Annex 2: Results from selected models for the 2010 Jack mackerel stock assessment

Viña del Mar

This annex contains the main results from the final models specified at the subgroup meeting.

Assessment model results

For the purposes of this section the three models presented represent the base case (Model 4 from Annex 1) and alternatives that seem to bracket model uncertainty (Models 5 and 6 from Annex 1).

The base case fit (Model 4) to the fishery age composition data is shown in Figures 1, 2, 3, and 4. This model fit to the indices is shown in Figure 5 while the fit to the index age compositions are shown in Figures 6, and 7. Selectivity estimates for the fishery and indices is shown over time in Figs.8 and 9 respectively. A summary of the time series stock status (spawning biomass, F, recruitment, total biomass) is shown in Fig. 10.

Model sensitivities

As an initial model evaluation, the impact of downweighting different types of indices was selected to illustrate potential structural errors in model assumptions and the influence it may have on trends and current abundance levels. For fishing mortality, the comparison of the base case and model sensitivities indicate higher levels for Model 6 (which downweighted CPUE data) relative to the base case and the model which downweights the acoustic indices (Model 5; Fig. 11). In terms of the effect on stock status relative to "unfished", the differences were relatively minor and in all cases, the stock appears to be below 10% of the unfished level (Fig. 12).

These models compared similarly with each other and with the TISVPA for total biomass (Fig. 13).

Projections

The following recruitment scenarios were proposed for projectionsduring the subgroup meeting:

1) Use average from 2005-2009
2) Use average from 2000-2009

For each of these periods, 100 stochastic simulations (in recruitment) were conducted assuming the same mean and variance for these two time periods. *Important: these recruitments are generated without regard to a stock recruitment relationship—at very low and high stock sizes the mean recruitment is constant.* These were run for the base case (Model 4) and the two sensitivities (Models 5 and 6). The subgroup further recommended examining constant catch scenarios with current levels (711 kt) and at 75%, 50%, 25%, and 1%. Constant catch solutions were obtained by iterating F's (assuming ratios among the 4 fleets to be similar to that observed in 2010) within the Baranof catch equation. The 3 models and 4 constant catch strategies and two recruitment scenarios results in 24 unique projection configurations. Each of these were project for 21 years (but only shown to 2020) and simulated 100 times.These simulations show that for the base case, future constant catches held at 533.25 kt for the 5-year average recruitment scenario may result in continued stock declines and increased fishing mortality (Fig. 14). A more optimistic scenario (based on the 10-year average recruitment projection) indicates that the current catch level (711 kt) is likely to result in reduced fishing mortality—butwith a large degree of uncertainty (Fig. 15).

For the 5-year average recruitment scenario, examination of mean values from projections indicates that for the stock to show signs of increase, a reduction in catch by about 50% would be required regardless of the model (Fig. 16). The more optimistic scenario based on the 10-year average recruitment projection indicates that even at the current catch level (711 kt) the stock is likely to increase (Fig. 17).

Tables

Table 1. Summary of data used for the joint jack mackerel (JJM) assessment model.

Figures

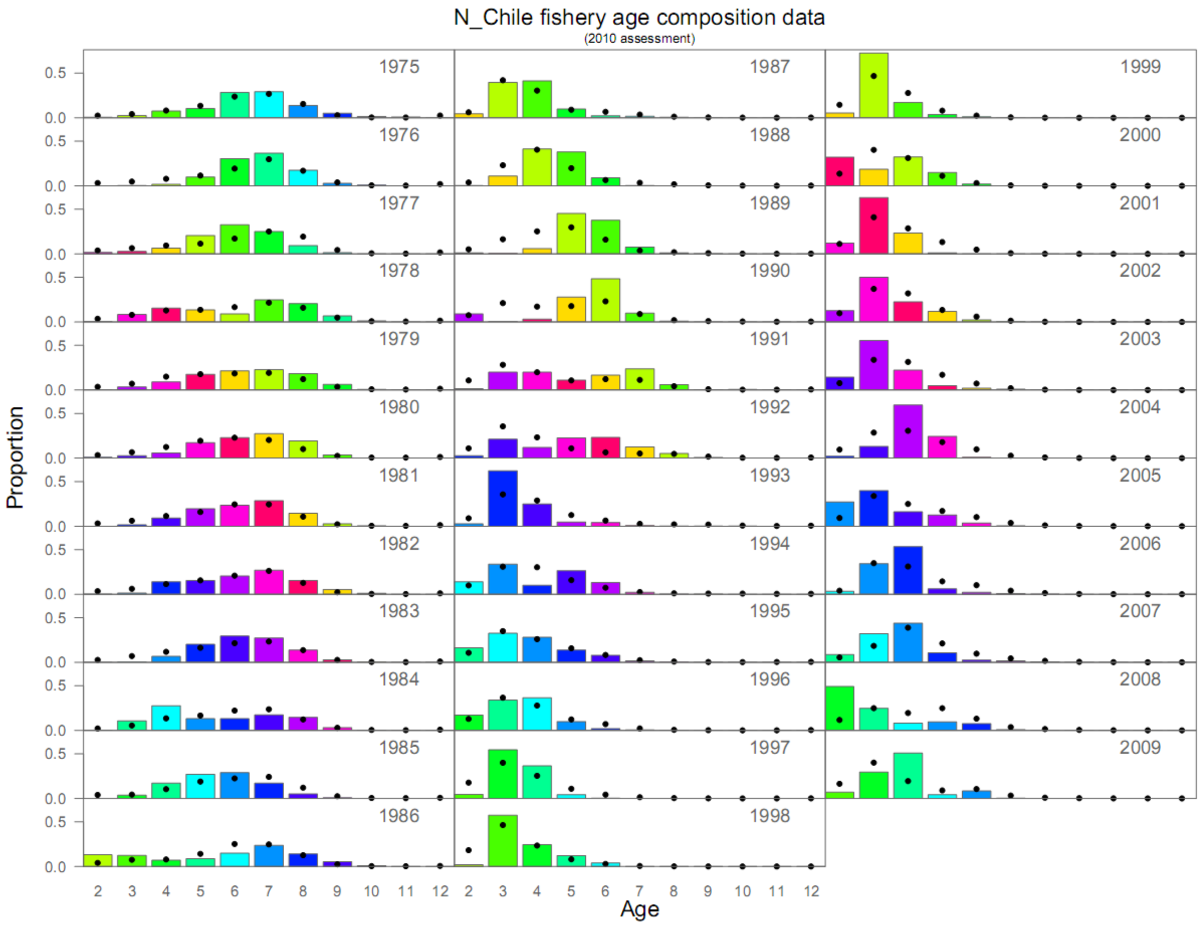

Figure 1. Base case model fit to the age compositions available for the Chilean northern zone fishery.

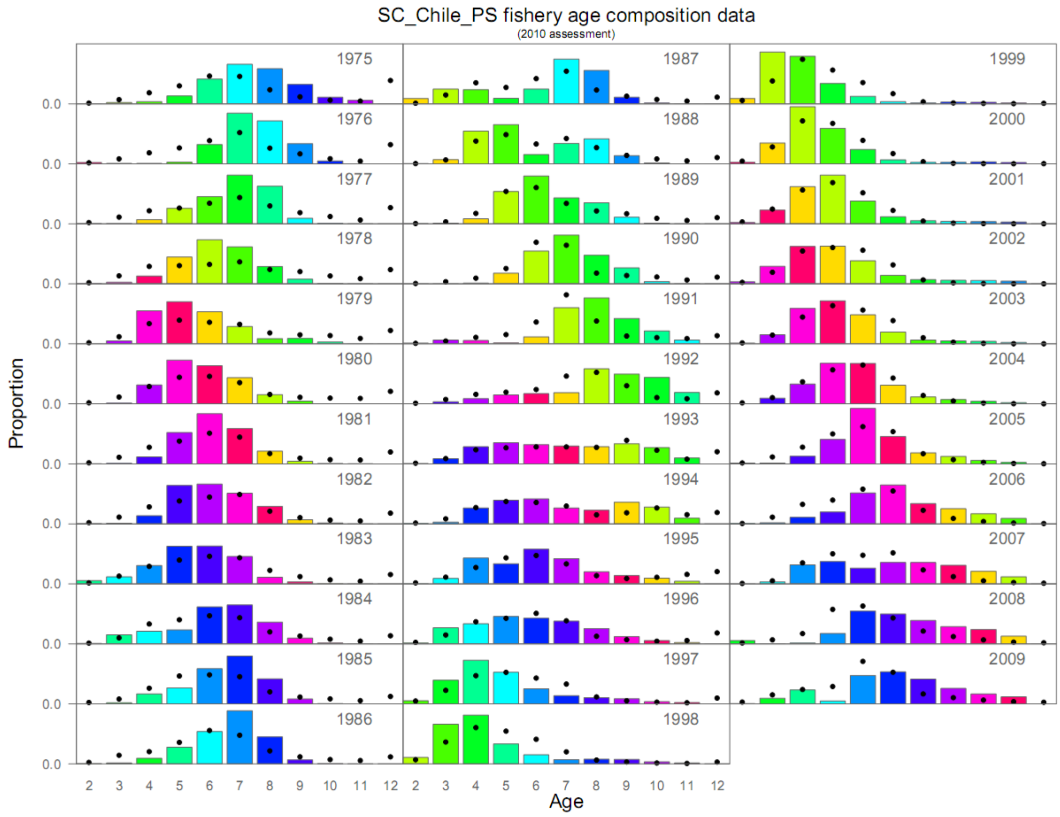

Figure 2. Base case model fit to the age compositions available for the **South-Central Chilean purse seine**fishery.

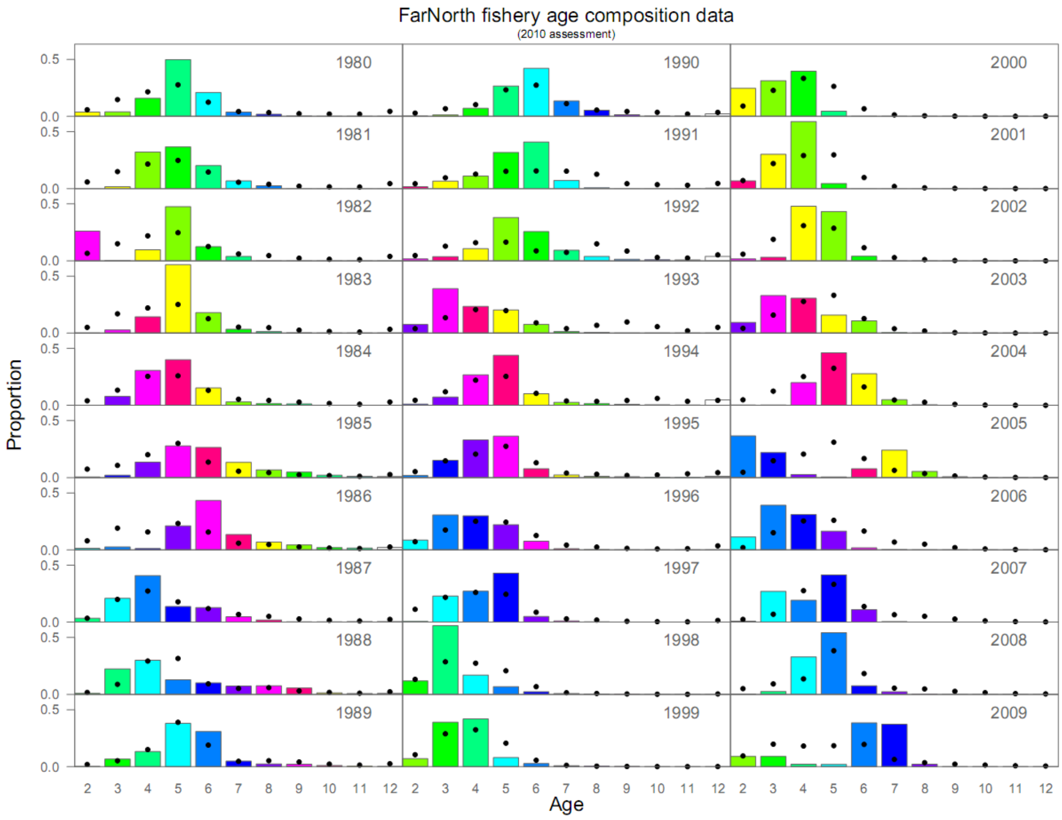

Figure 3. Base case model fit to the age compositions available for the zone north of chilefishery.

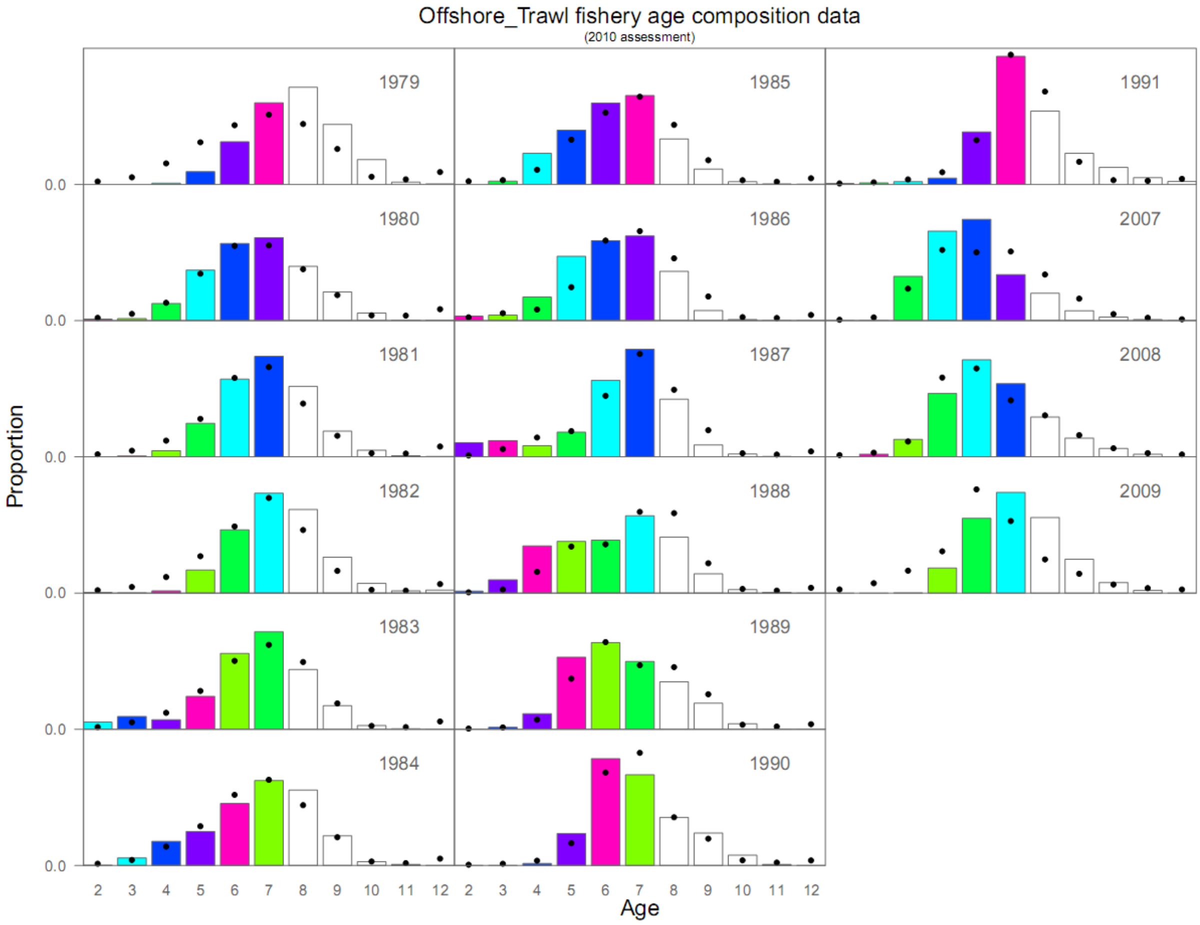

Figure 4. Base case model fit to the age compositions available for the **offshore trawl**fishery.

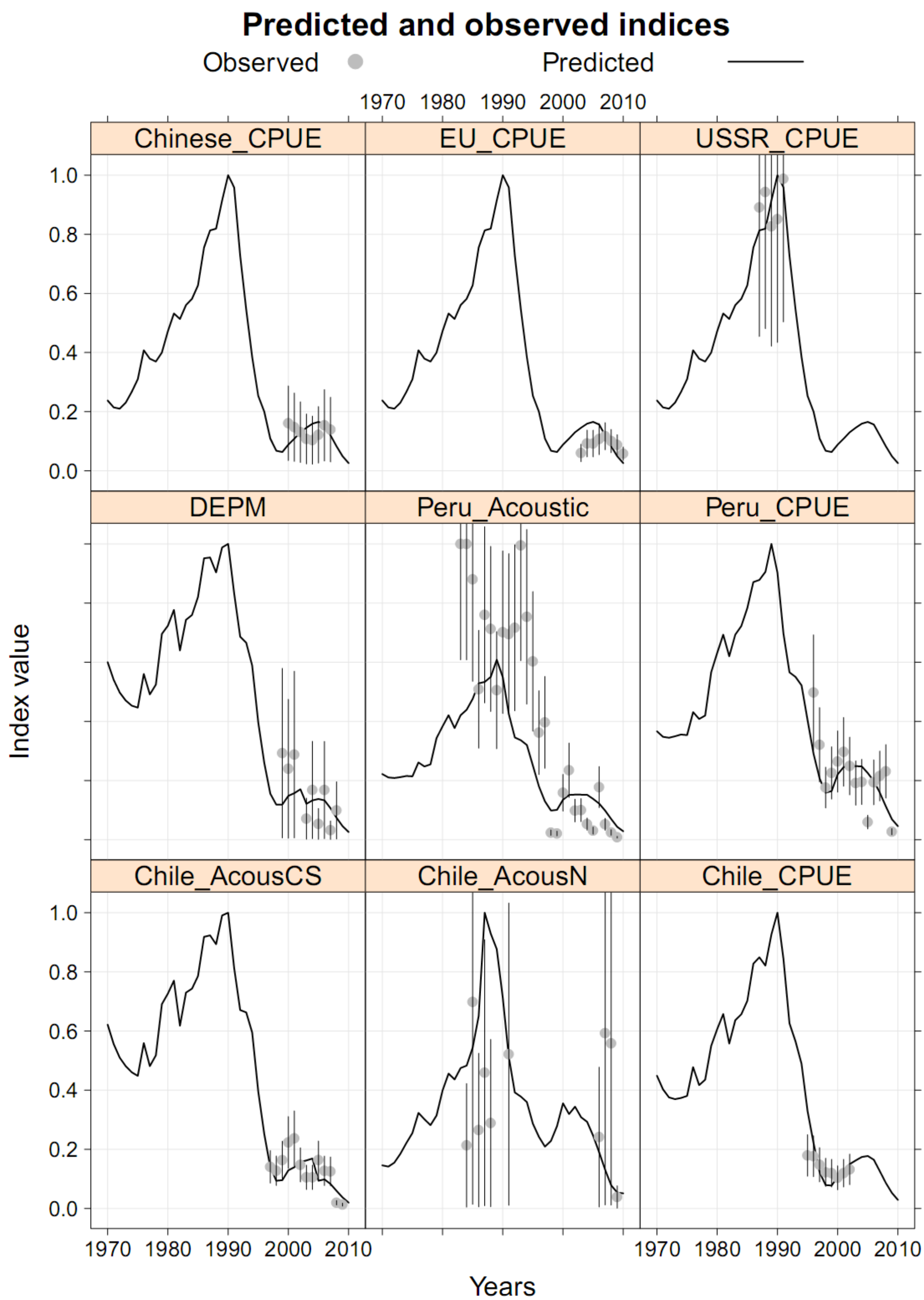

Figure 5. Base case model fit to different indices. Vertical bars represent 2 standard deviations around the observations.

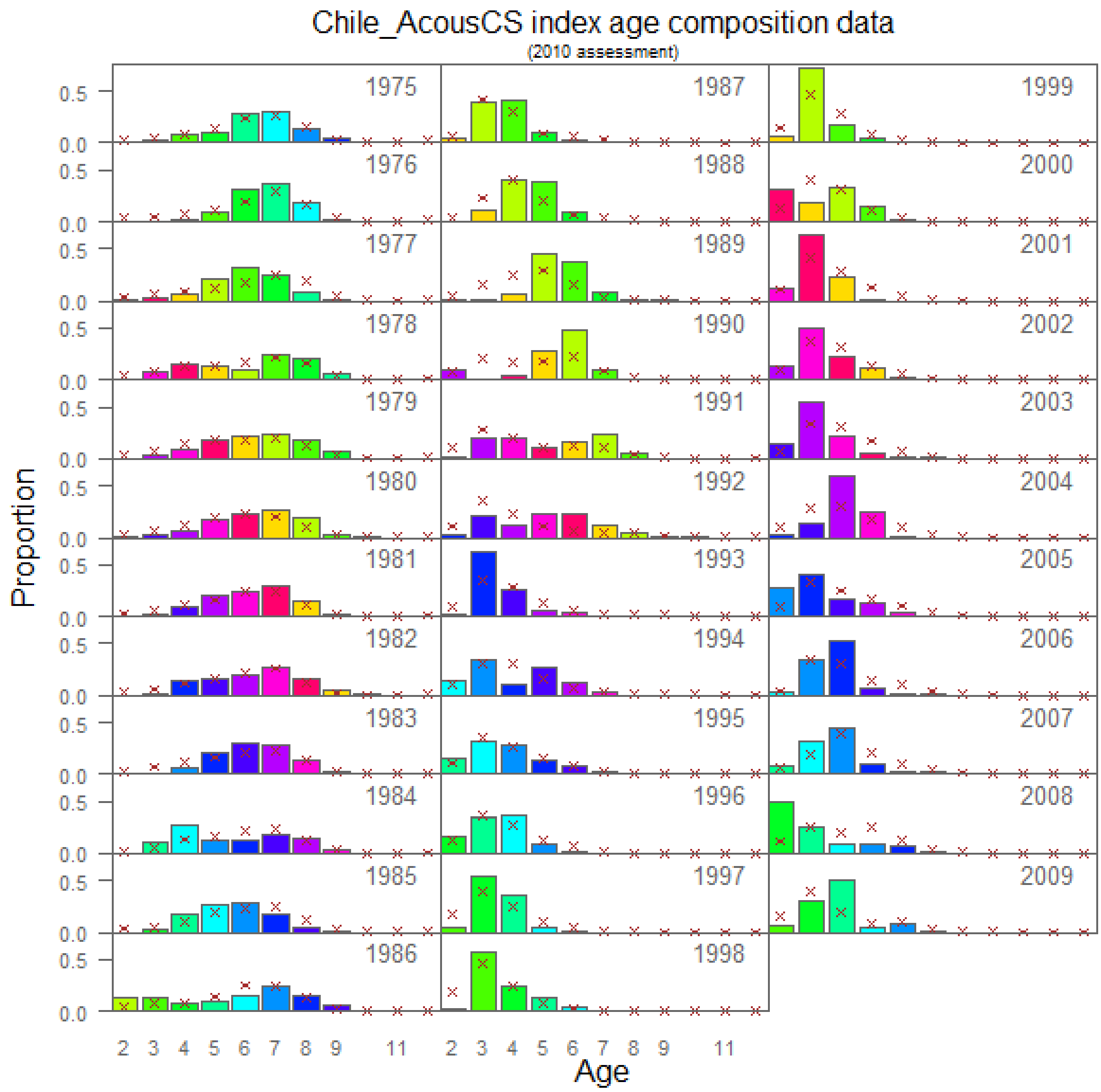

Figure 6. Base case model fit (x's) to age composition data (columns) for age samples collected during the CS Chilean region acoustic surveys

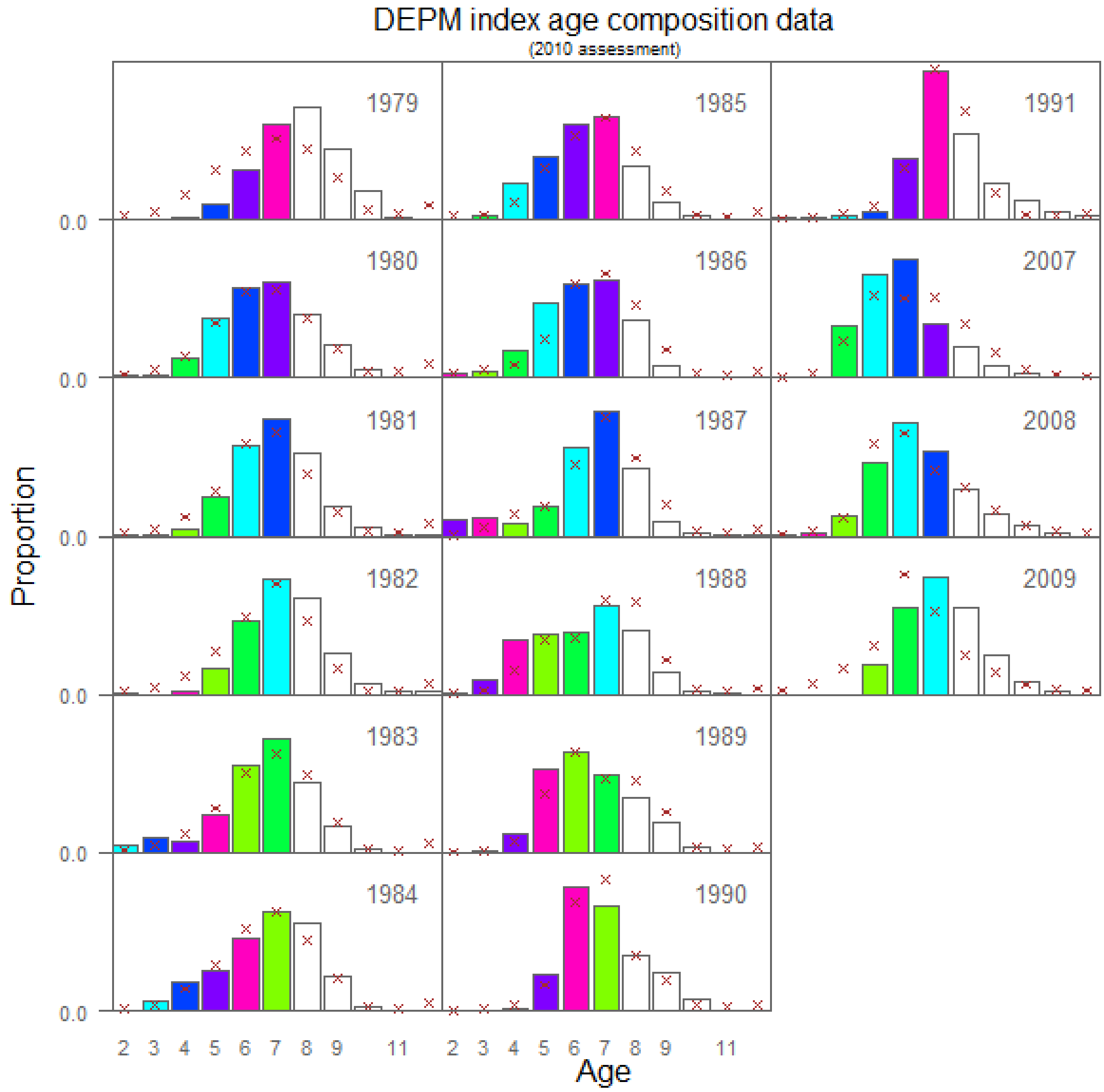

Figure 7. Base case model fit (x's) to age composition data (columns) for age samples collected during the daily egg production surveys.

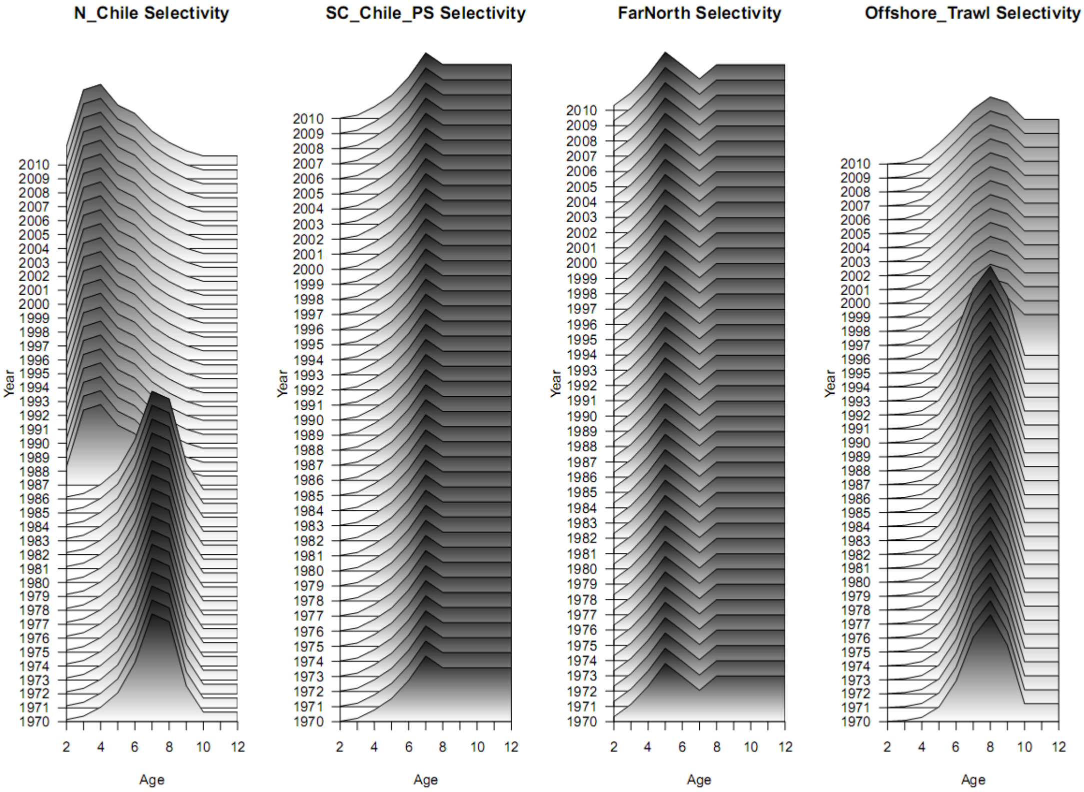

Figure 8. Base case model estimates of selectivity by fishery over time.

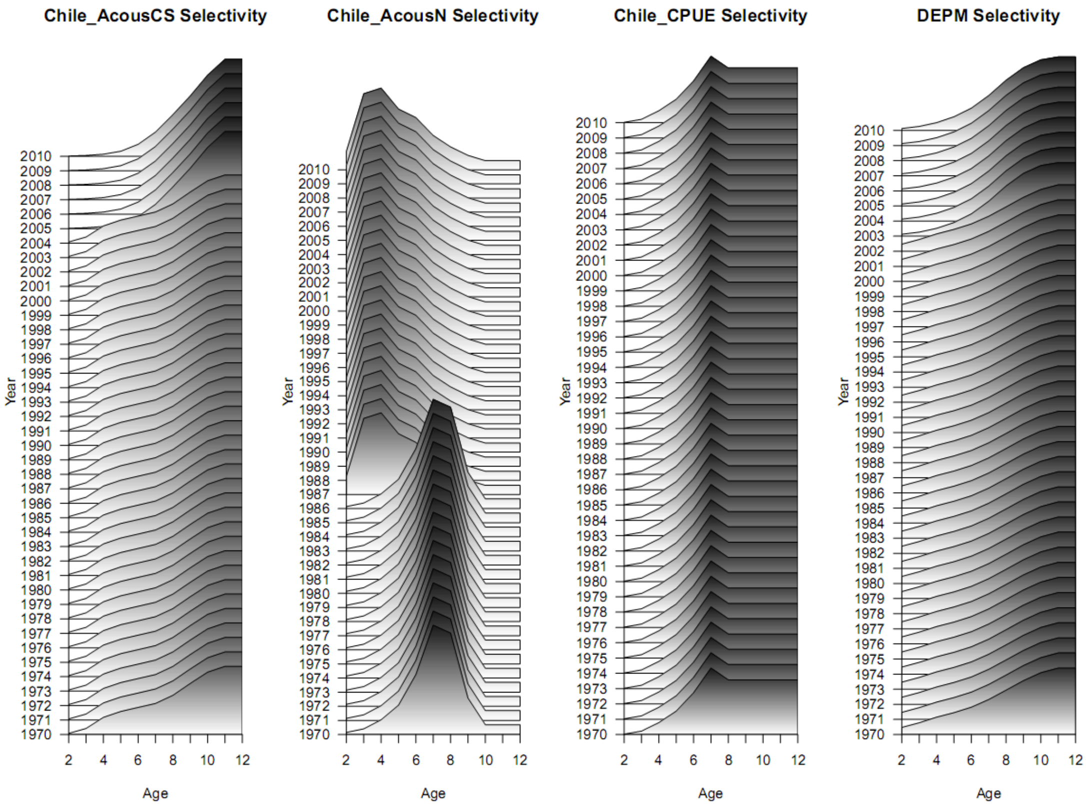

Figure 9. Base case model estimates of selectivity for each index over time.

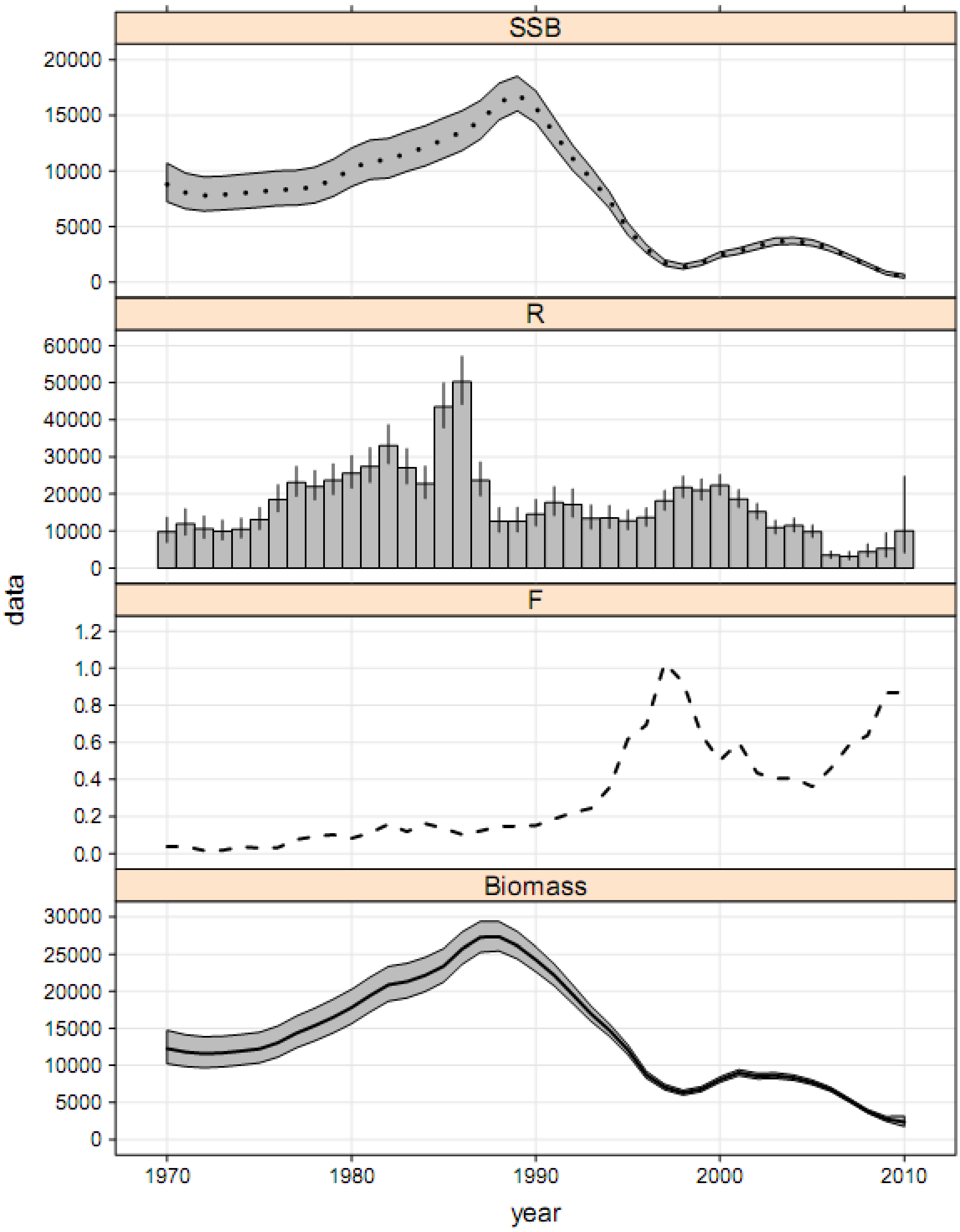

Figure 10. Base case model summary estimates over time showing spawning biomass (kt; top), recruitment at age 2 (millions; 2nd from top) total fishing mortality (3rd) and total biomass (kt; bottom).

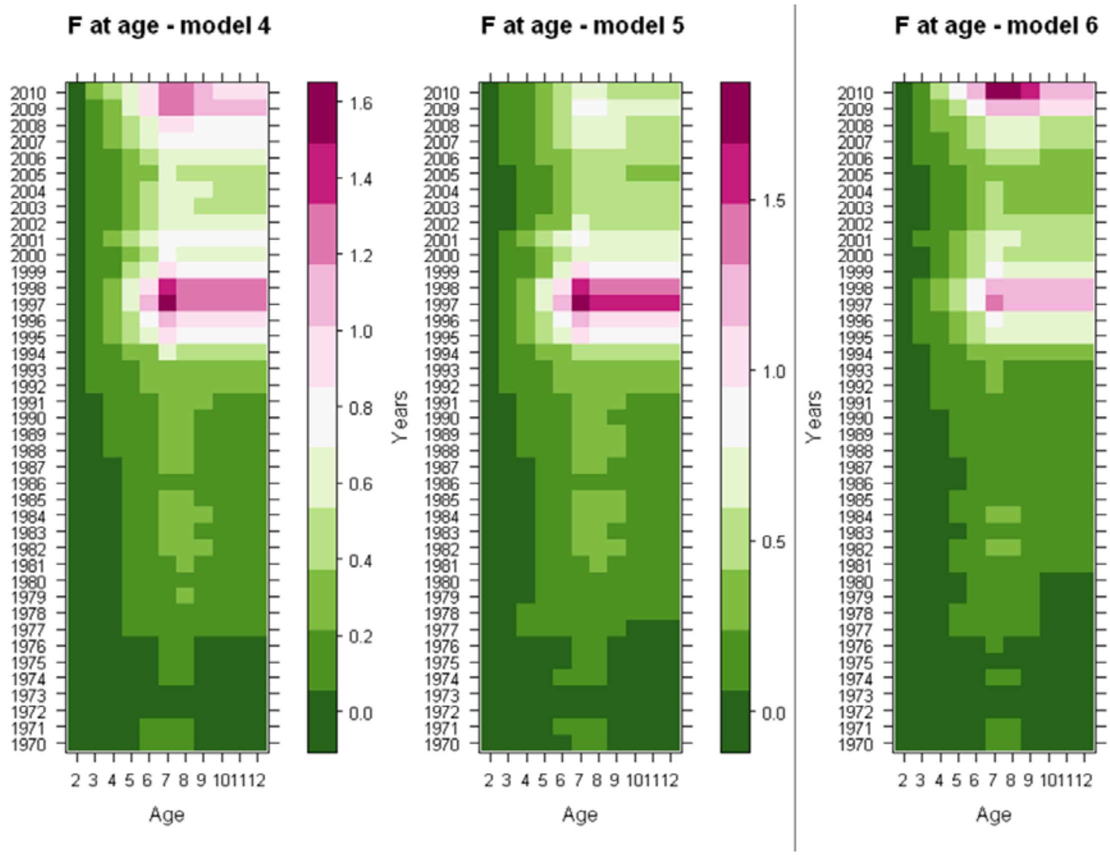

Figure 11. Historical fishing mortality at age for the base casel (Model 4; left most) and sensitivities (Models 5, and 6).

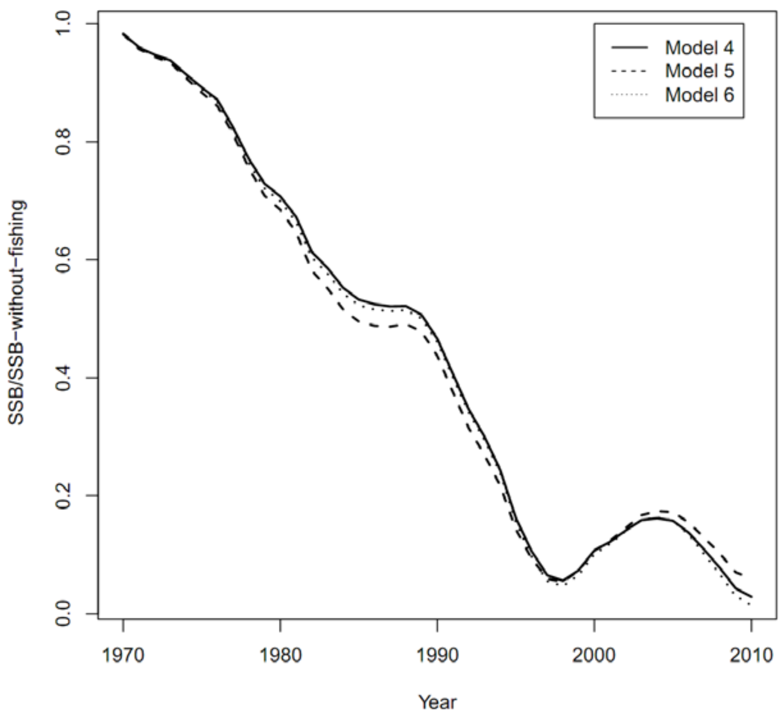

Figure 12. Results of relative spawning biomass trajectories for the base case (Model 4) and the two sensitivities (Models 5 and 6). These estimates are computed as the ratio of the estimated spawning biomass over the estimated spawning biomass had no fishing occurred (i.e., that only natural mortality affected subsequent numbers at age based on the recruitment at age two as estimated).

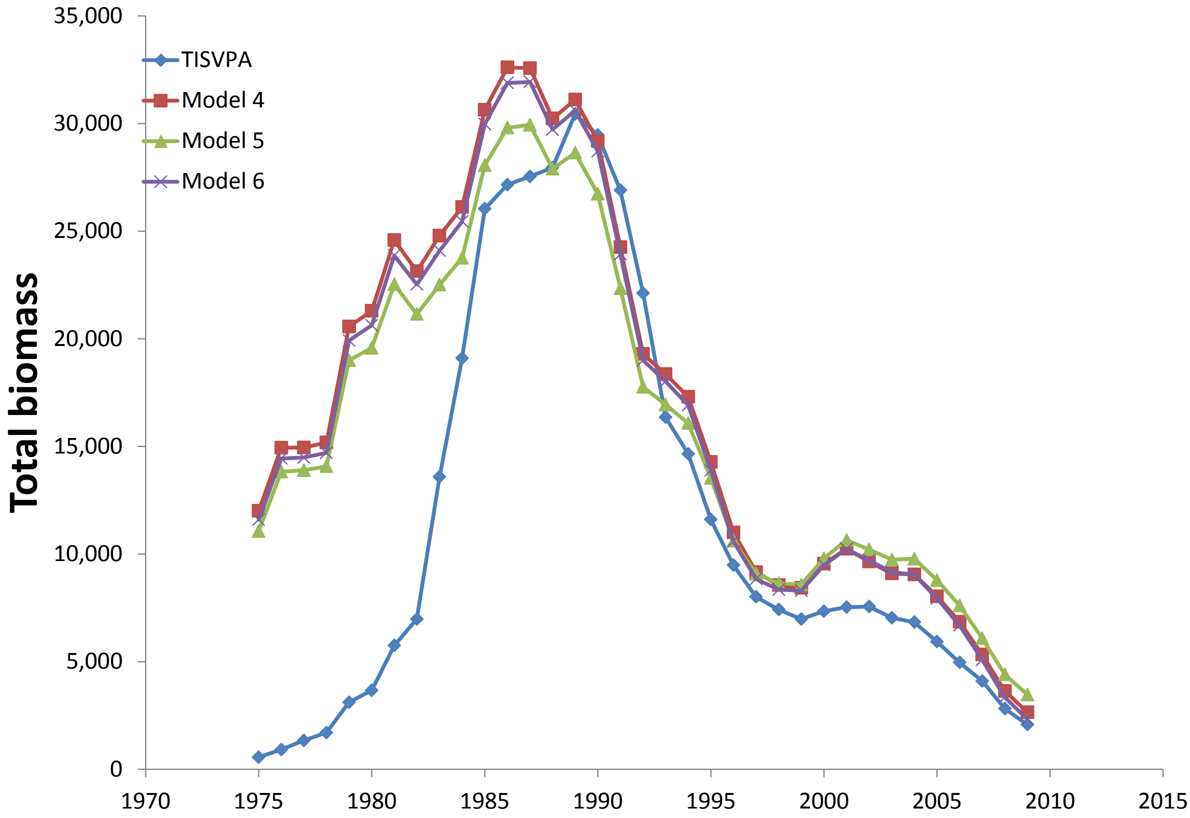

Figure 13. Total biomass estimates comparing the TISVPA model to that of the base case (Model 4) and the two sensitivities that were selected (Models 5 and 6).

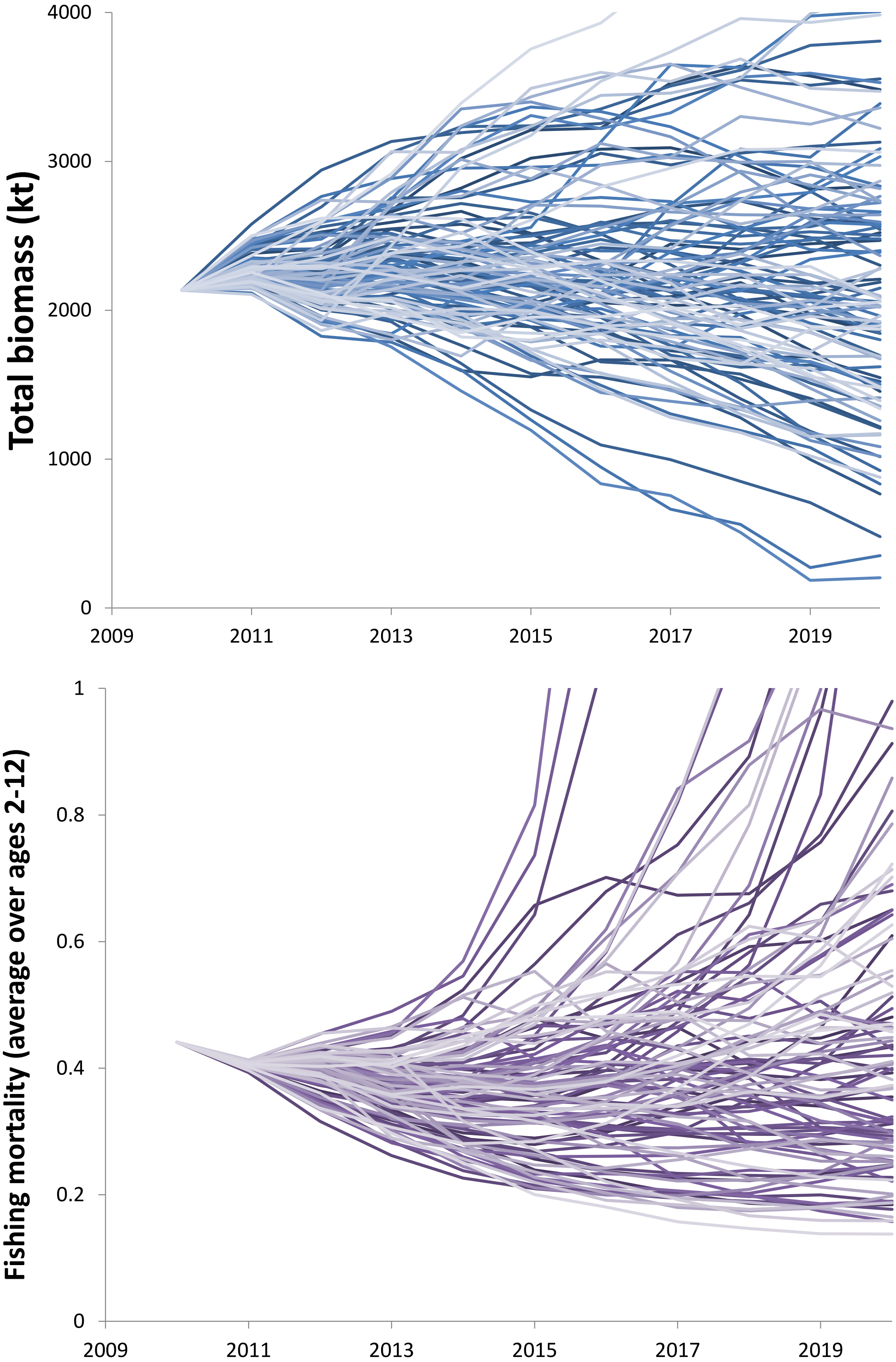

Figure 14. Stochastic projections of biomass (kt; top panel) and fishing mortality (average 2-12; bottom panel) for the base case model (Model 4) under the assumption that future recruitment has the same mean and variance as the **5-year** period 2005-2009 and assuming constant catch of 533.25 kt (75% of 2010 catch).

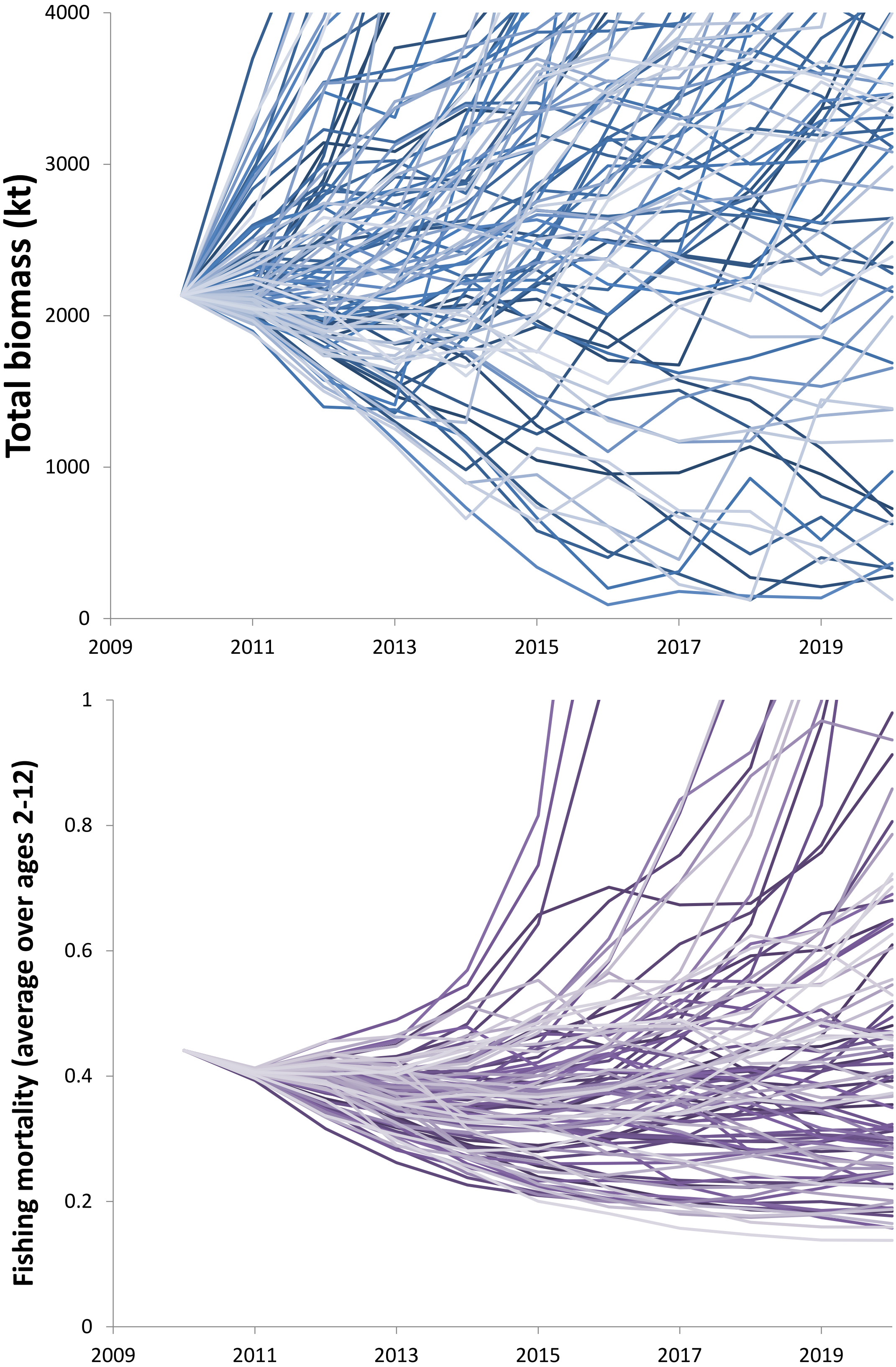

Figure 15. Stochastic projections of biomass (kt; top panel) and fishing mortality (average 2-12; bottom panel) for the base case model (Model 4) under the assumption that future recruitment has the same mean and variance as the **10-year** period 2000-2009 and assuming constant catch of 711 kt (equal to the 2010 catch).

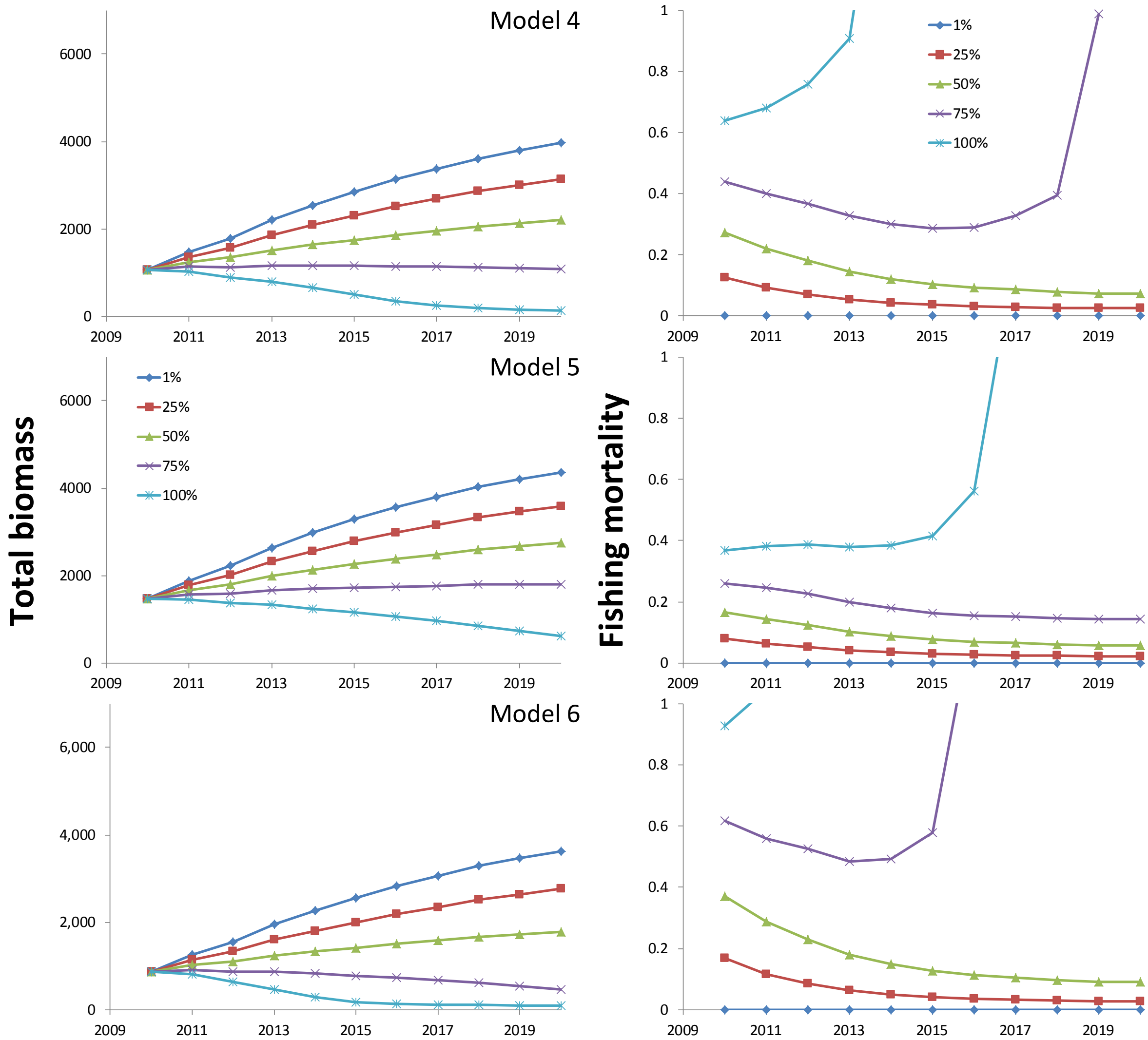

Figure 16. Projections of mean biomass (kt, left panels) and average fishing mortality (over ages 2-12; right panels) for the base case model (Model 4; top row) and the 2 sensitivities (Models 5 and 6) under the assumption that future recruitment has the same mean and variance as the **5-year**period 2005-2009 (which is different for each model). Total biomass is on the left, and future catch is on the right. The different harvest levels are based on 1%, 25%, 50%, 75%, and 100% of the status quo catch.

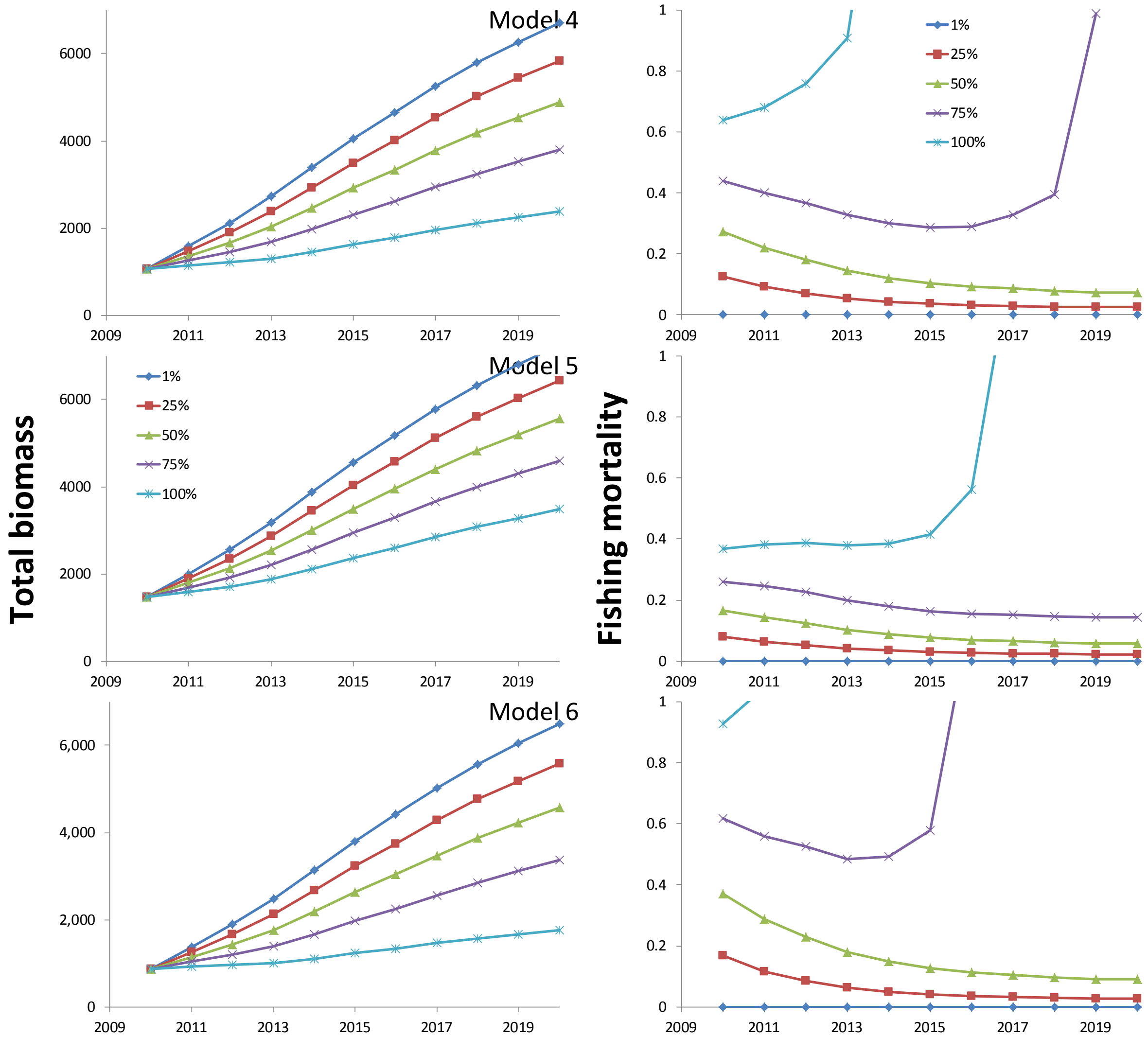

Figure 17. Projections of mean biomass (kt, left panels) and average fishing mortality (over ages 2-12; right panels) for the base case model (Model 4; top row) and the 2 sensitivities (Models 5 and 6) under the assumption that future recruitment has the same mean and variance as the **10-year** period 2000-2009 (which is different for each model). Total biomass is on the left, and future catch is on the right. The different harvest levels are based on 1%, 25%, 50%, 75%, and 100% of the status quo catch.