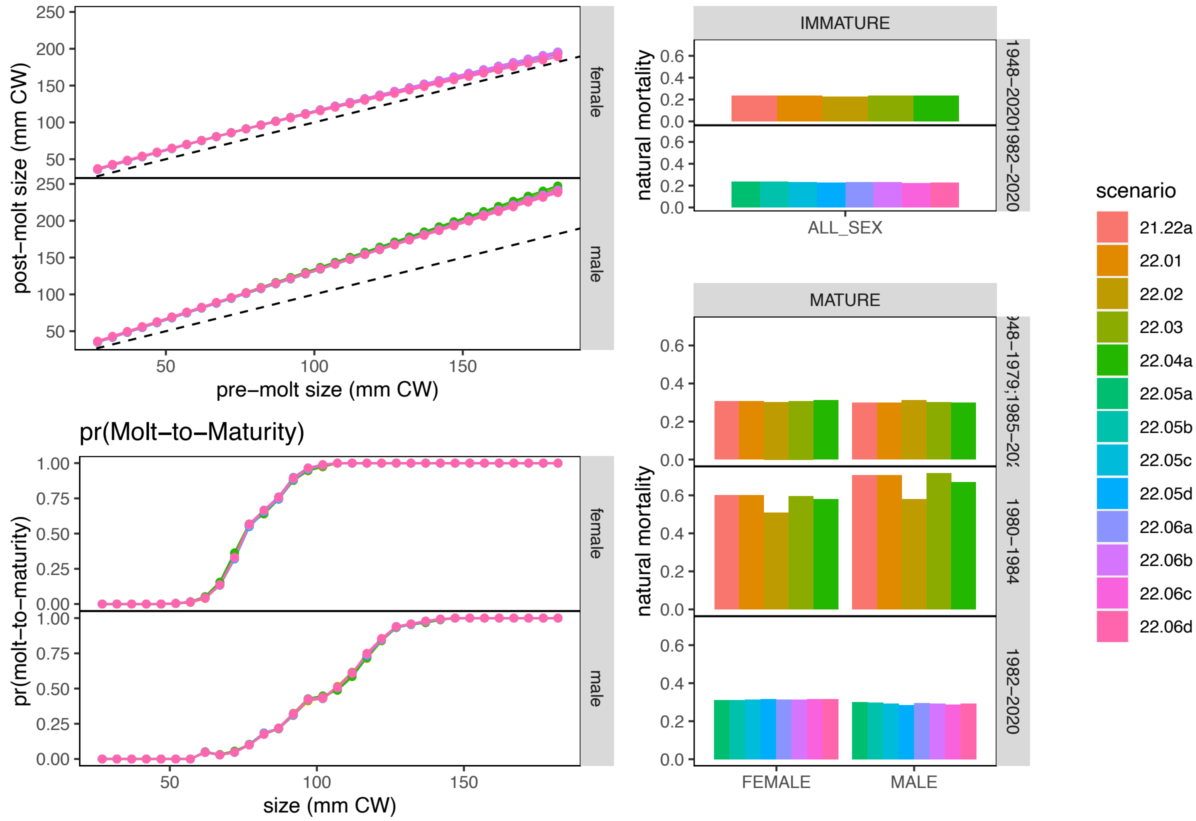

Figure 3. Comparison of population processes estimated in the various model considered “successful”. Upper left: estimated mean growth curves; lower left: estimated size-specific probabilities of undergoing the molt to maturity; upper right: estimates of M for immature crab (the values apply to the entire model period, but the model periods differ between those initialized in 1948 [upper panel] and in 1982 [lower panel]); lower right: estimates of M for mature crab (in two time blocks for models initialized in 1948, on time block for those initialized in 1982.

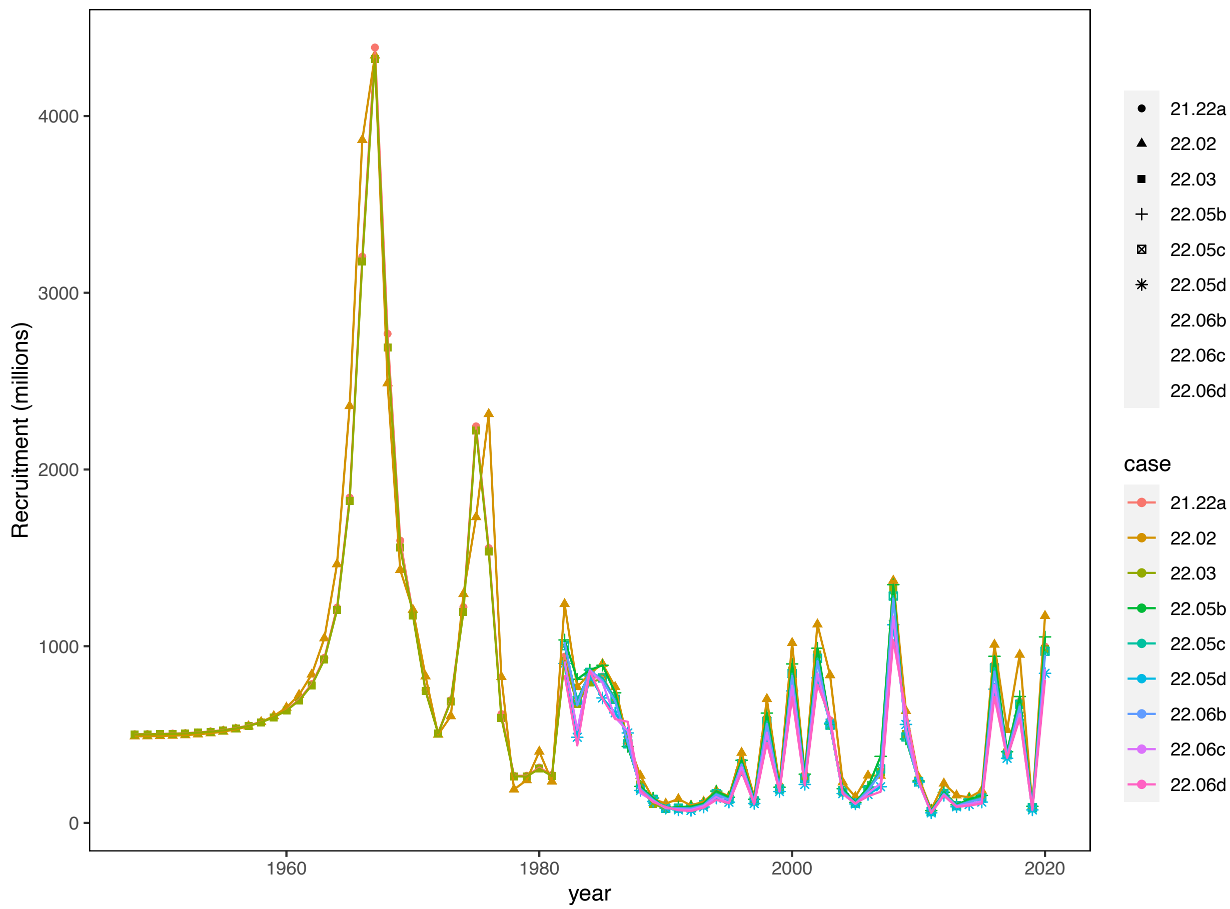

Figure 4. Estimated recruitment (full model periods).

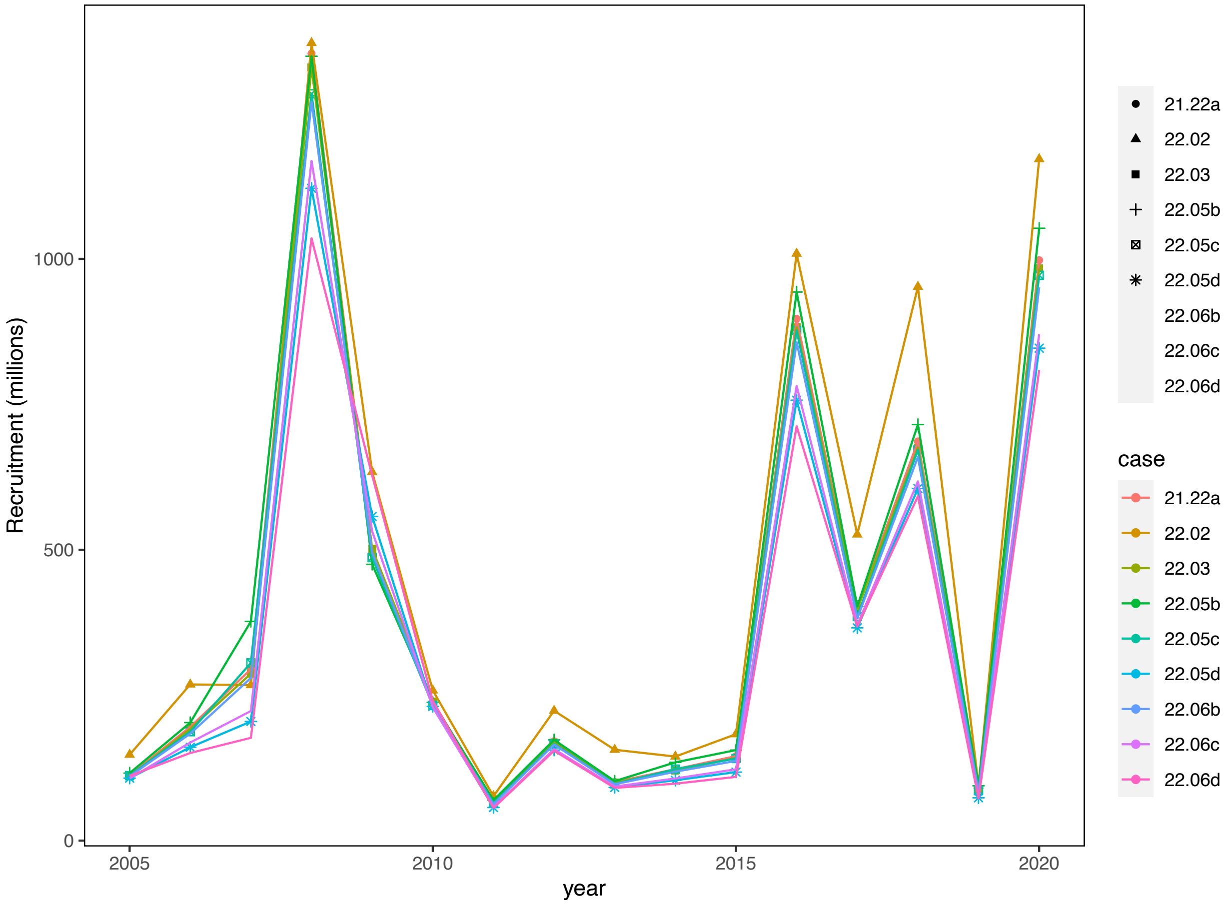

Figure 5. Recent trends in estimated recruitment.

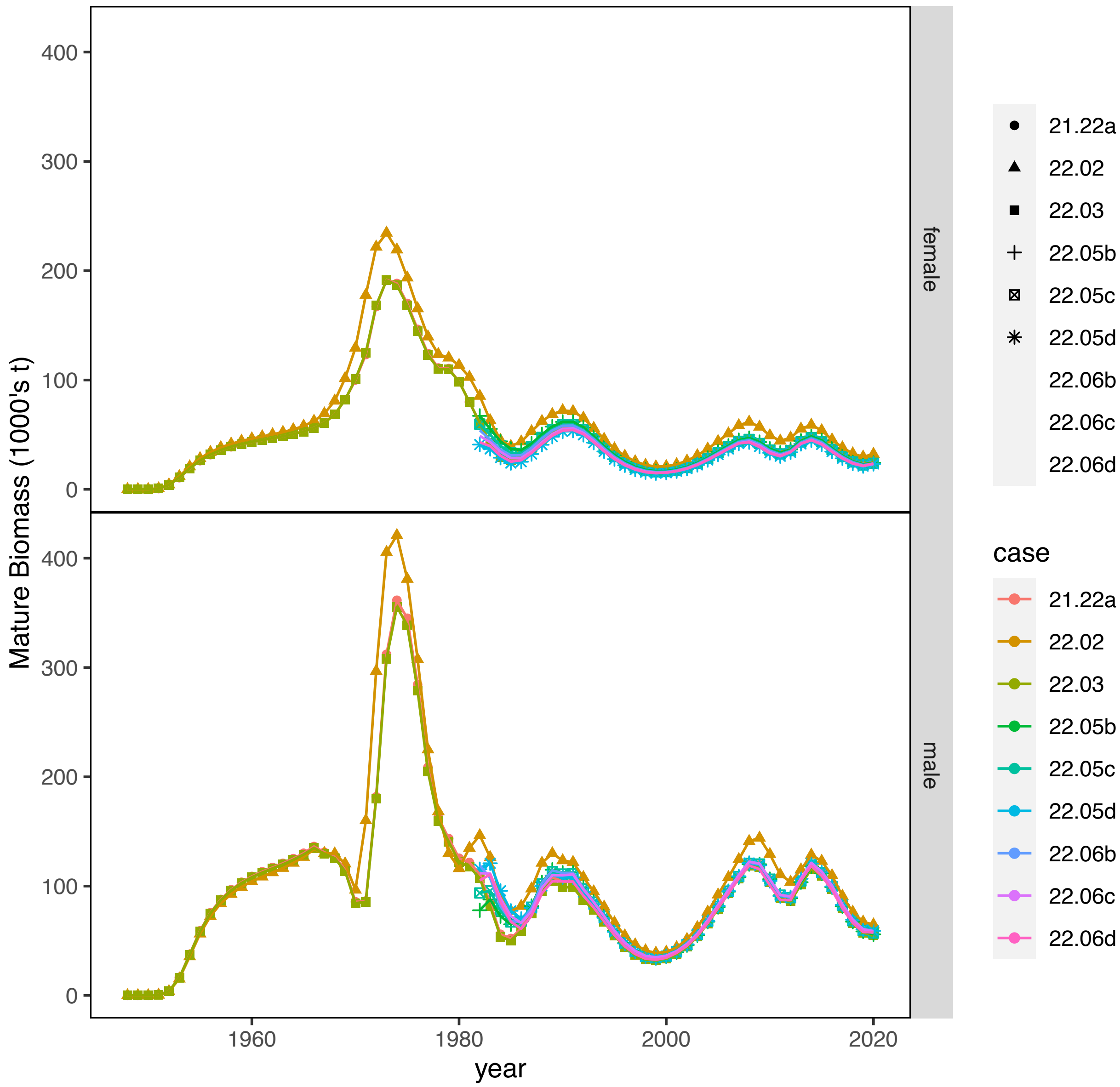

Figure 6. Estimated trends in mature biomass (full model periods).

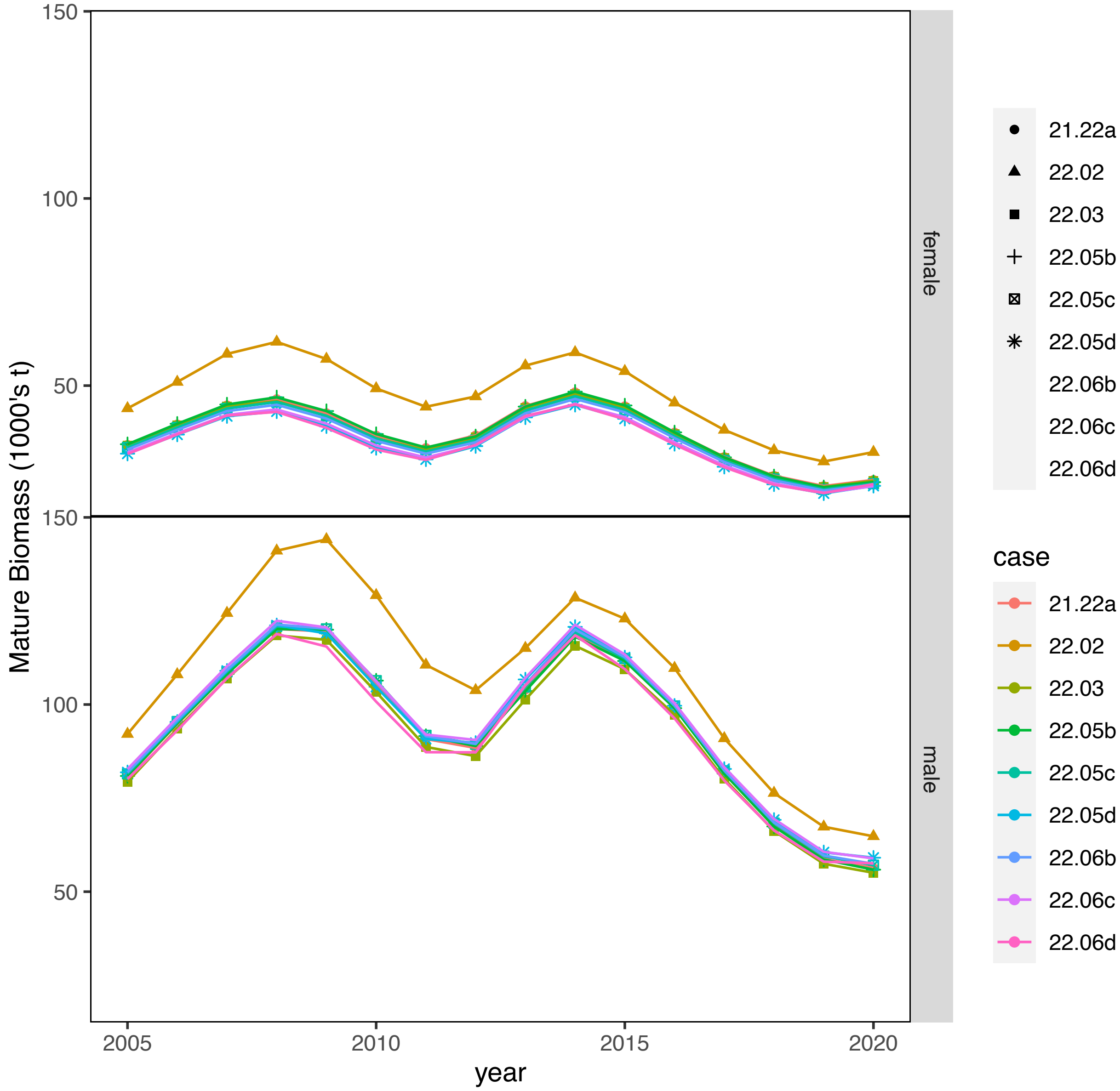

Figure 7. Estimated recent trends in mature biomass.

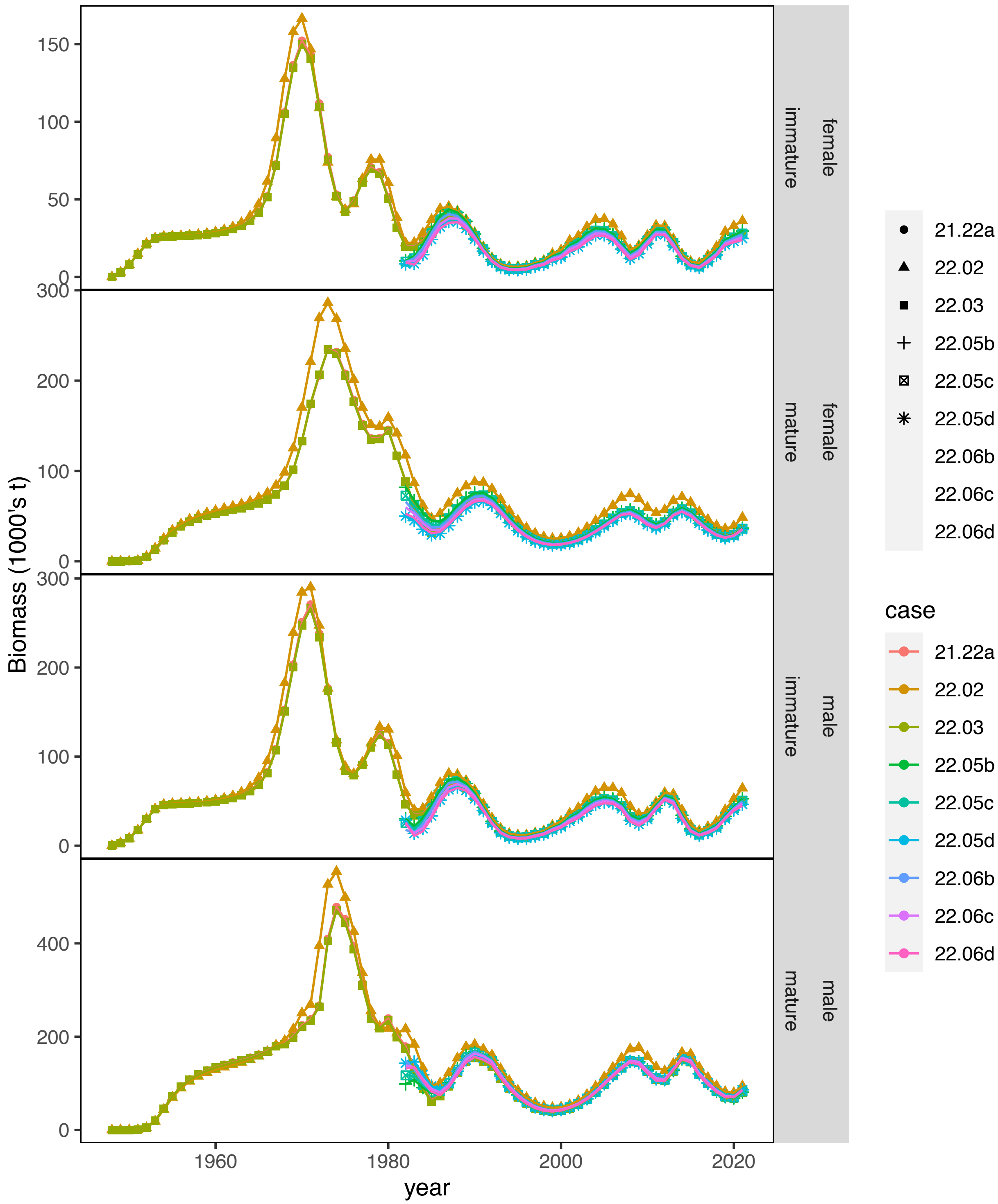

Figure 8. Trends in population biomass (full model periods).

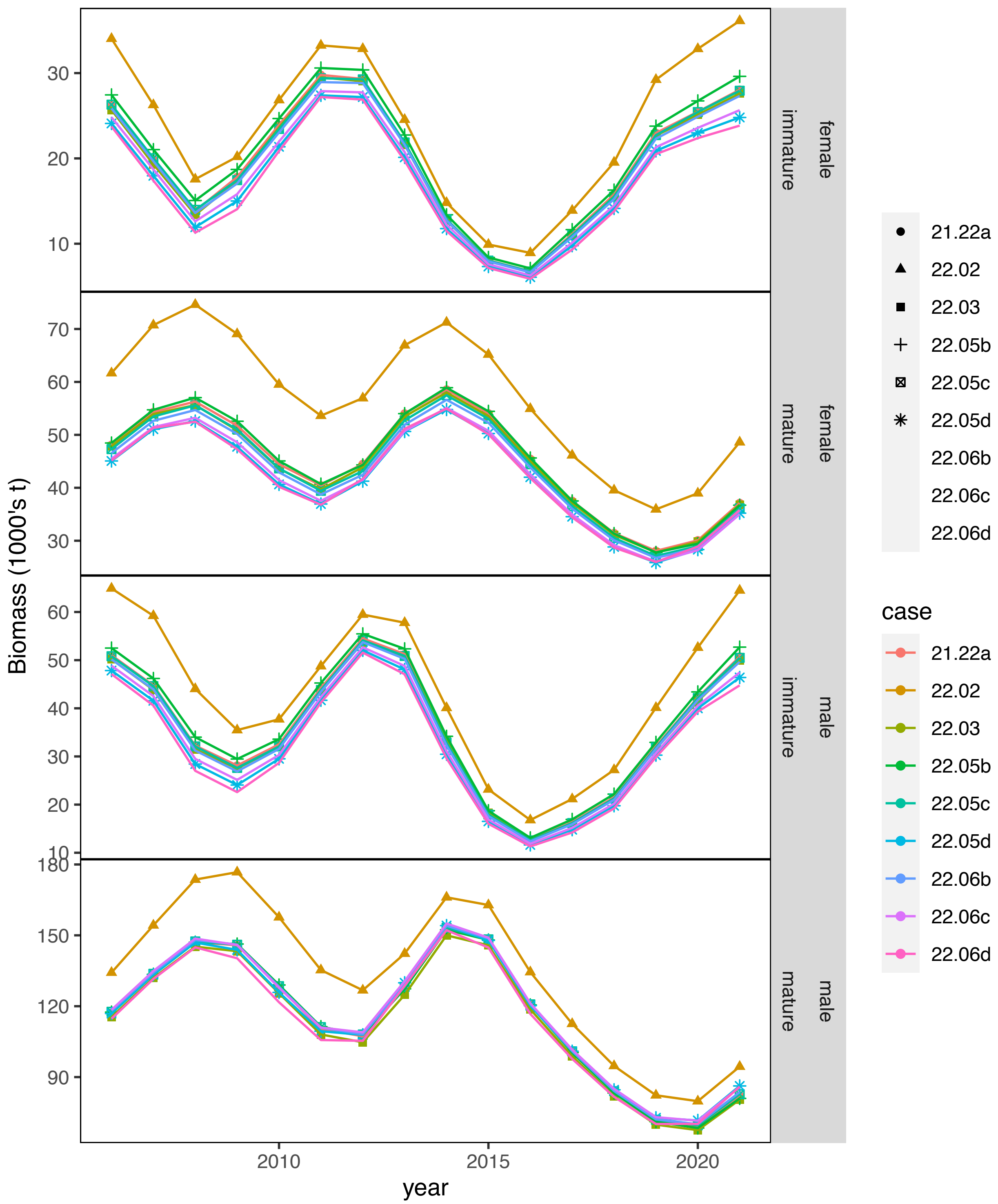

Figure 9. Estimated recent trends in population biomass/

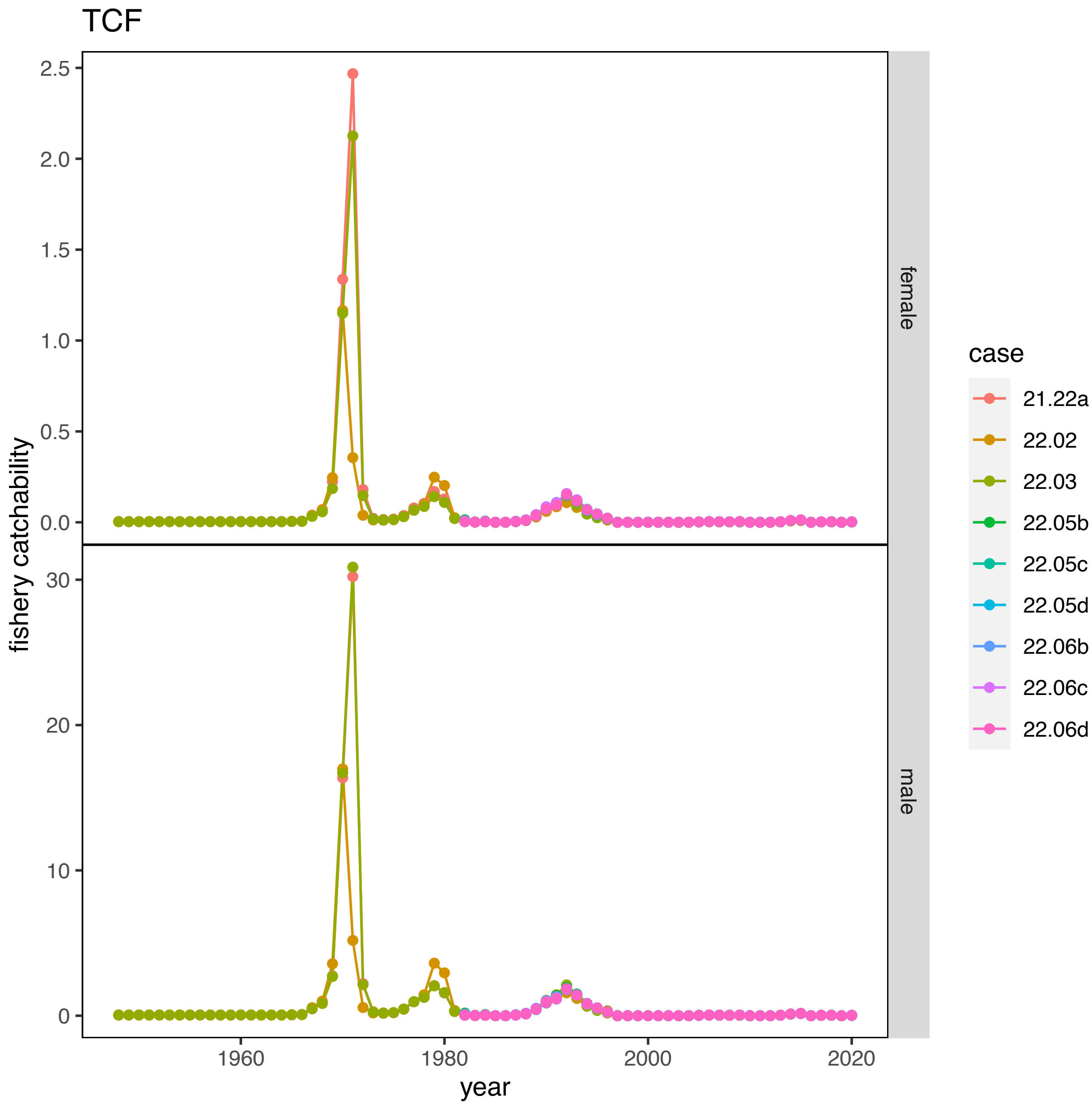

Figure 10. Estimated fully-selected capture rates in the directed fishery.

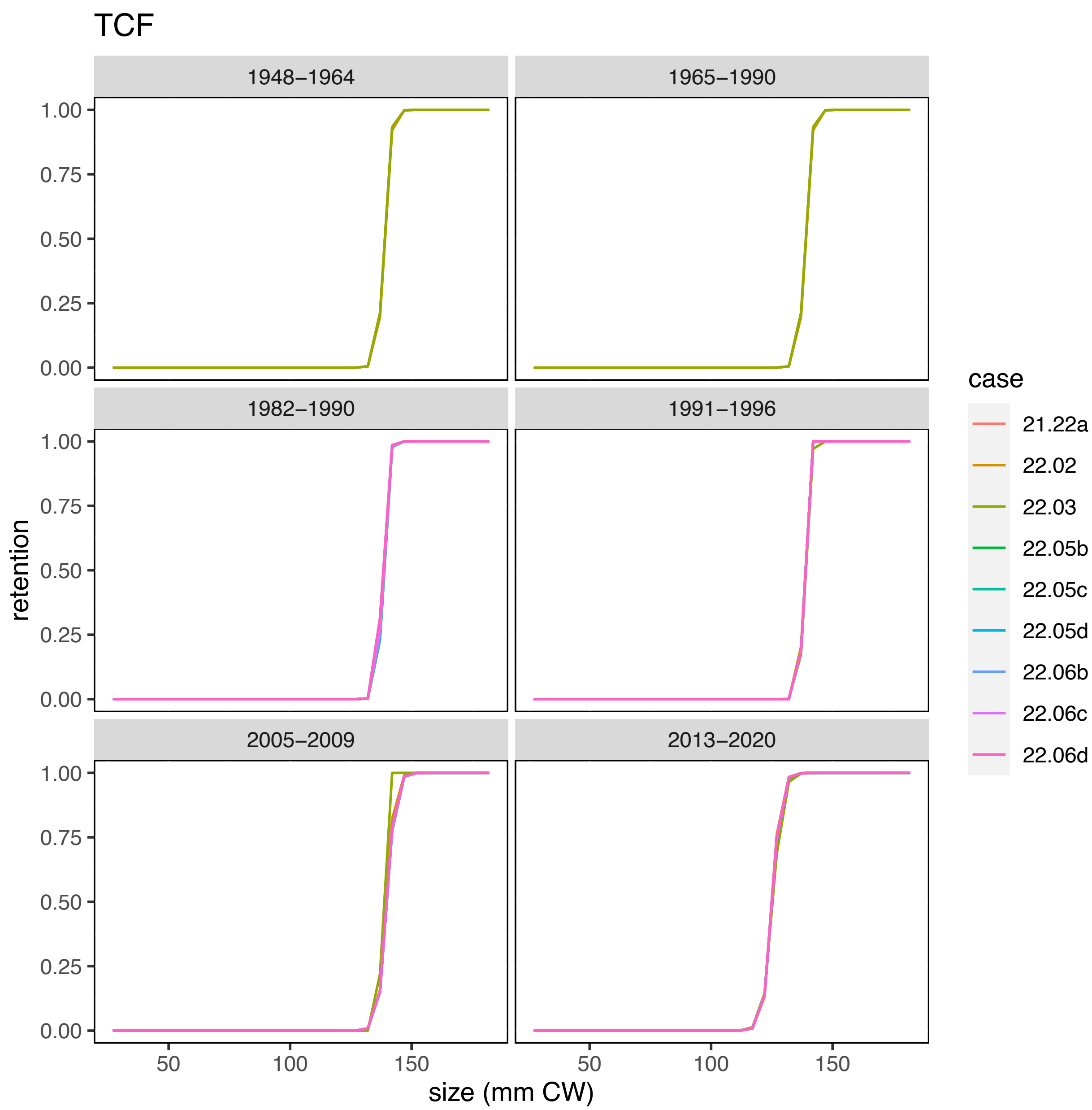

Figure 11. Estimated size-specific retention in the directed fishery during different time periods (not all models use the same time blocks).

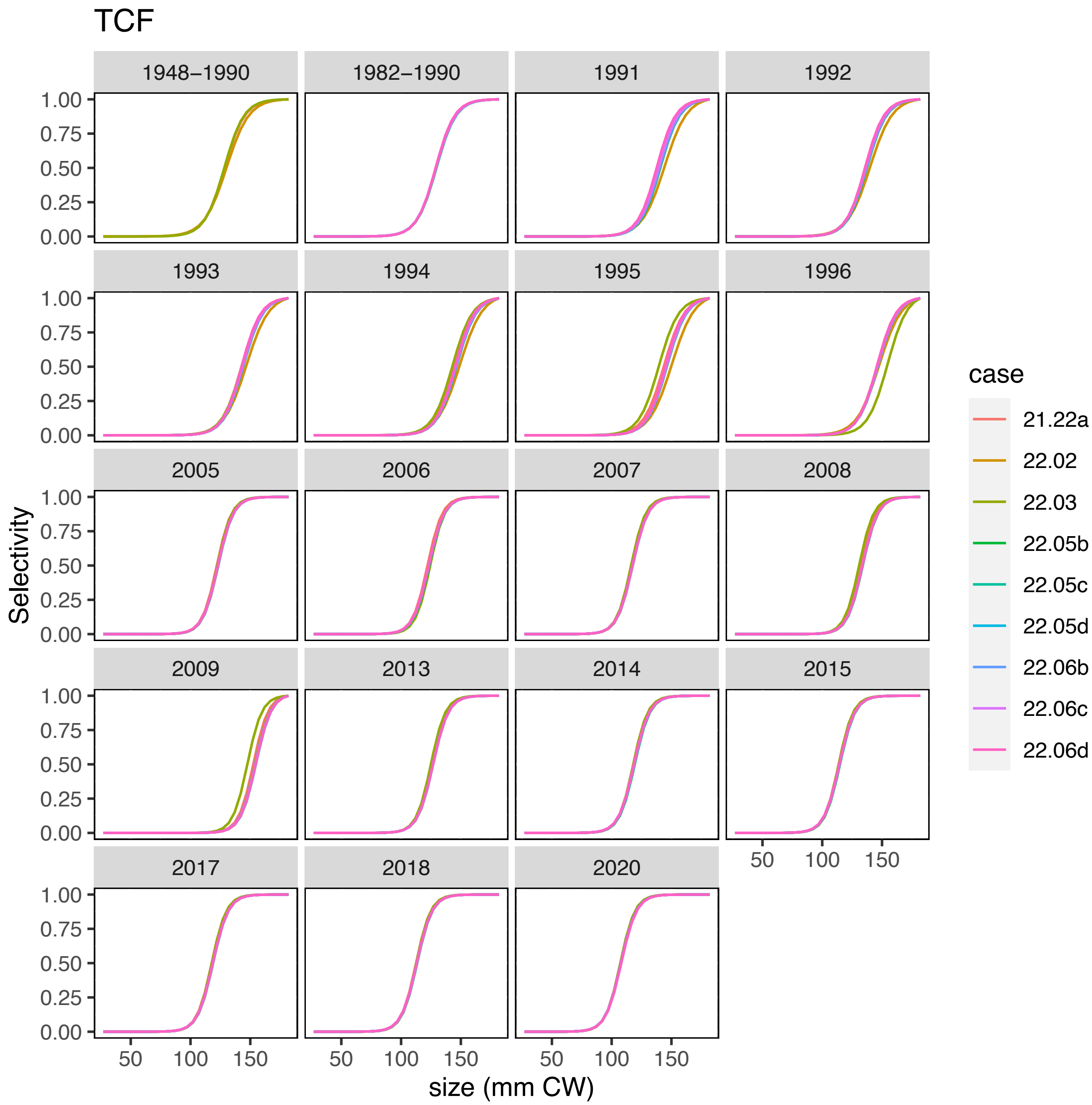

Figure 12. Estimated size-specific selectivity for males in the directed fishery during different time periods (not all models use the same time blocks).

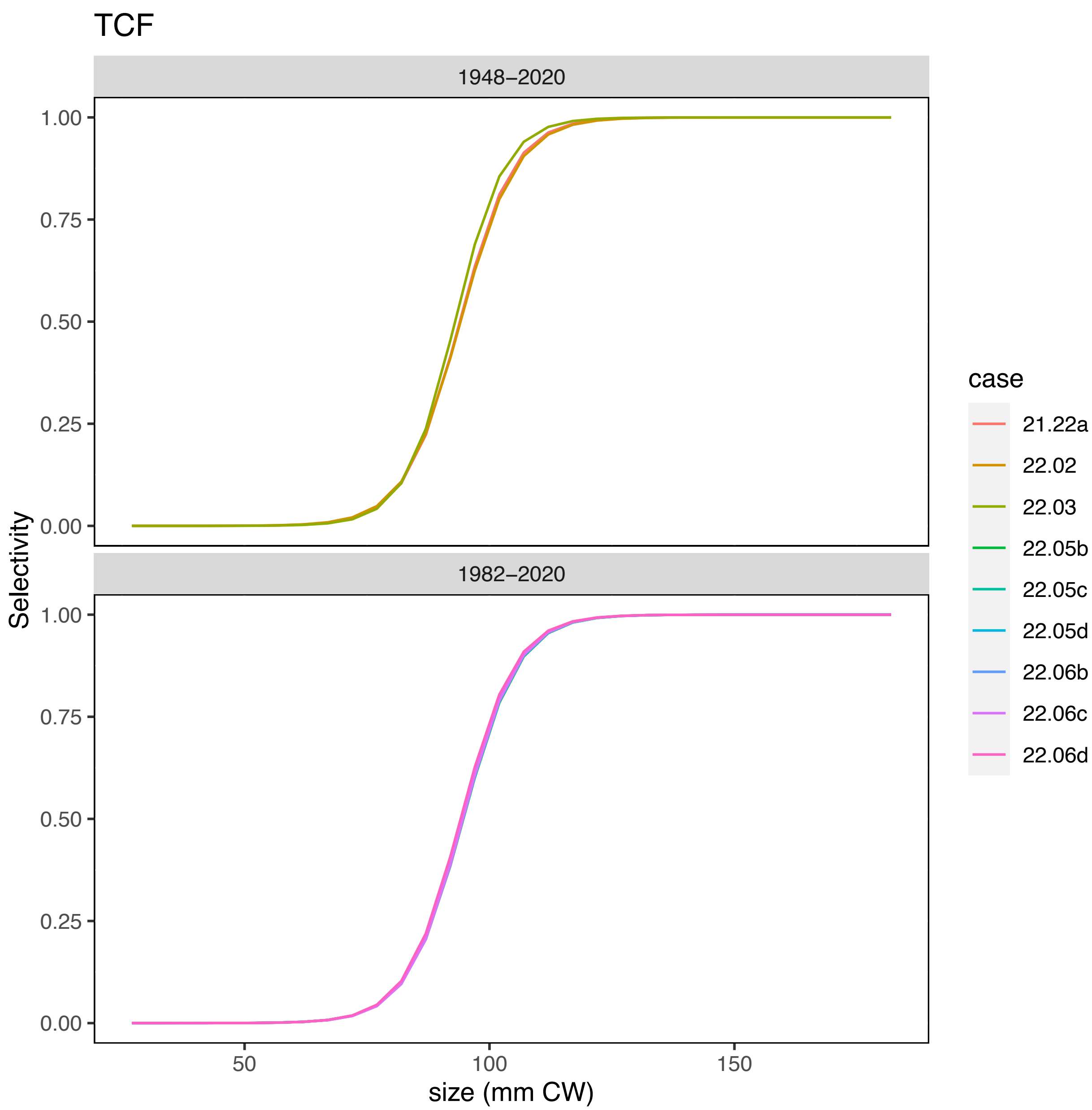

Figure 13. Estimated size-specific bycatch selectivity for females in the directed fishery during different time periods (not all models use the same time blocks).

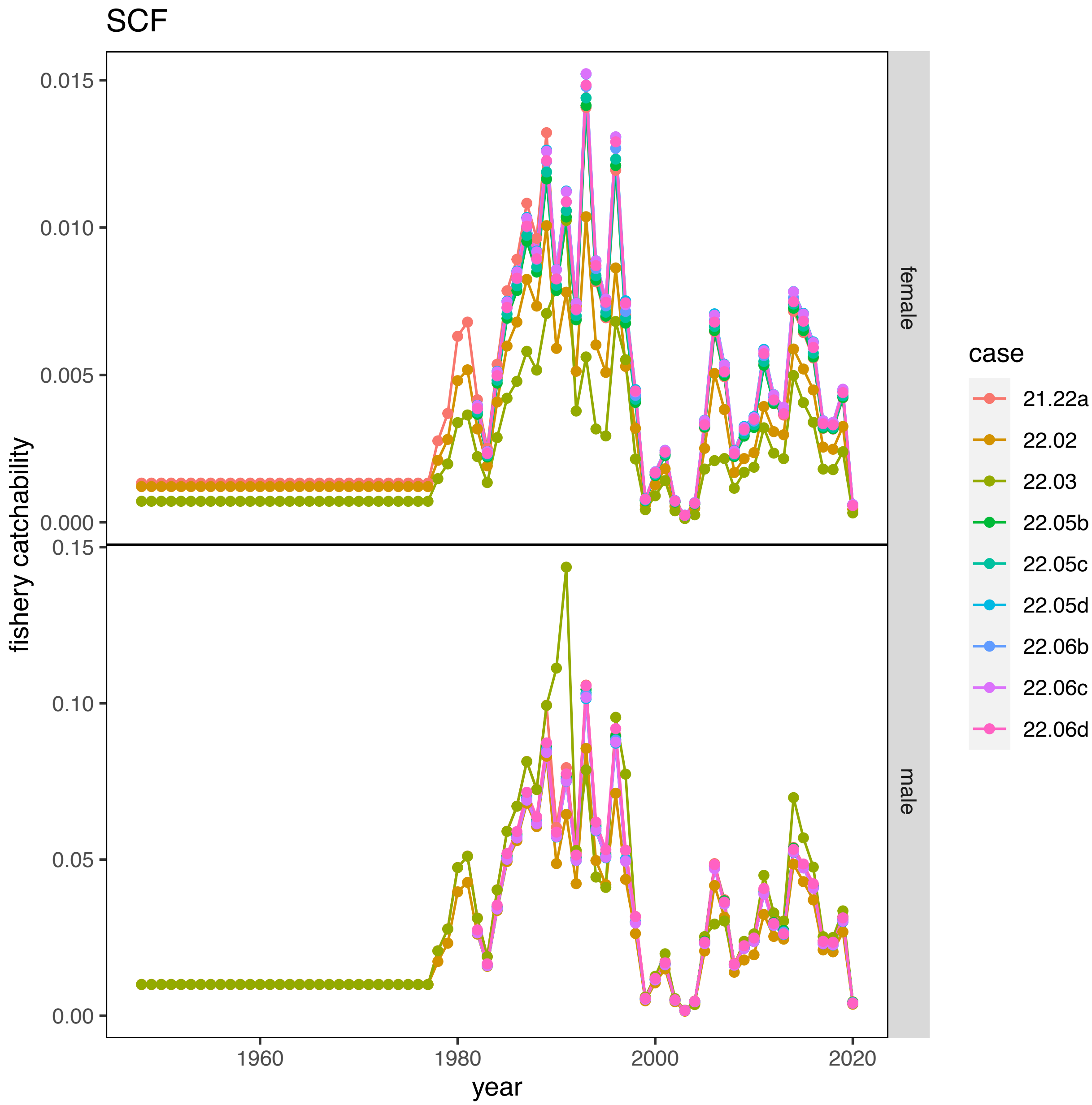

Figure 14. Estimated fully-selected bycatch capture rates in the snow crab fishery.

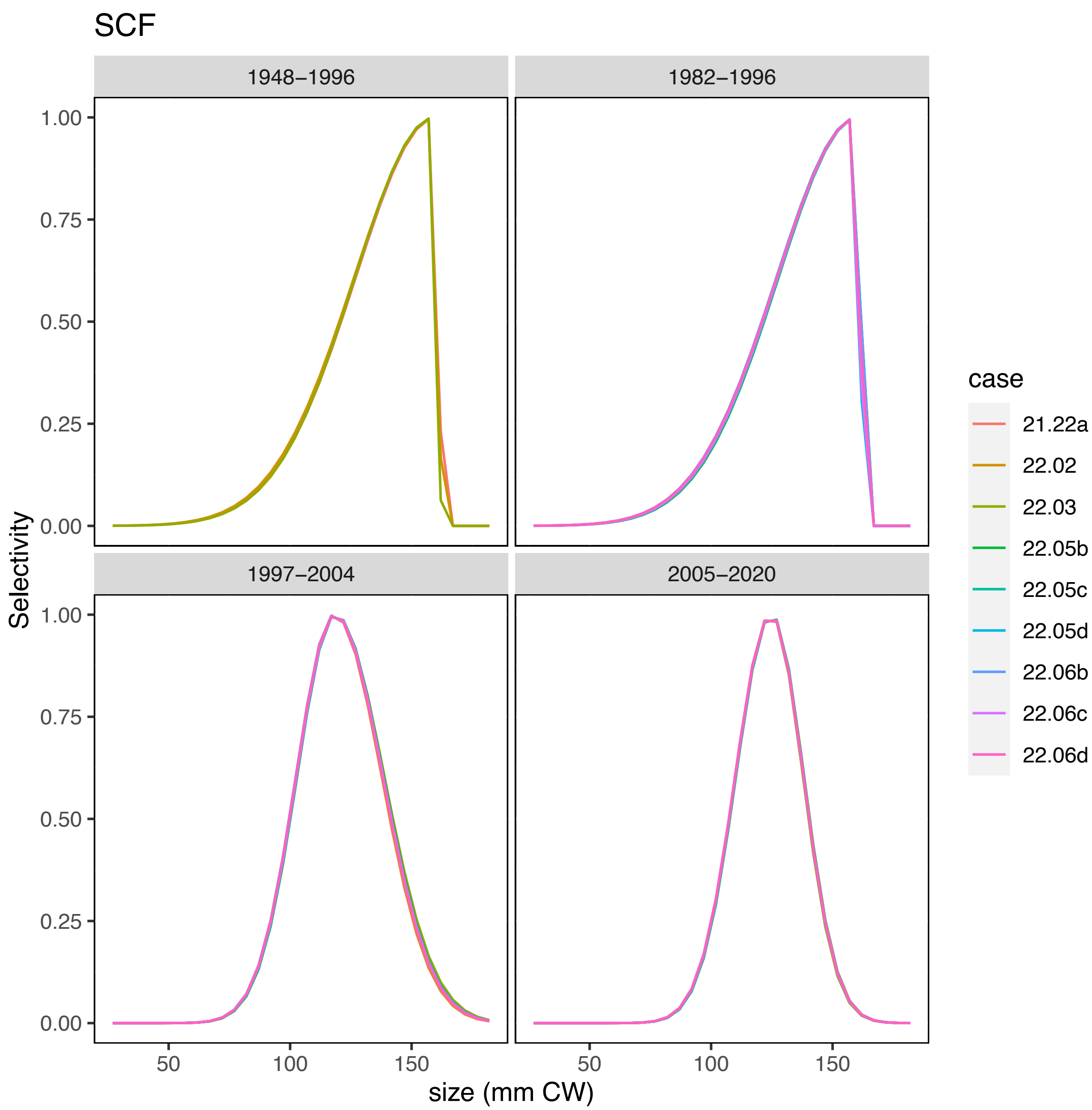

Figure 15. Estimated size-specific bycatch selectivity for males in the snow crab fishery during different time periods (not all models use the same time blocks).

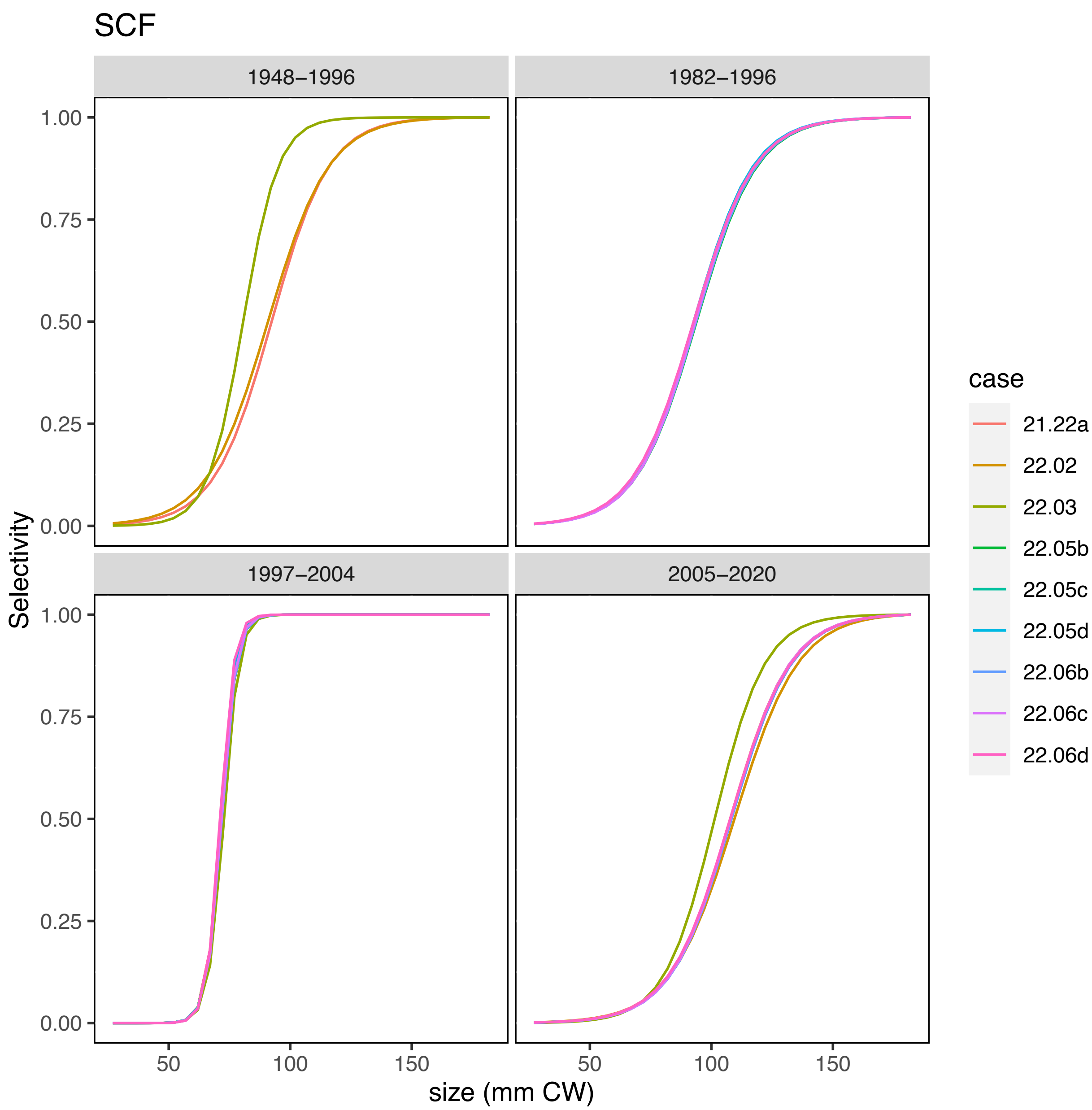

Figure 16. Estimated size-specific bycatch selectivity for females in the snow crab fishery during different time periods (not all models use the same time blocks).

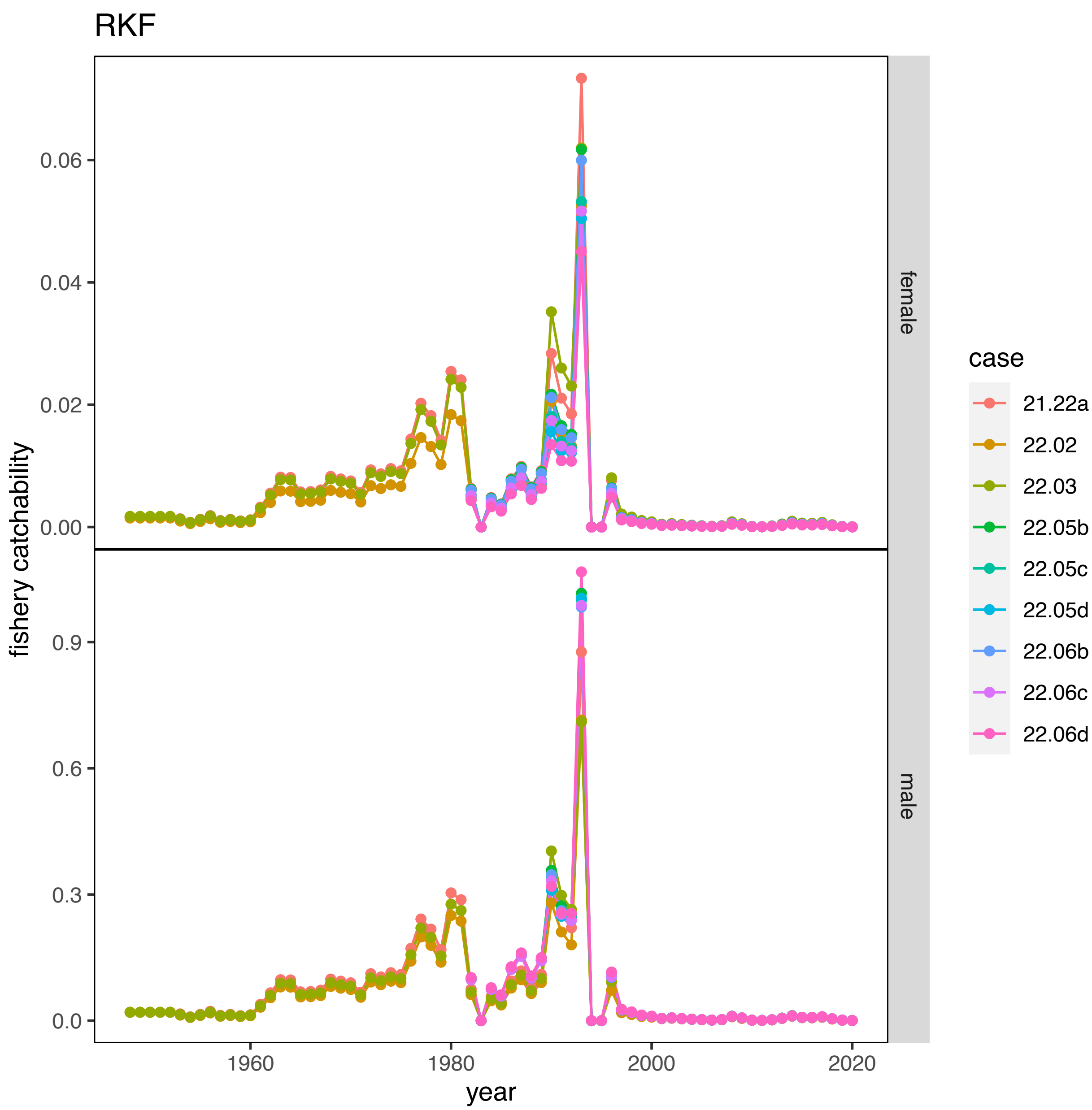

Figure 17. Estimated fully-selected bycatch capture rates in the BBRKC fishery.

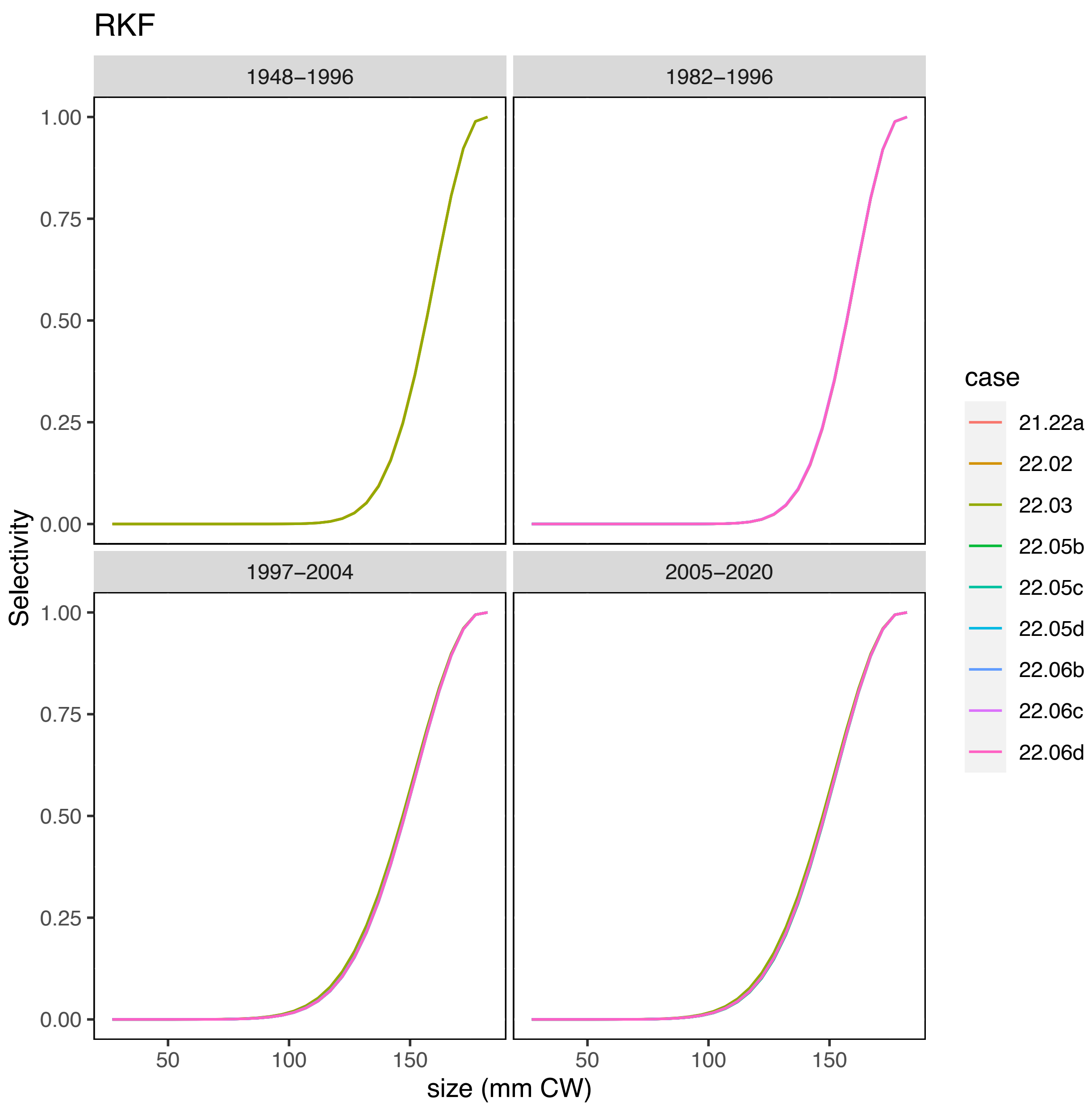

Figure 18. Estimated size-specific bycatch selectivity for males in the BBRKC fishery during different time periods (not all models use the same time blocks).

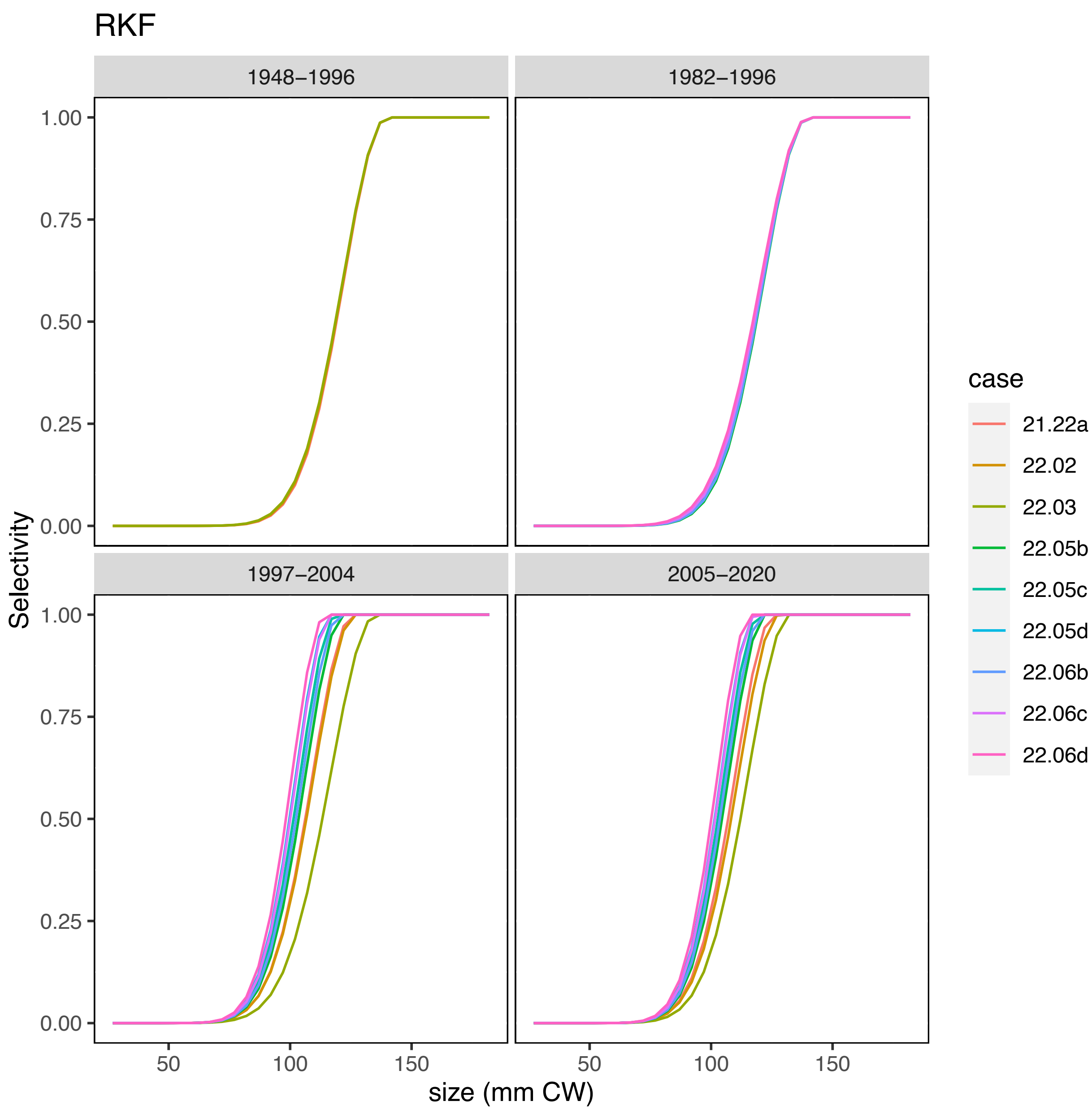

Figure 19. Estimated size-specific bycatch selectivity for females in the BBRKC fishery during different time periods (not all models use the same time blocks).

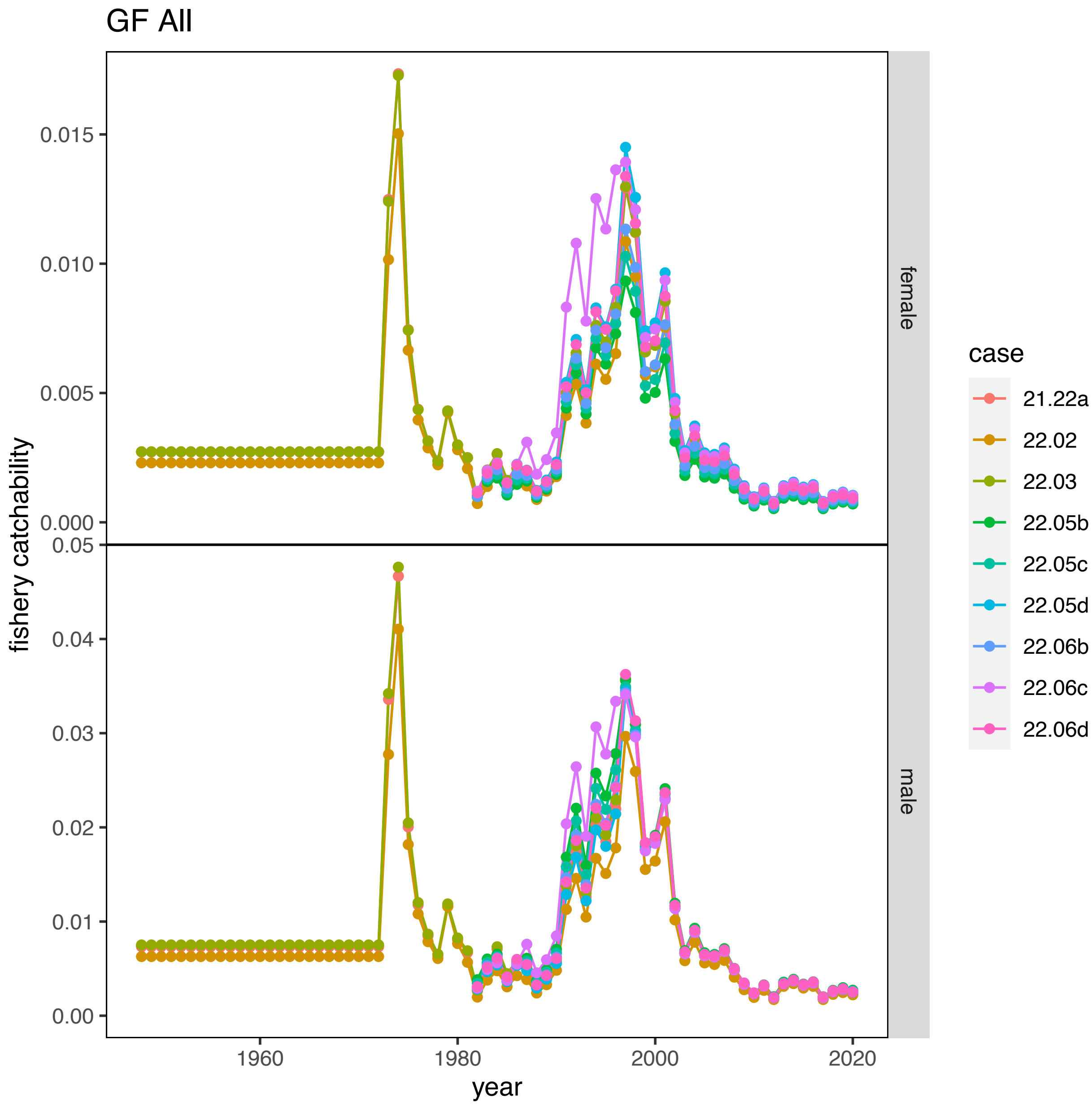

Figure 20. Estimated fully-selected bycatch capture rates in the groundfish fisheries.

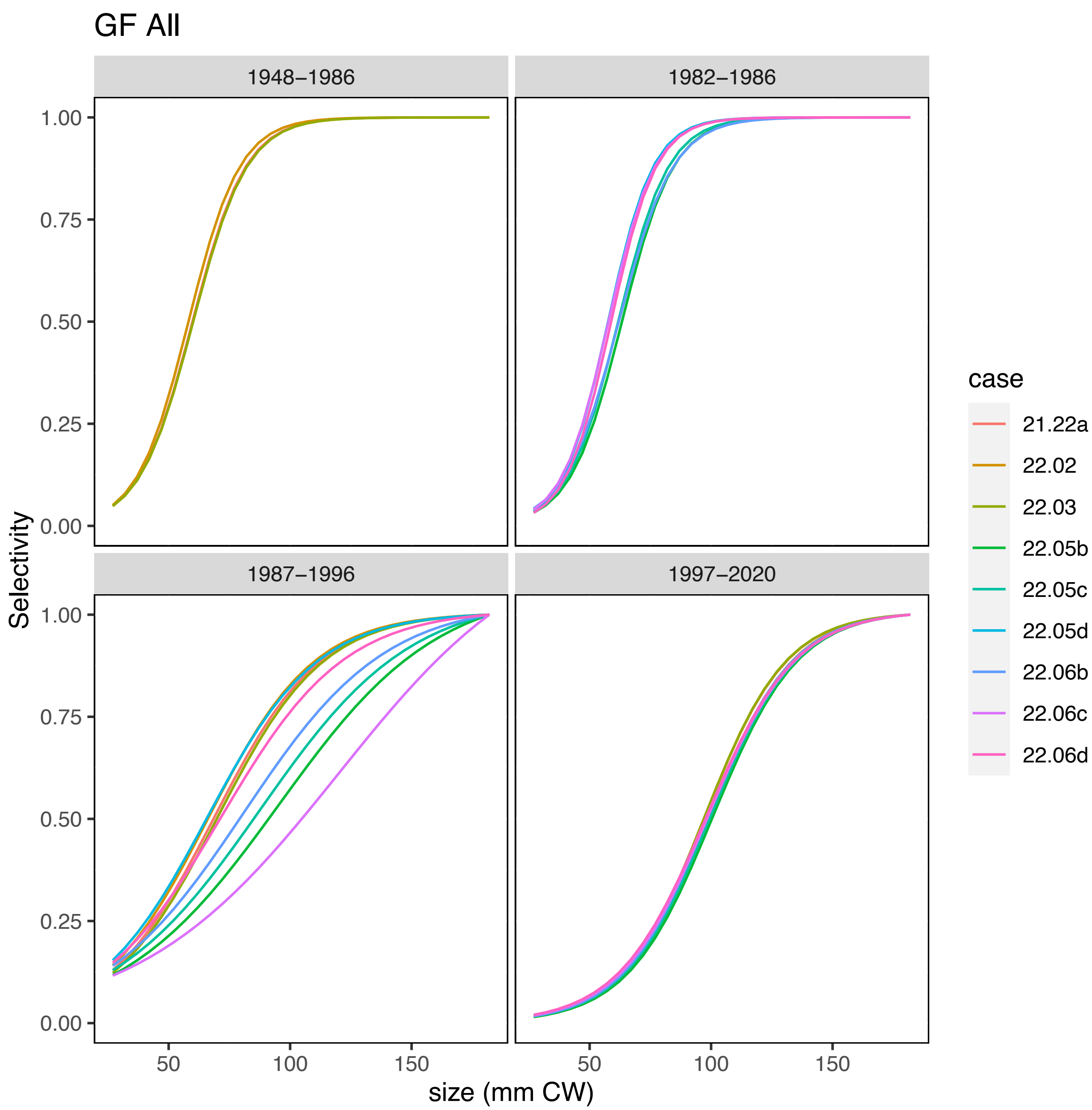

Figure 21. Estimated size-specific bycatch selectivity for males in the groundfish fisheries during different time periods (not all models use the same time blocks).

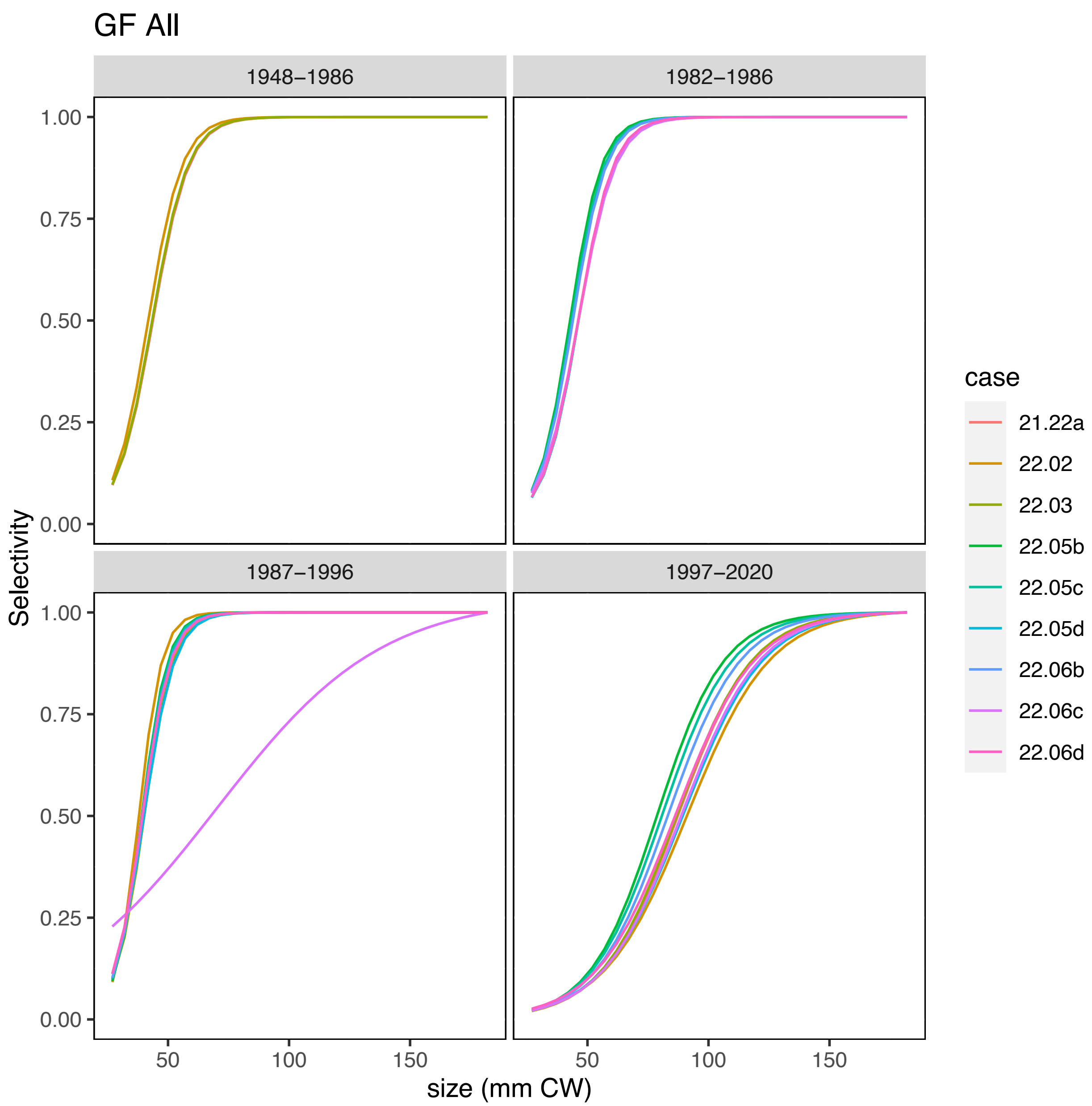

Figure 22. Estimated size-specific bycatch selectivity for females in the groundfish fisheries during different time periods (not all models use the same time blocks).

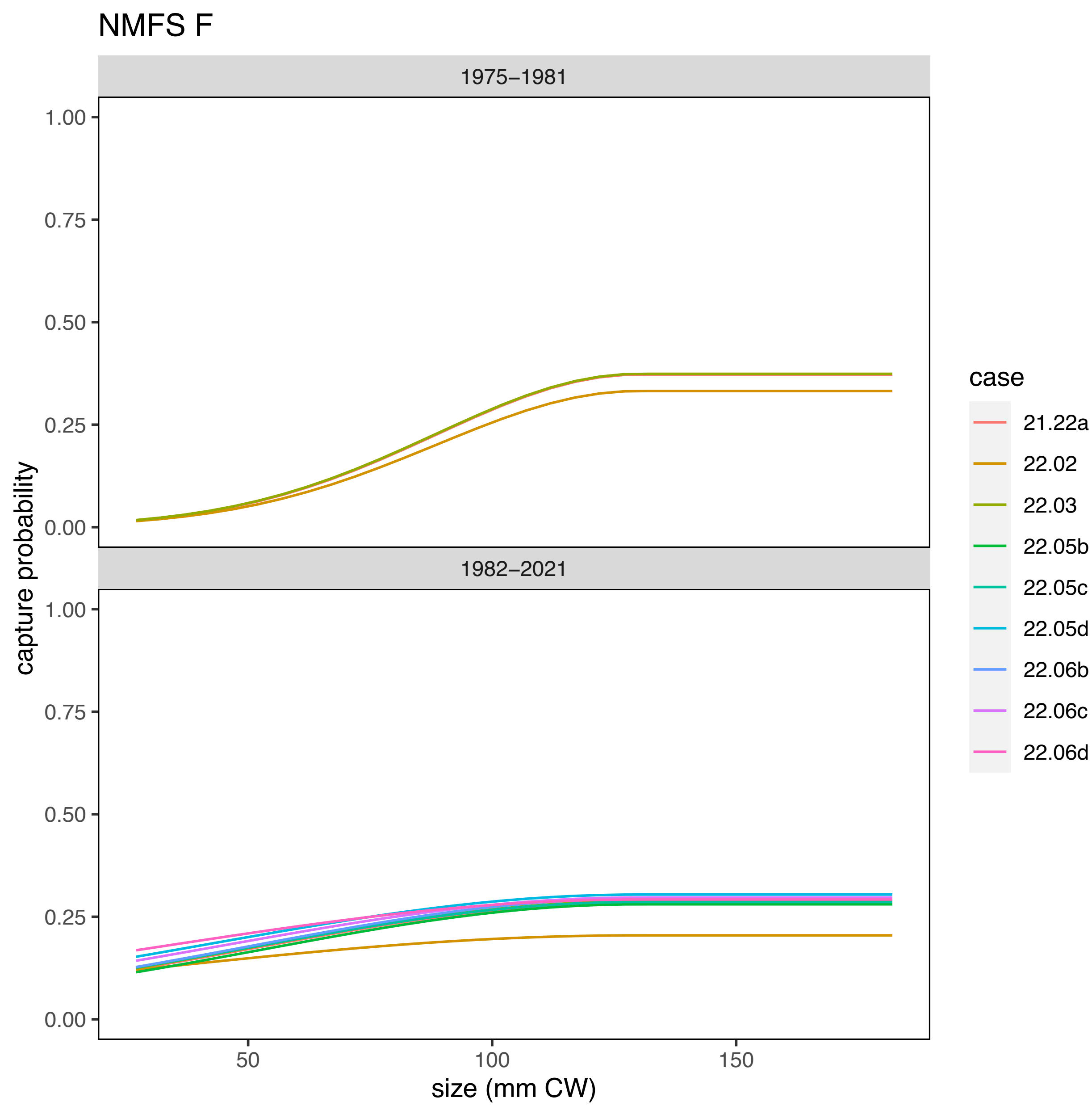

Figure 23. Estimated size-specific capture probability (survey *q* x selectivity) for females in the NMFS EBS shelf bottom trawl survey during different time periods (not all models use the same time blocks).

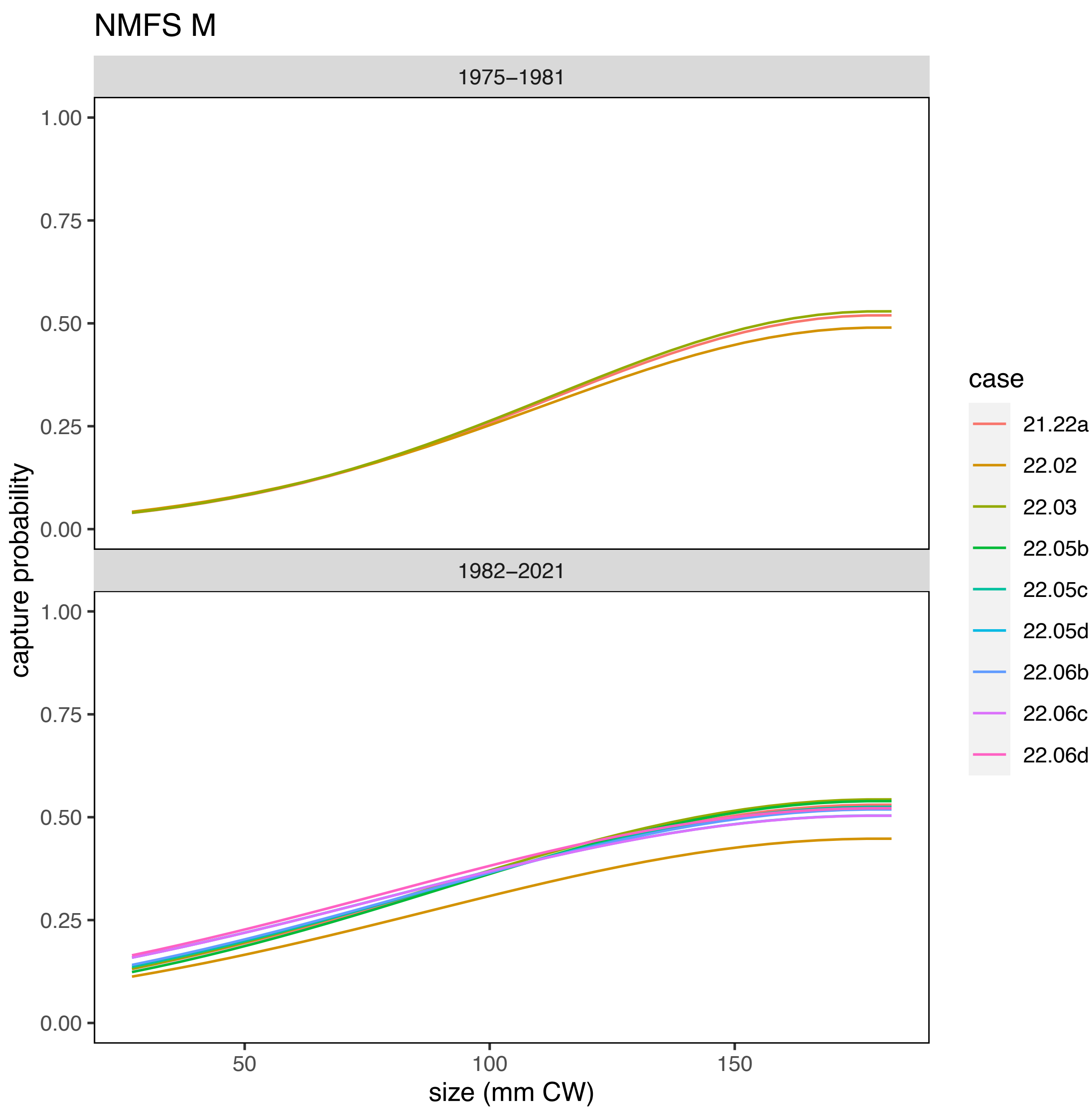

Figure 24. Estimated size-specific capture probability (survey *q* x selectivity) for males in the NMFS EBS shelf bottom trawl survey during different time periods (not all models use the same time blocks).

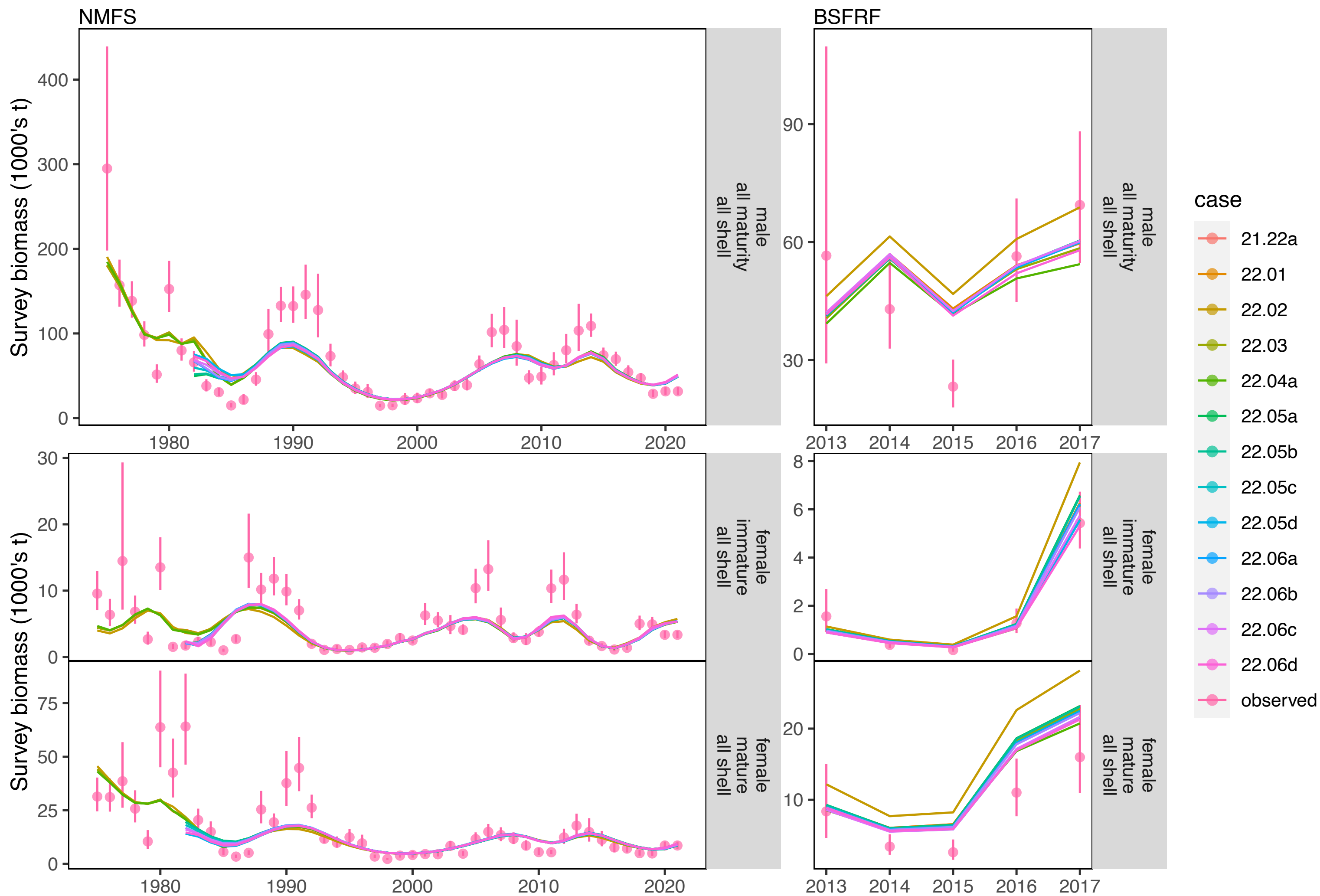

Figure 25. Comparison of model fits to survey biomass data.

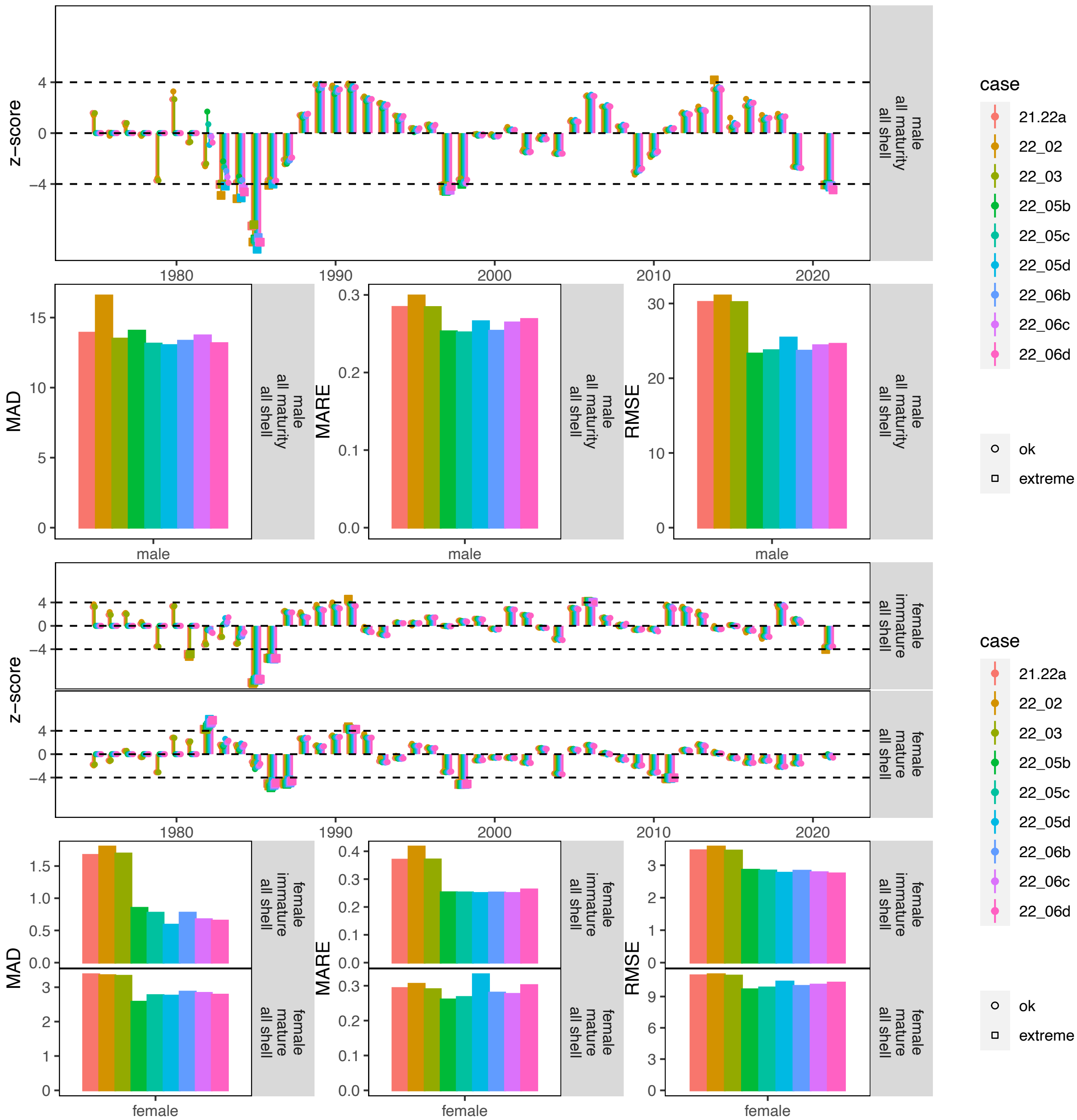

Figure 26. Comparison of diagnostic quantities for fits to NMFS survey biomass time series across models considered successful. Upper two rows: diagnostics for male crab; lower two rows: diagnostics for female crab. MAD: median absolute deviation; MARE: median absolute relative error; RMSE: root mean square error.

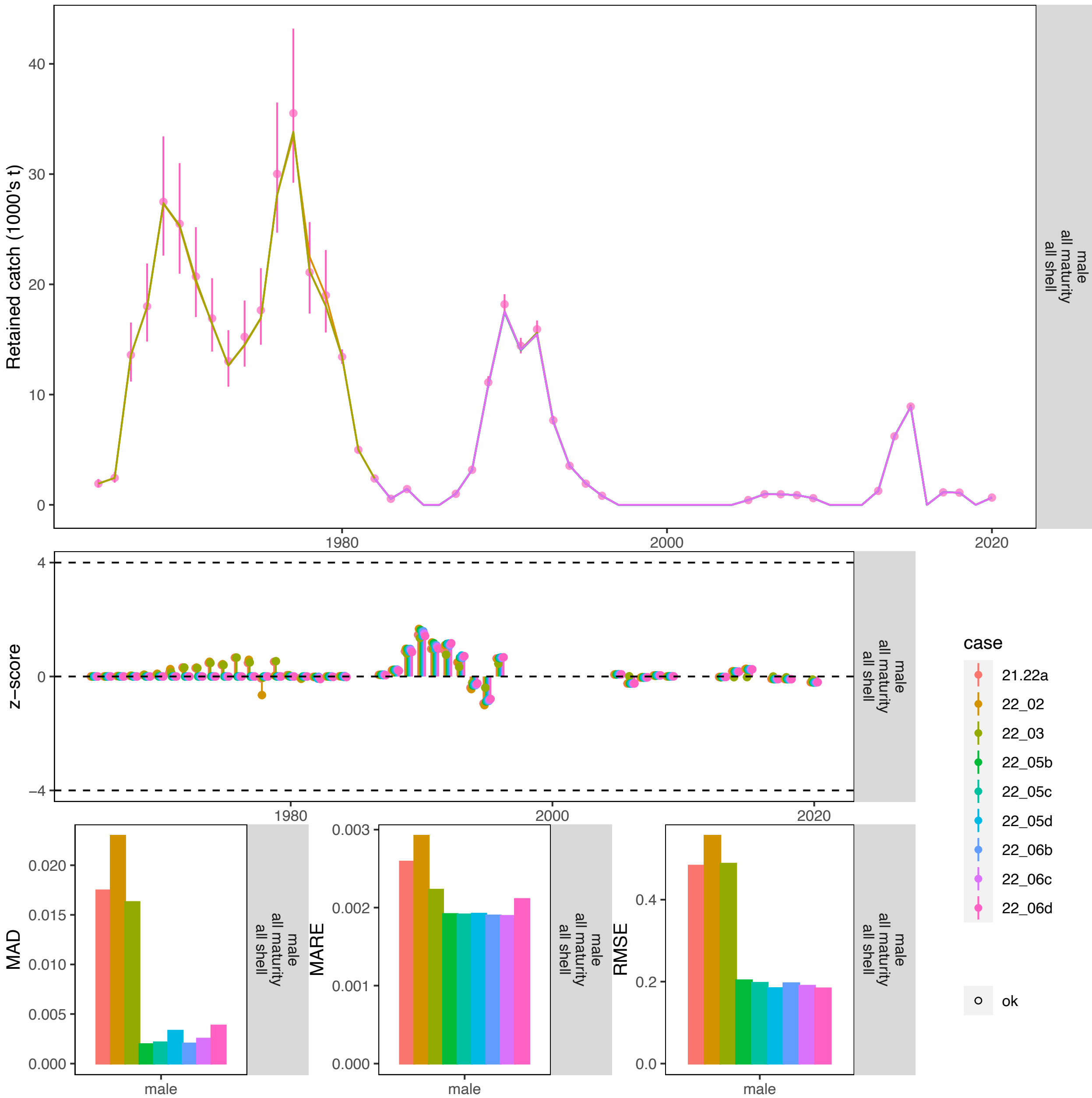

Figure 27. Comparison of diagnostic quantities for fits to retained catch biomass in the directed fishery across models considered successful. Upper row: time series of observed and model-predicted values. Middle row: Z-scores from the time series fit. Lower row: summary diagnostics. MAD: median absolute deviation; MARE: median absolute relative error; RMSE: root mean square error.

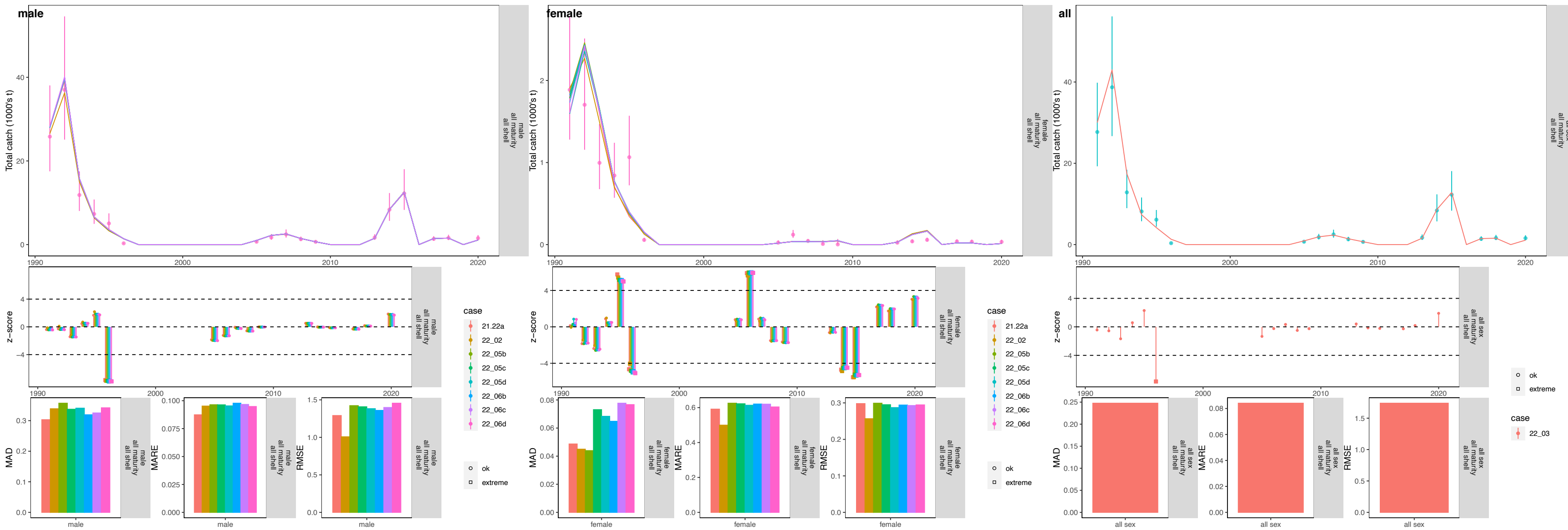

Figure 28. Comparison of diagnostic quantities for fits to total catch biomass in the directed fishery across models considered successful. Upper row: time series of observed and model-predicted values. Middle row: Z-scores from the time series fit. Lower row: summary diagnostics. MAD: median absolute deviation; MARE: median absolute relative error; RMSE: root mean square error. First column: fits to males; second column: fits to females; third column: fits to combined sexes.

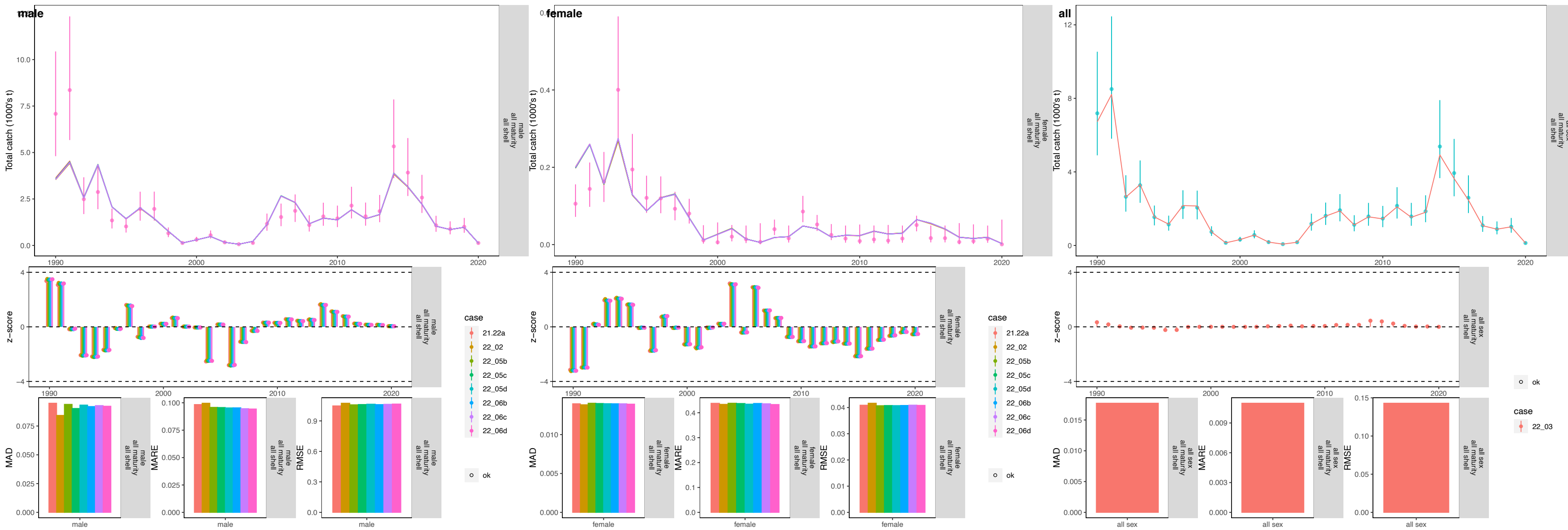

Figure 29. Comparison of diagnostic quantities for fits to total bycatch biomass in the snow crab fishery across models considered successful. Upper row: time series of observed and model-predicted values. Middle row: Z-scores from the time series fit. Lower row: summary diagnostics. MAD: median absolute deviation; MARE: median absolute relative error; RMSE: root mean square error. First column: fits to males; second column: fits to females; third column: fits to combined sexes.

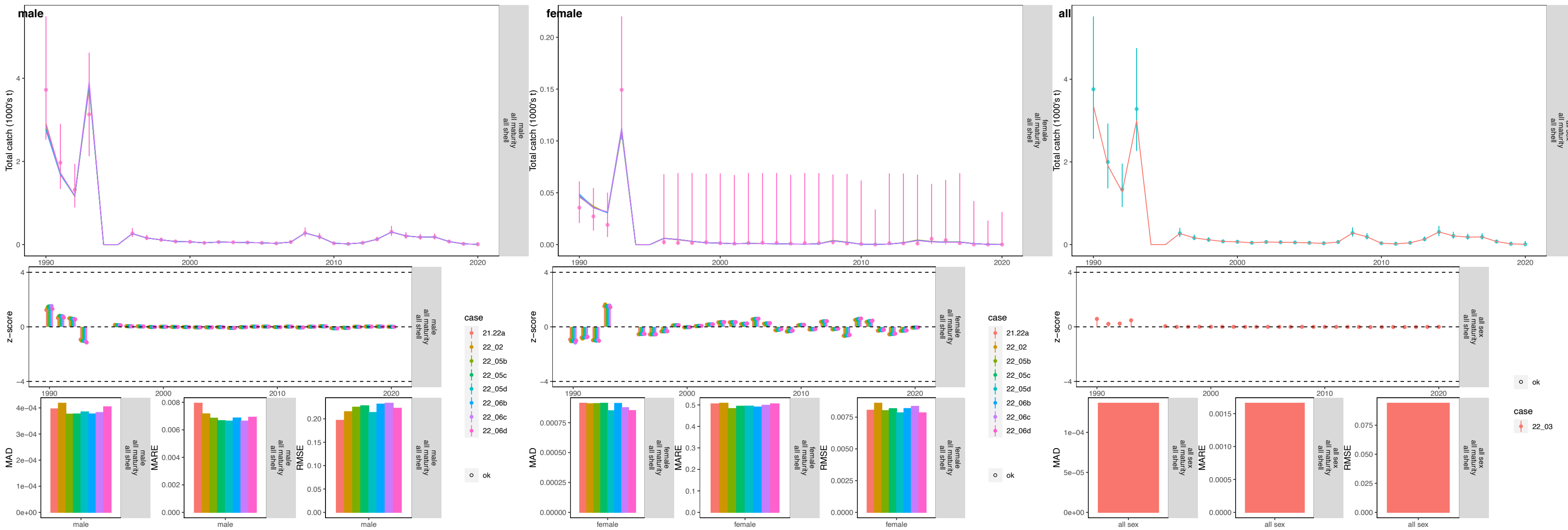

Figure 30. Comparison of diagnostic quantities for fits to total bycatch biomass in the BRKC fishery across models considered successful. Upper row: time series of observed and model-predicted values. Middle row: Z-scores from the time series fit. Lower row: summary diagnostics. MAD: median absolute deviation; MARE: median absolute relative error; RMSE: root mean square error. First column: fits to males; second column: fits to females; third column: fits to combined sexes.

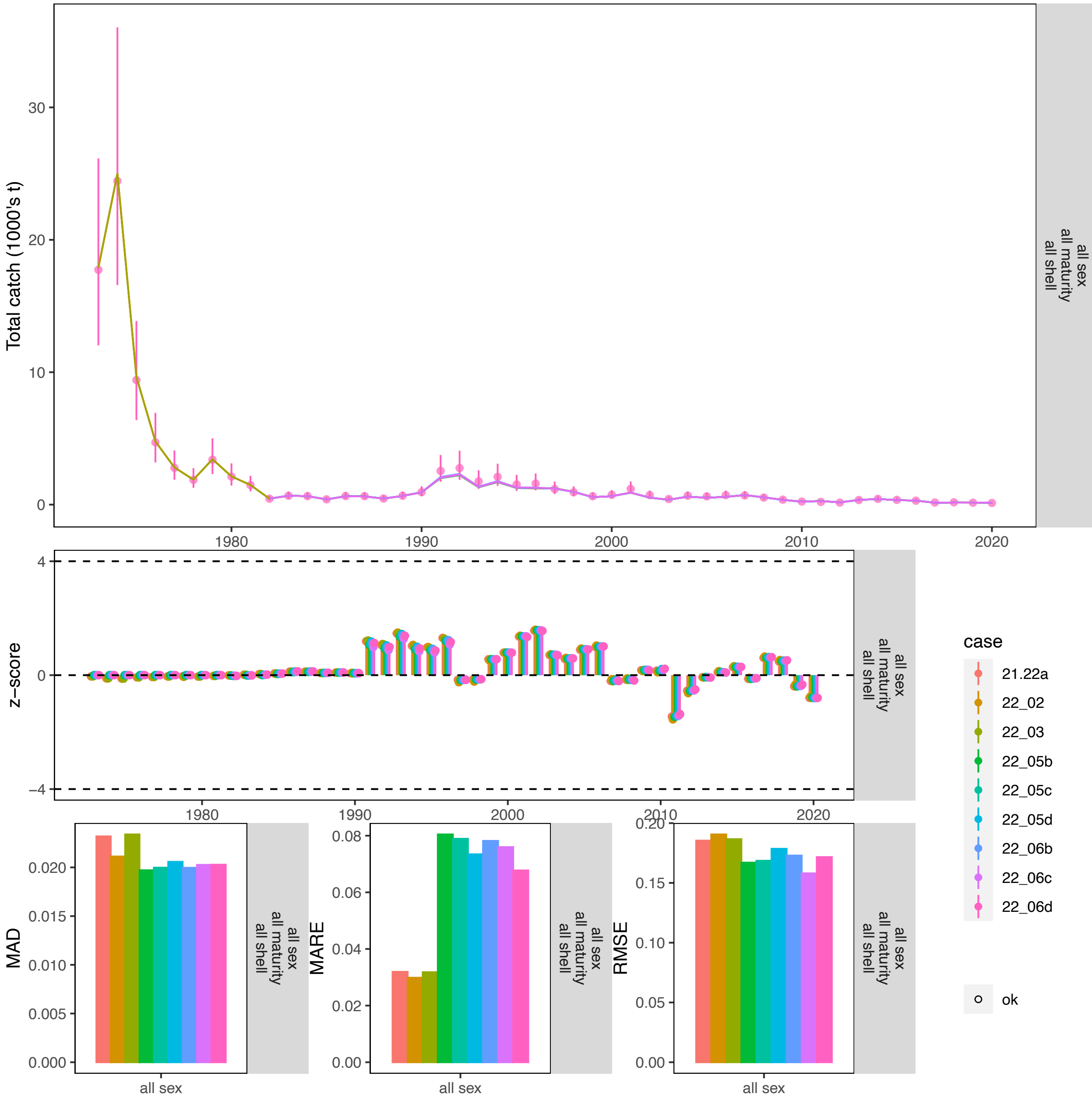

Figure 31. Comparison of diagnostic quantities for fits to retained catch biomass in the groundfish fisheries across models considered successful. Upper row: time series of observed and model-predicted values. Middle row: Z-scores from the time series fit. Lower row: summary diagnostics. MAD: median absolute deviation; MARE: median absolute relative error; RMSE: root mean square error.

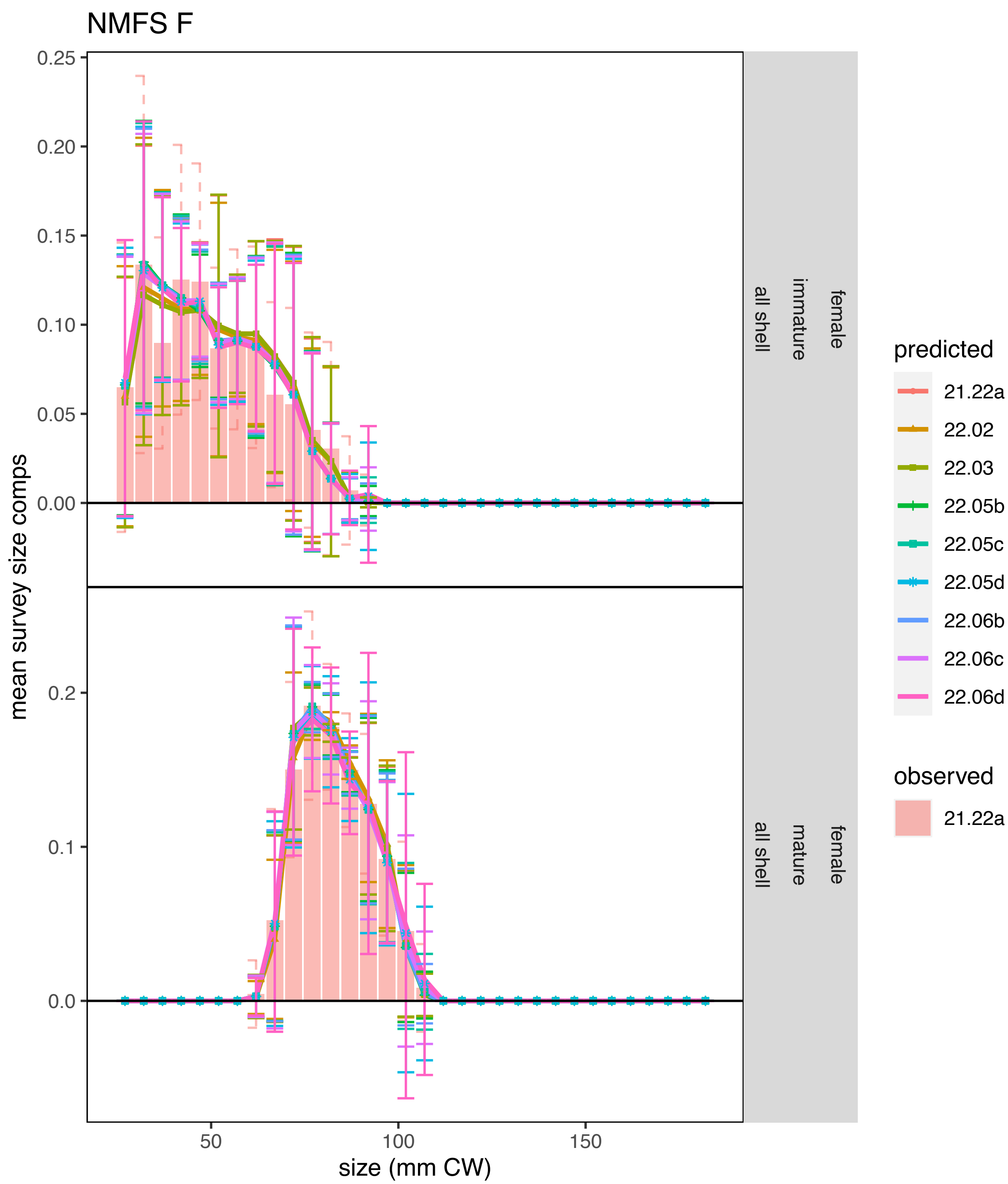

Figure 32. Comparison of mean survey size comps with mean model-predicted size comps for females in the NMFS EBS shelf bottom trawl survey across all models deemed successful. The vertical bars indicate the degree of variability in the model-predicted (solid bars) and observed compositions.

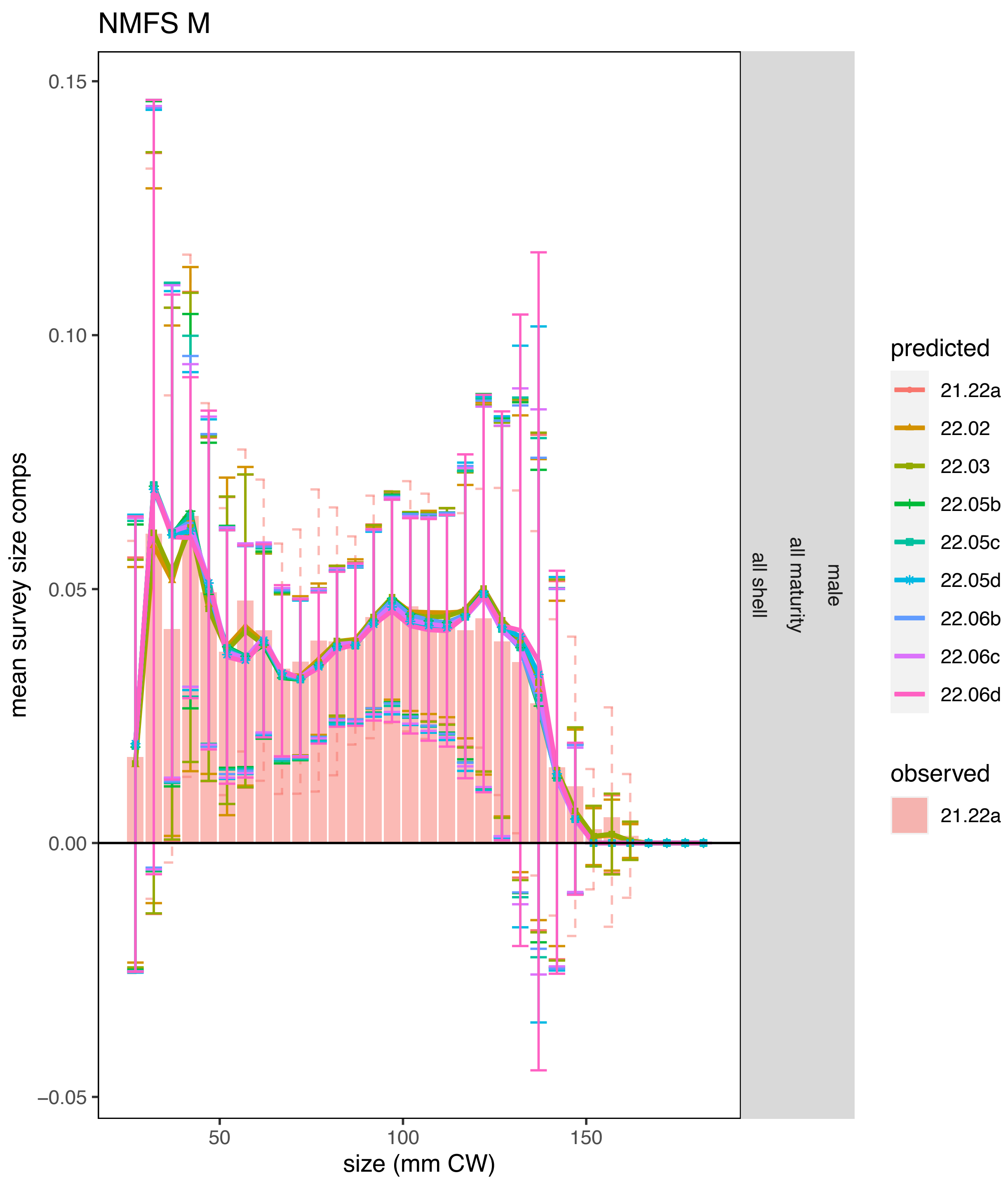

Figure 33. Comparison of mean survey size comps with mean model-predicted size comps for males in the NNMFS EBS shelf bottom trawl survey across all models deemed successful. The vertical bars indicate the degree of variability in the model-predicted (solid bars) and observed compositions.

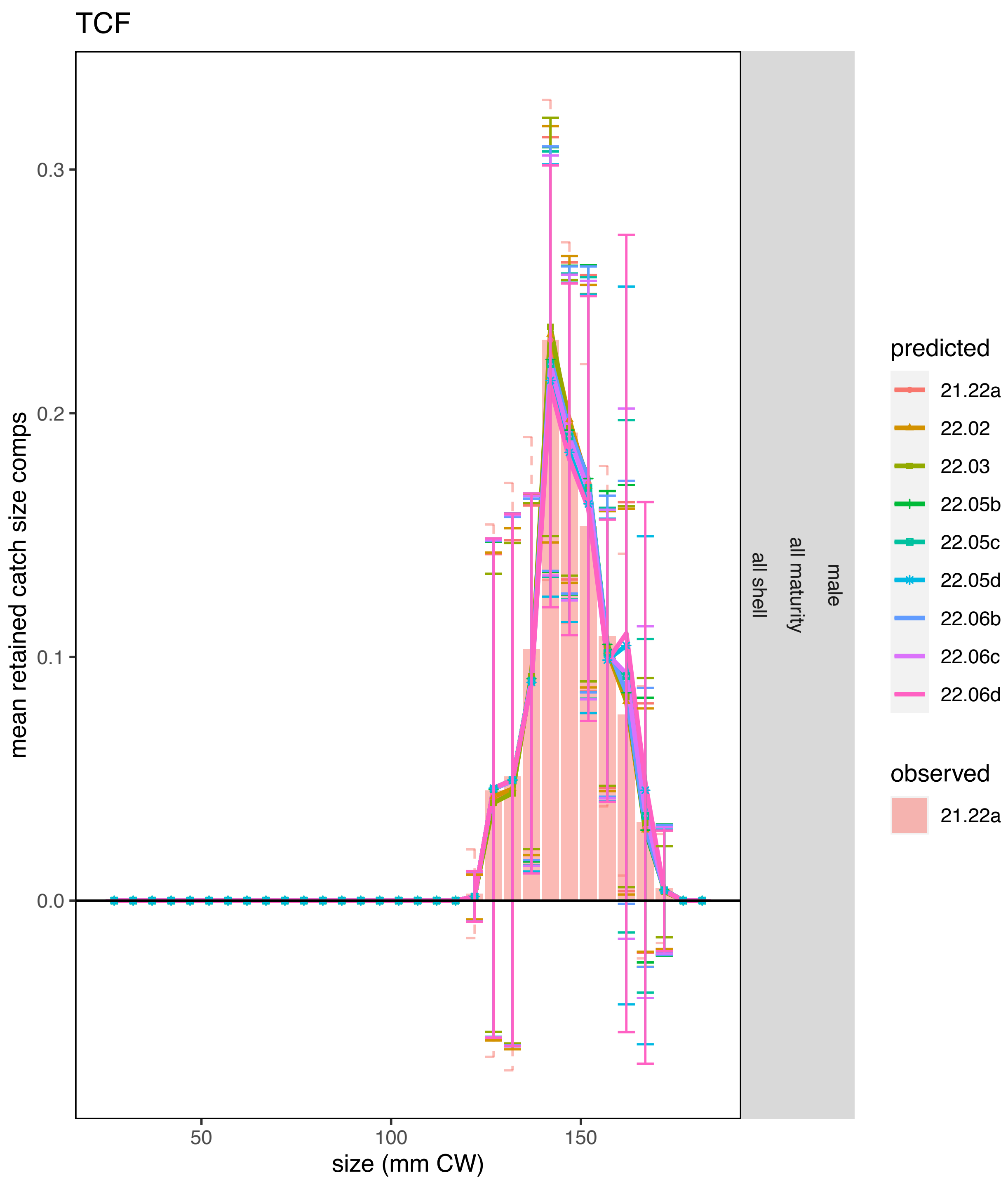

Figure 34. Comparison of mean retained catch size comps with mean model-predicted size comps for males retained in the directed fishery across all models deemed successful. The vertical bars indicate the degree of variability in the model-predicted (solid bars) and observed compositions (dashed lines).

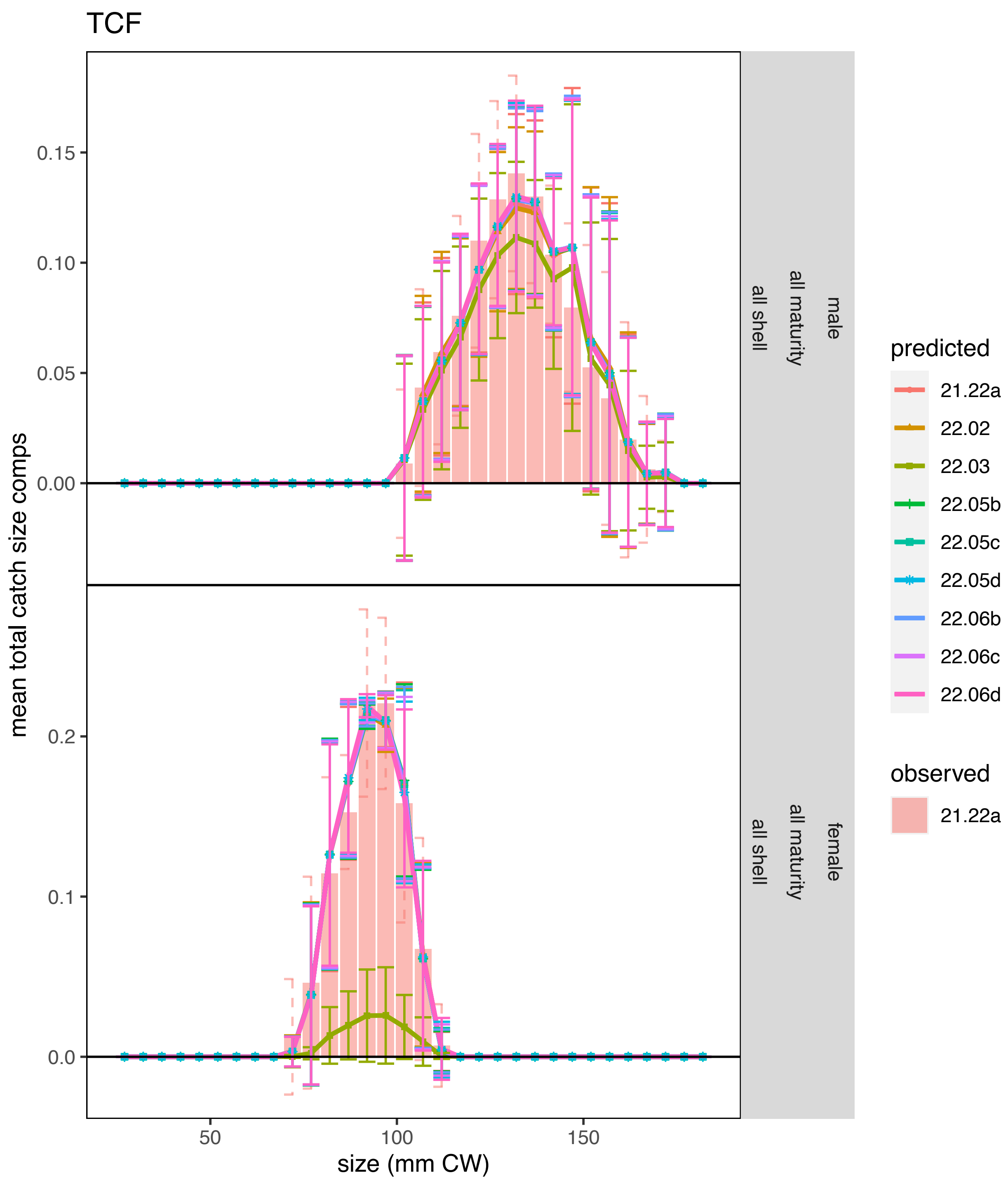

Figure 35. Comparison of mean fishery catch size comps with mean model-predicted size comps in the directed fishery across all models deemed successful. The vertical bars indicate the degree of variability in the model-predicted (solid bars) and observed compositions. Note that the predicted size comps for Model 20.03 are scaled incorrectly for comparison with the other models.

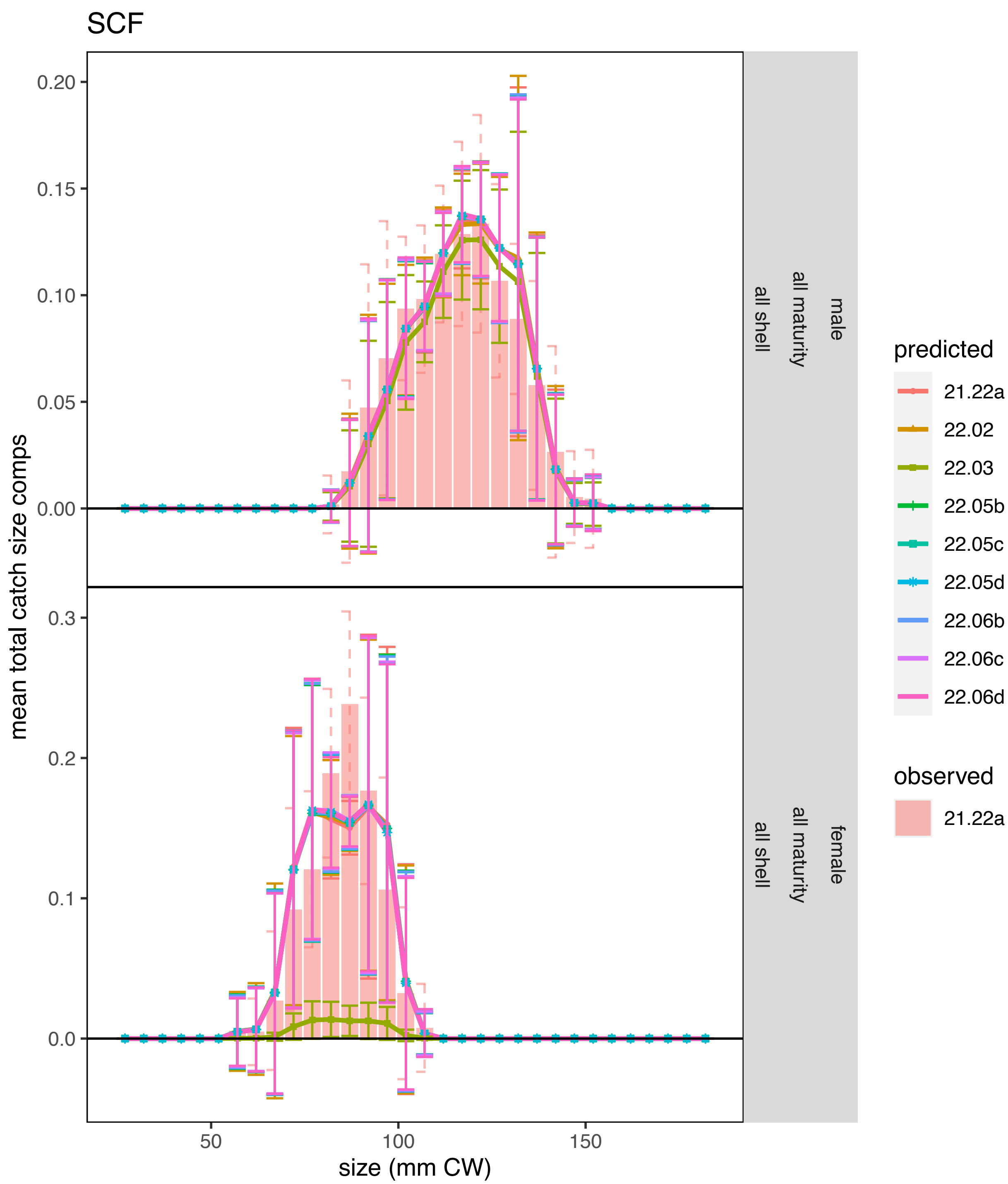

Figure 36. Comparison of mean catch size comps with mean model-predicted size comps for crab bycatch in the snow crab fishery across all models deemed successful. The vertical bars indicate the degree of variability in the model-predicted (solid bars) and observed compositions (dashed lines). Note that the predicted size comps for Model 20.03 are scaled incorrectly for comparison with the other models.

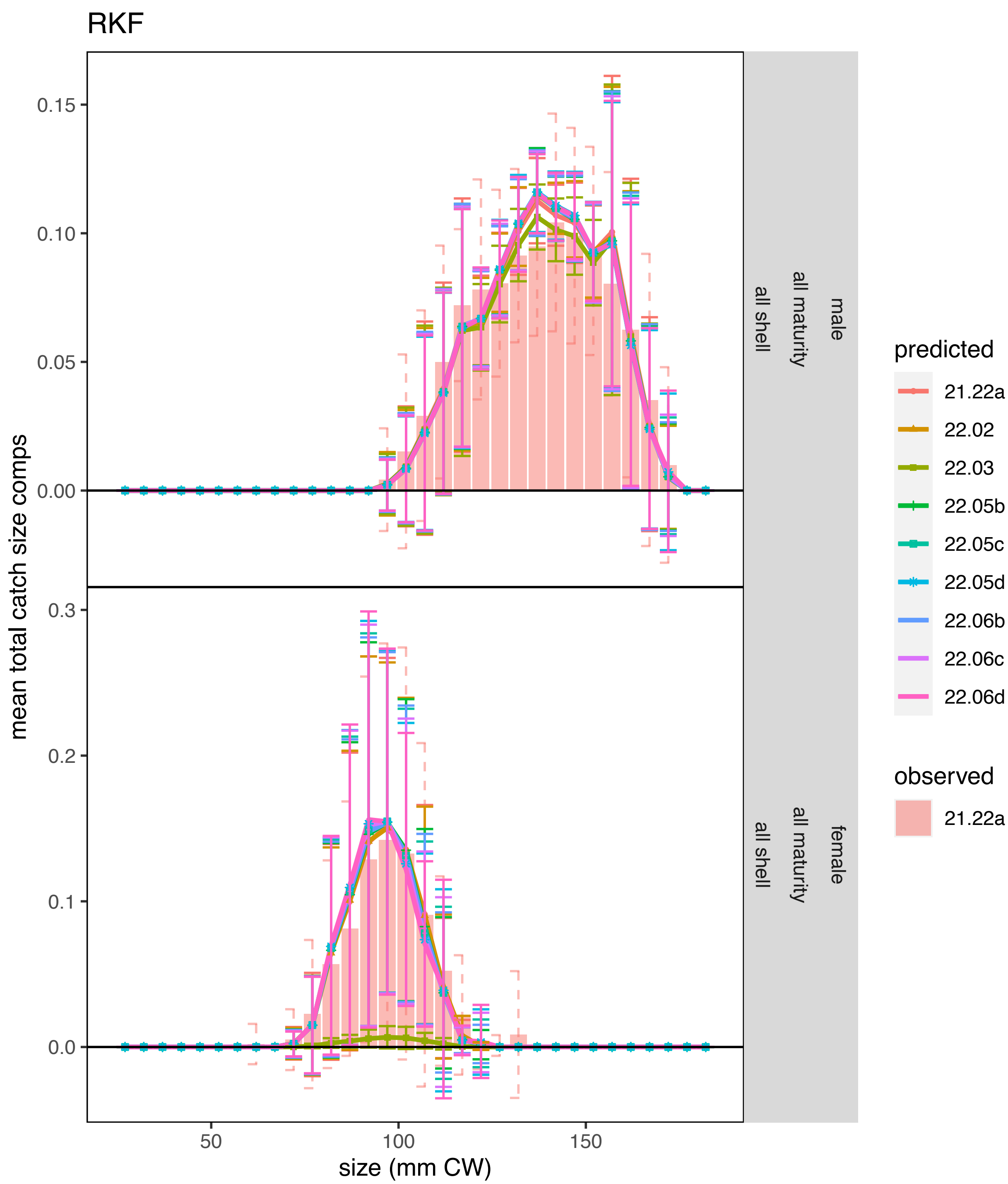

Figure 37. Comparison of mean catch size comps with mean model-predicted size comps for crab bycatch in the BBRKC fishery across all models deemed successful. The vertical bars indicate the degree of variability in the model-predicted (solid bars) and observed compositions (dashed lines). Note that the predicted size comps for Model 20.03 are scaled incorrectly for comparison with the other models.

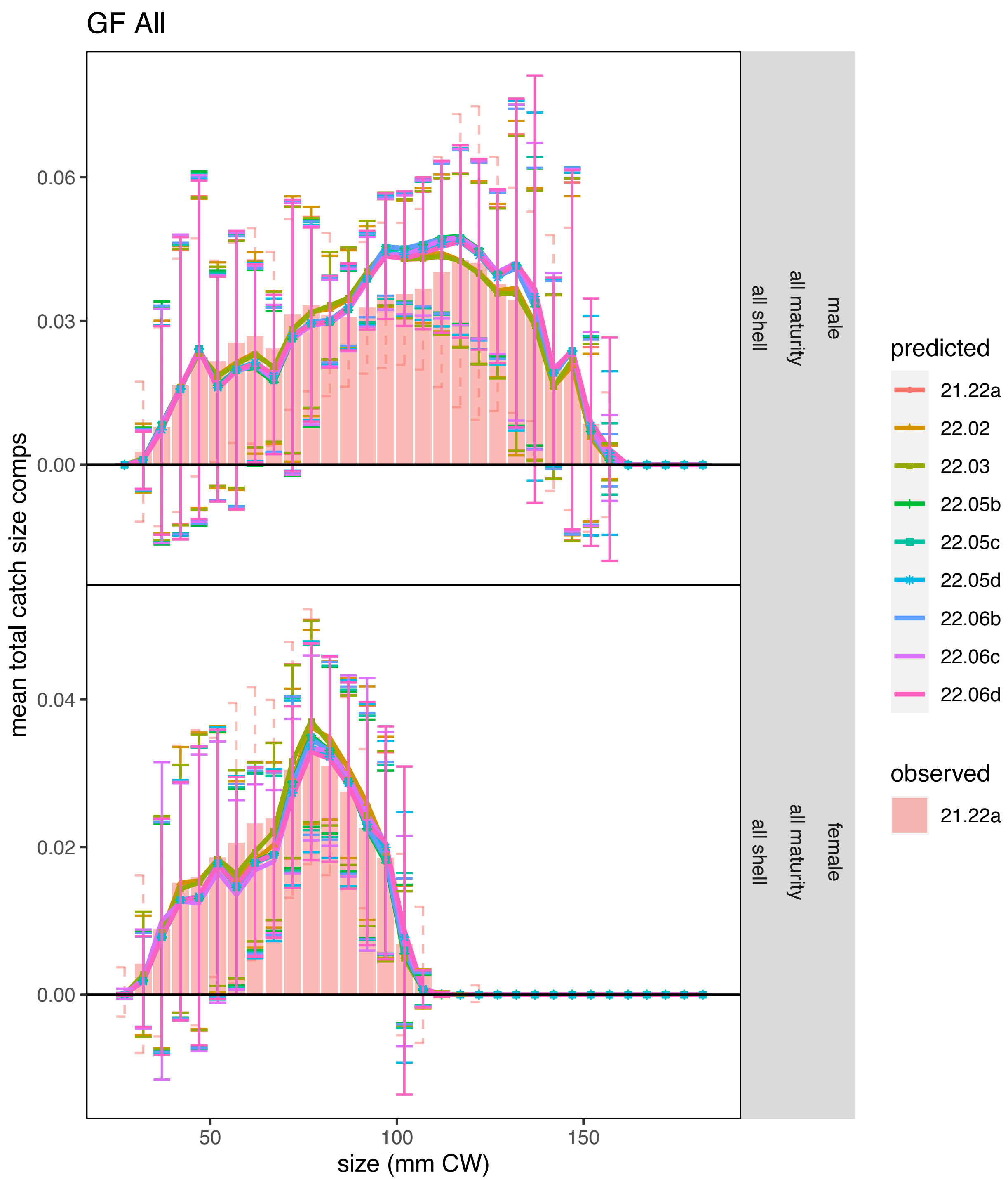

Figure 38. Comparison of mean catch size comps with mean model-predicted size comps for crab bycatch in the groundfish fisheries across all models deemed successful. The vertical bars indicate the degree of variability in the model-predicted (solid bars) and observed compositions (dashed lines).