Stock Assessment for Petrale Sole

STAR Panel 24-28 July 2023

Stock assessment team: Ian Taylor, Vlada Gertseva, and Nick Tolimieri

Review Panel: John Field (chair), Kristin Marshall, Joseph Powers, Martin Cryer, Whitney Roberts (GMT), Gerry Richter (GAP), Marlene Bellman (PFMC staff)
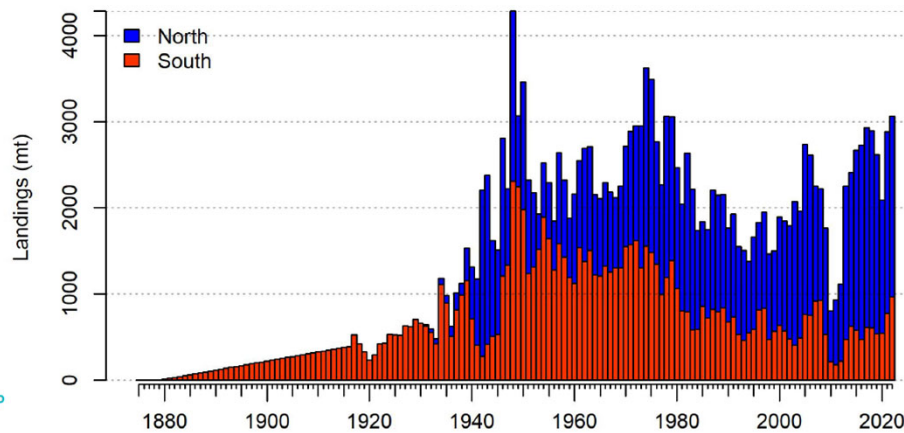
Assessment history

- Stock has assessed or updated with high frequency

- Declared overfished in 2009 (reference points also changed).

- Declared rebuilt in 2015.

- Last full assessment in 2013.
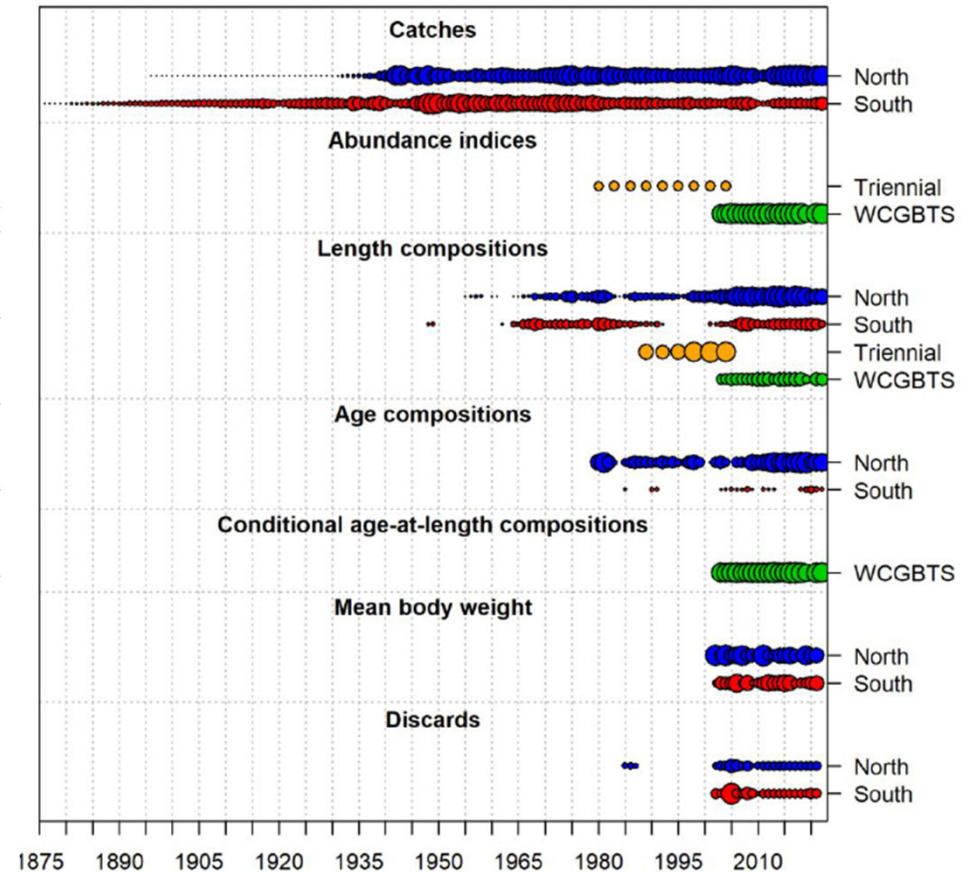
- Last update assessment in 2019.
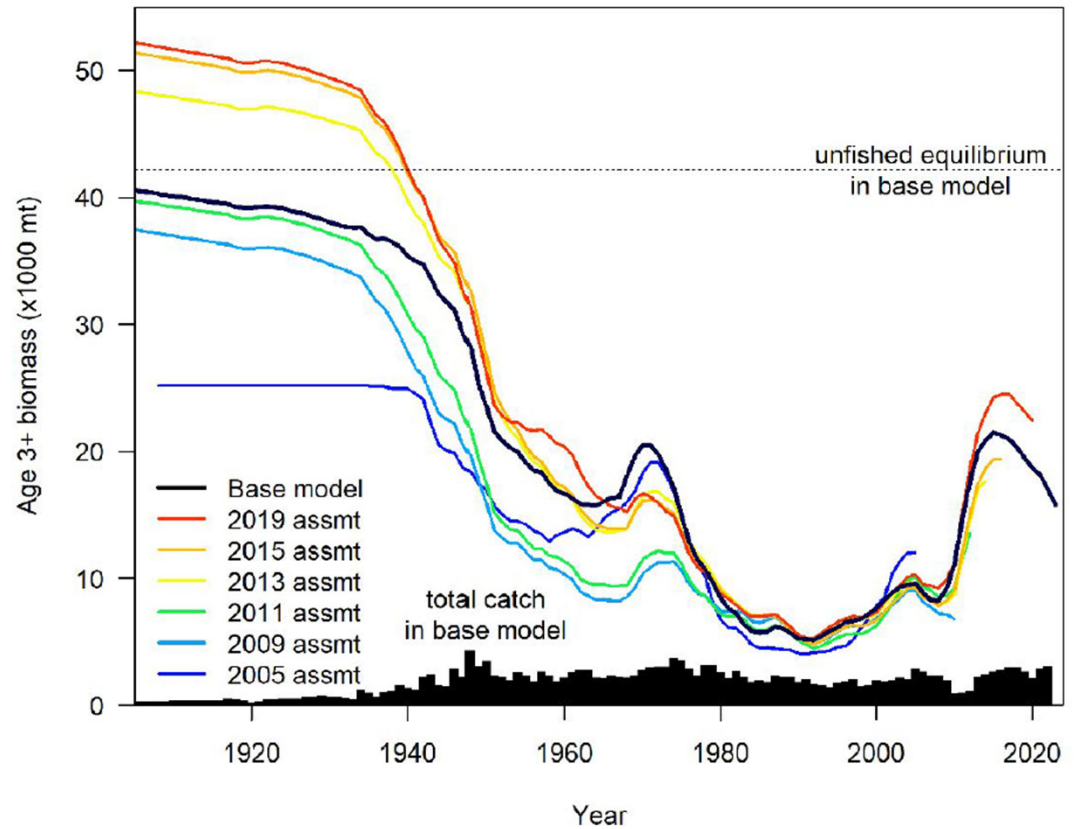
Data Sources

Nearly all catches from commercial trawl gear, so very little fleet complexity.

"South"= California, "North" = OR/WA.

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Major changes from 2019 assessment

- Earlier models had distinct "winter" and "summer" fishing fleets, this model aggregates into single annual fleets.

- A fishery-dependent CPUE index that was included in earlier models was excluded, based on concerns over hyperstability and confidence in WCGBTS index

- Previous assessments treated triennial survey as two distinct time series, this assessment combines back into a single time series

- Revisions to WA historical catches, as well as discards in recent time period

- Steepness fixed at 0.80, was estimated in 2013 benchmark (and subsequent updates)

- New maturity ogive, new fecundity data included
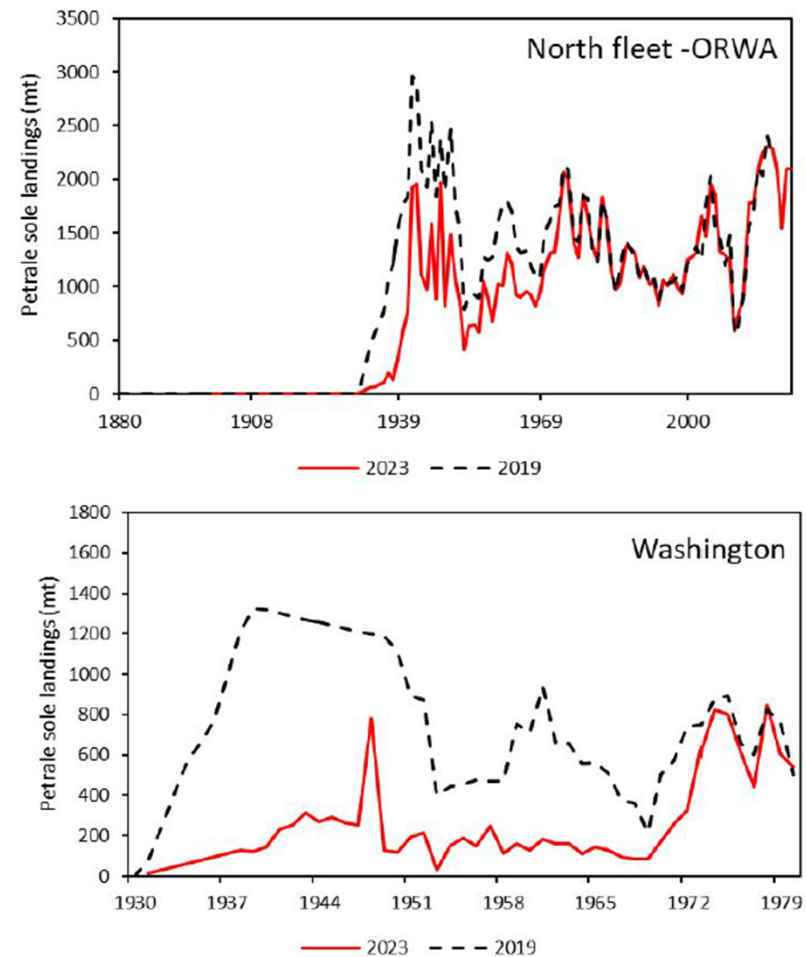
Basic model details

- Stock synthesis version 3.30.21 (released February 2023).

- Modeling period begins in 1876, unfished equilibrium prior to that.

- One area, two fleets (North and South), two sexes.

- Mortality and growth fully estimated for each sex separately.

- Steepness fixed at 0.8 (Myer's prior from meta-analysis).

- Asymptotic selectivity, sex specific, with time blocks on selectivity and retention.

- Recruitment estimated from early 1960s through present.

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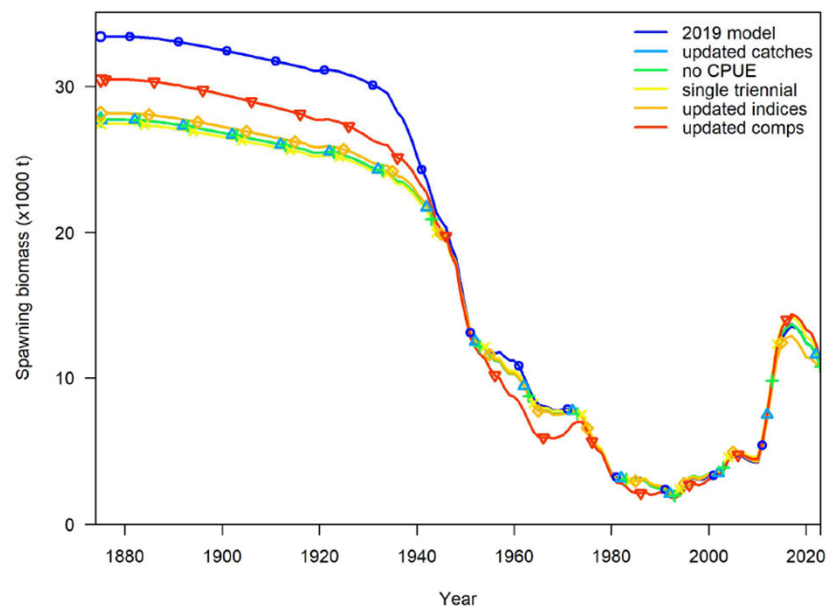
Environmental index of recruitment

- Based on paper by Haltuch et al. (2020), but index from that analysis could not be extended past 2010 due to issues with ROMS time series

- New analysis by Nick Tolimieri conducted using alternative oceanographic model data

- Best fitting model explained 68% of the variance in recruitment deviations from 1993-2018, would suggest higher recent recruitments.

- Index shows promise but would benefit from further testing, validation and review(STAT opinion, STAR concurred).
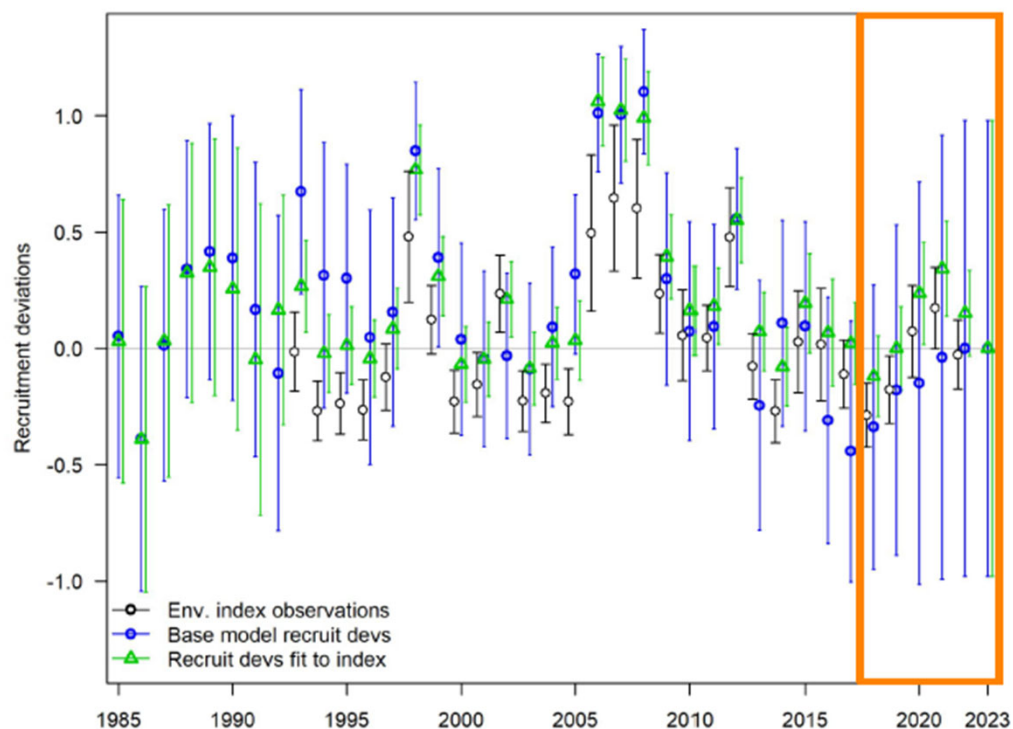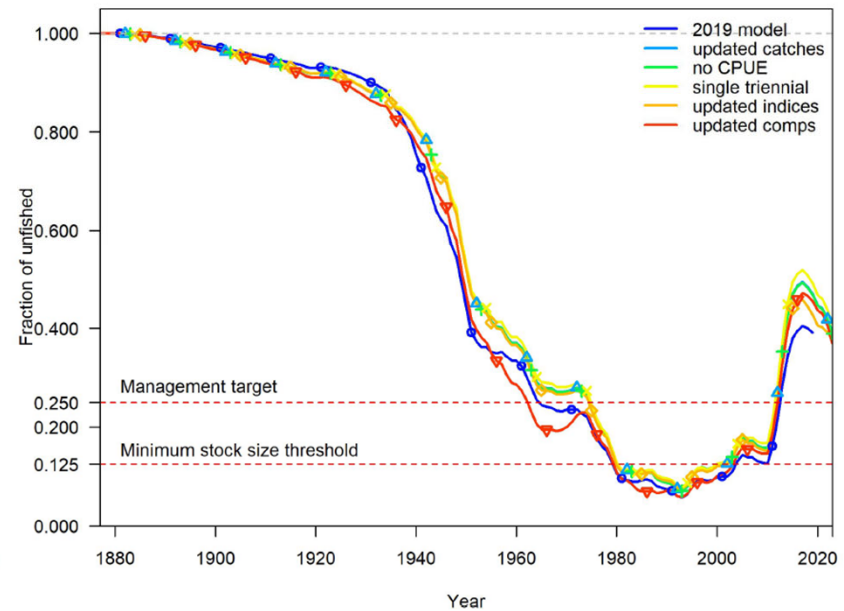
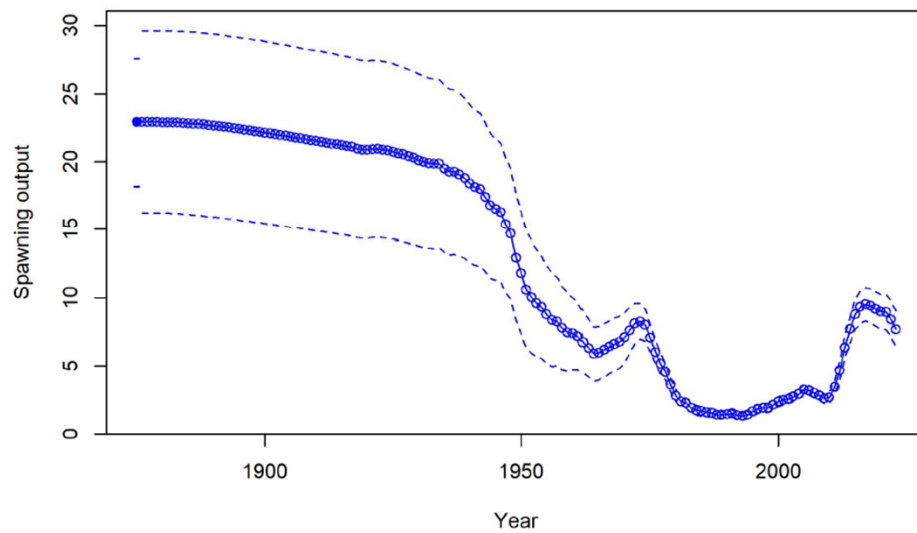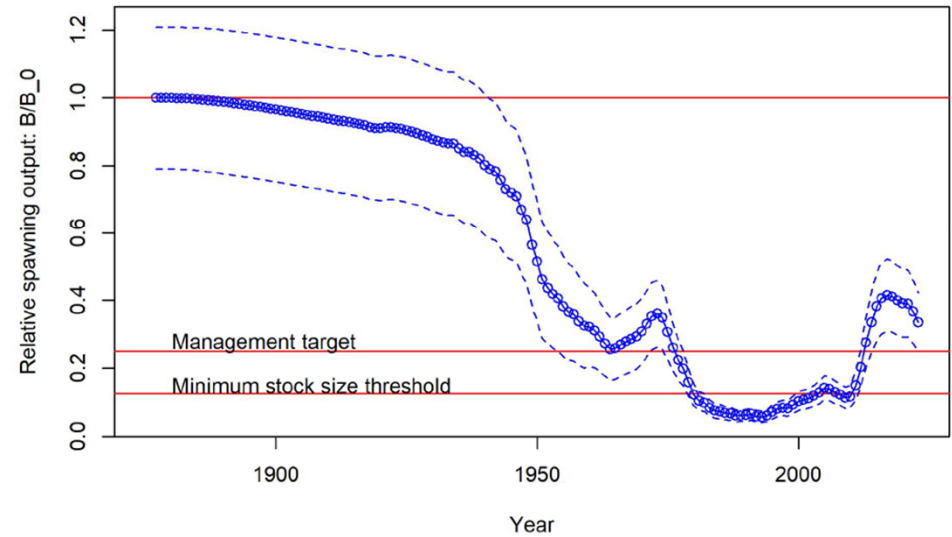# Bridging from 2019 to 2023 model

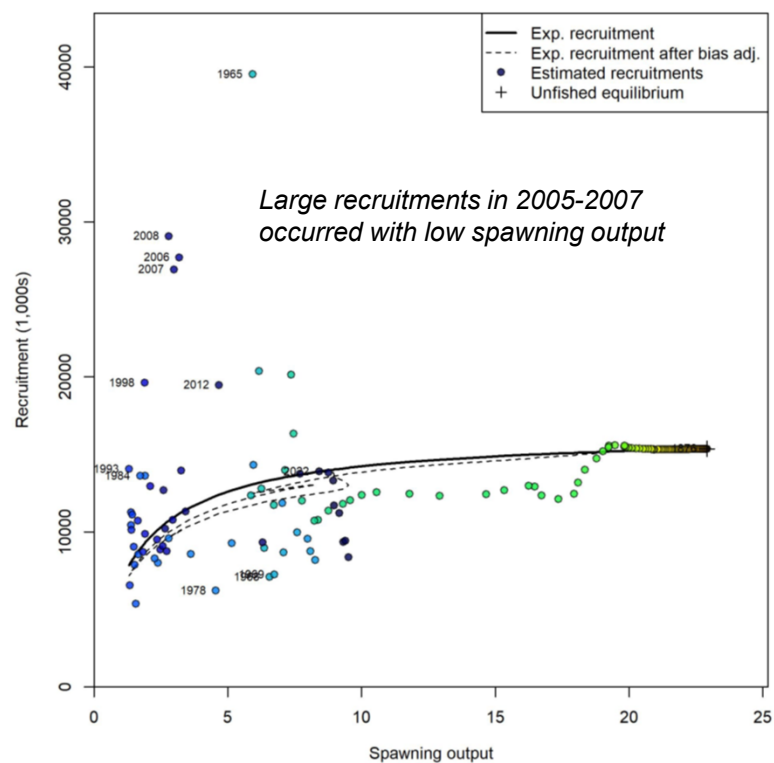Spawning biomass

Fraction unfished
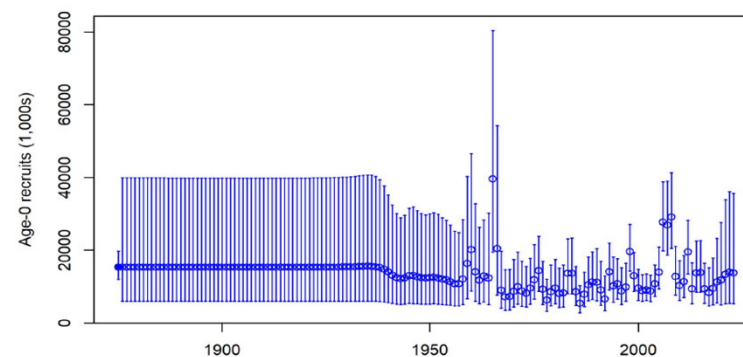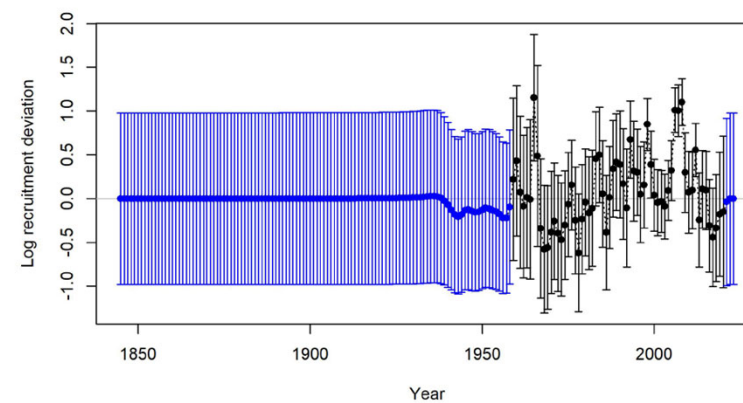
Base model results

Spawning biomass — Fraction unfished

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Recruitment

Large recruitments in 2005-2007 occurred with low spawning output

Impacts of Fishing

Fishing intensity (1 - SPR)

Selectivity patterns

Survey data fits

- Poor fit to 1980 and 2004 years of triennial index is typical of other flatfish assessments (more on this later)

- Fit to WCGBTS index is among the best across all west coast groundfish stocks- considered highly informative

- However, not clear why 2018 and 2019 fits are poor, and model also diverges a bit from most recent data points (2021, 2022).
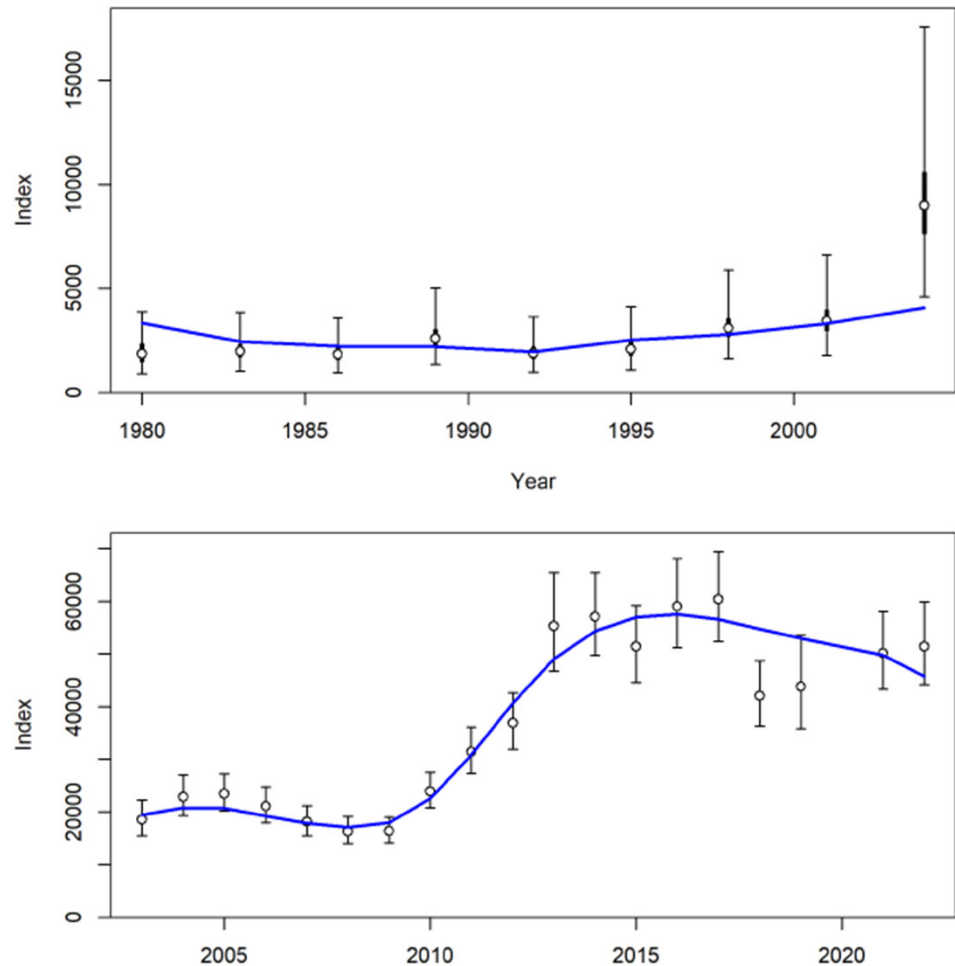
Length data generally well behaved, informative
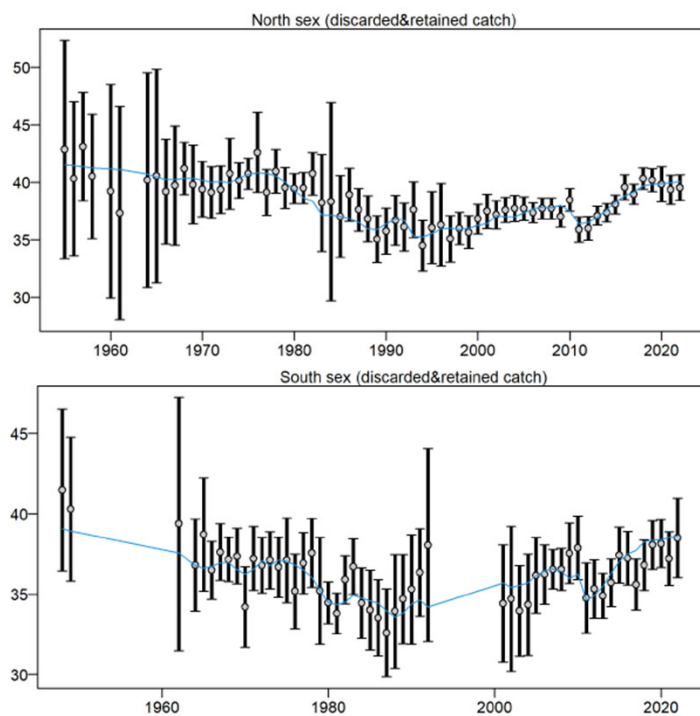
Retrospective analyses generally well behaved, influenced primarily by low survey index points in 2018, 2019
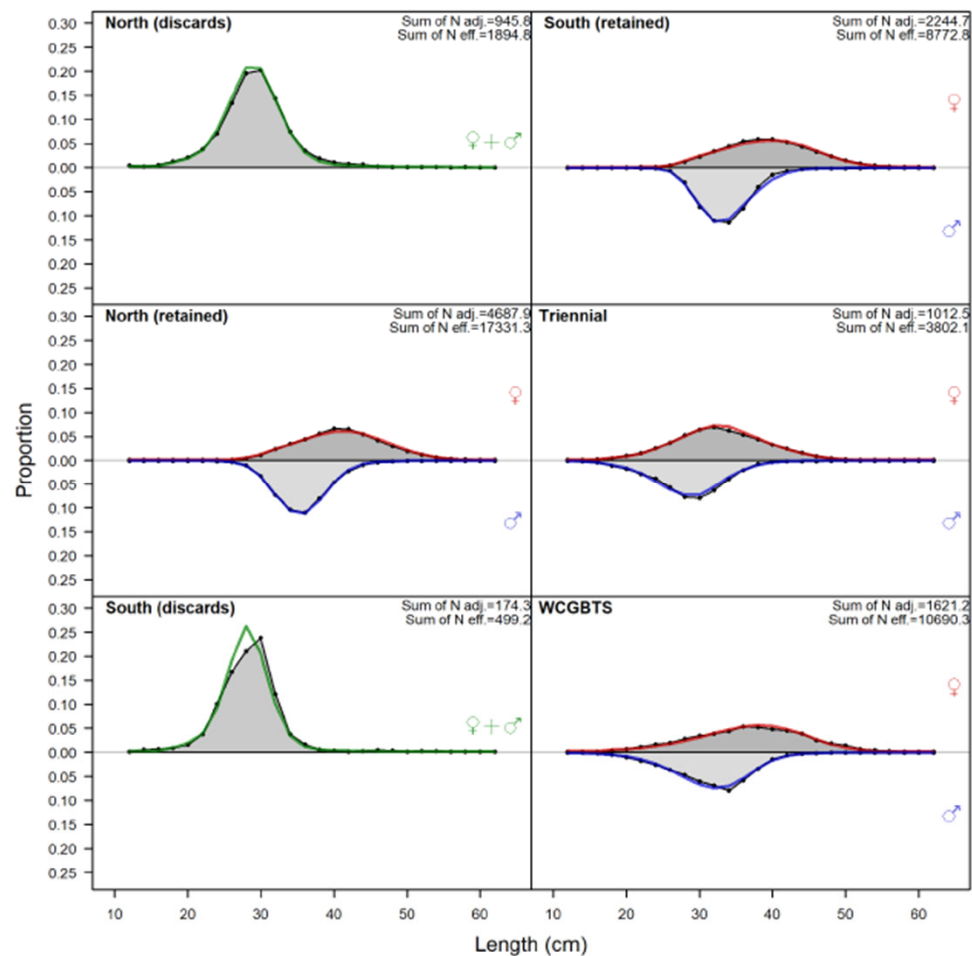

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Likelihood profiles

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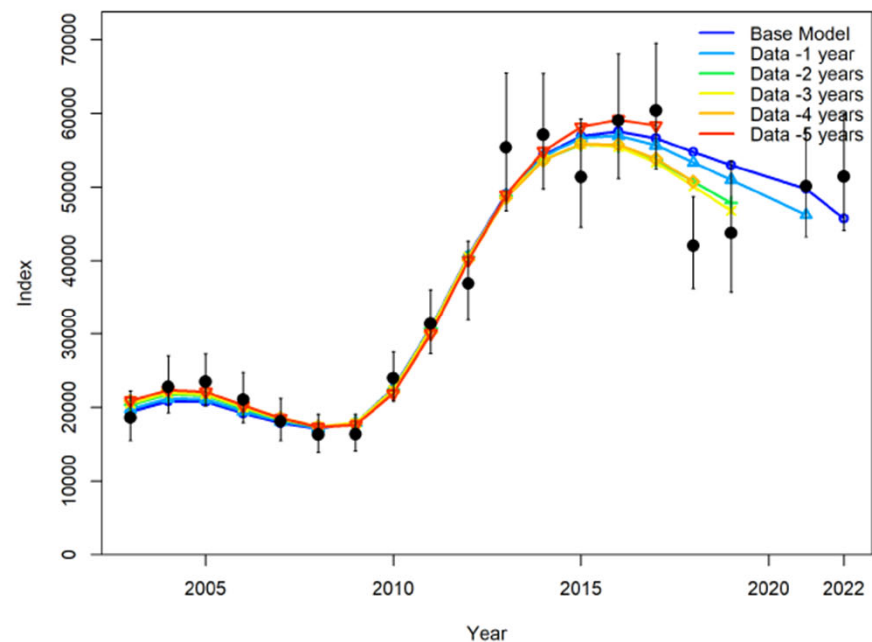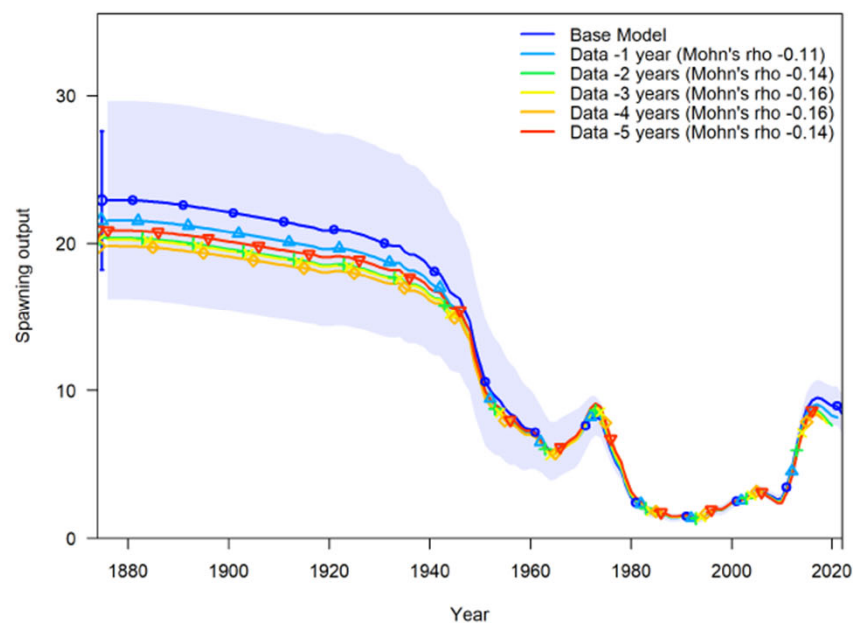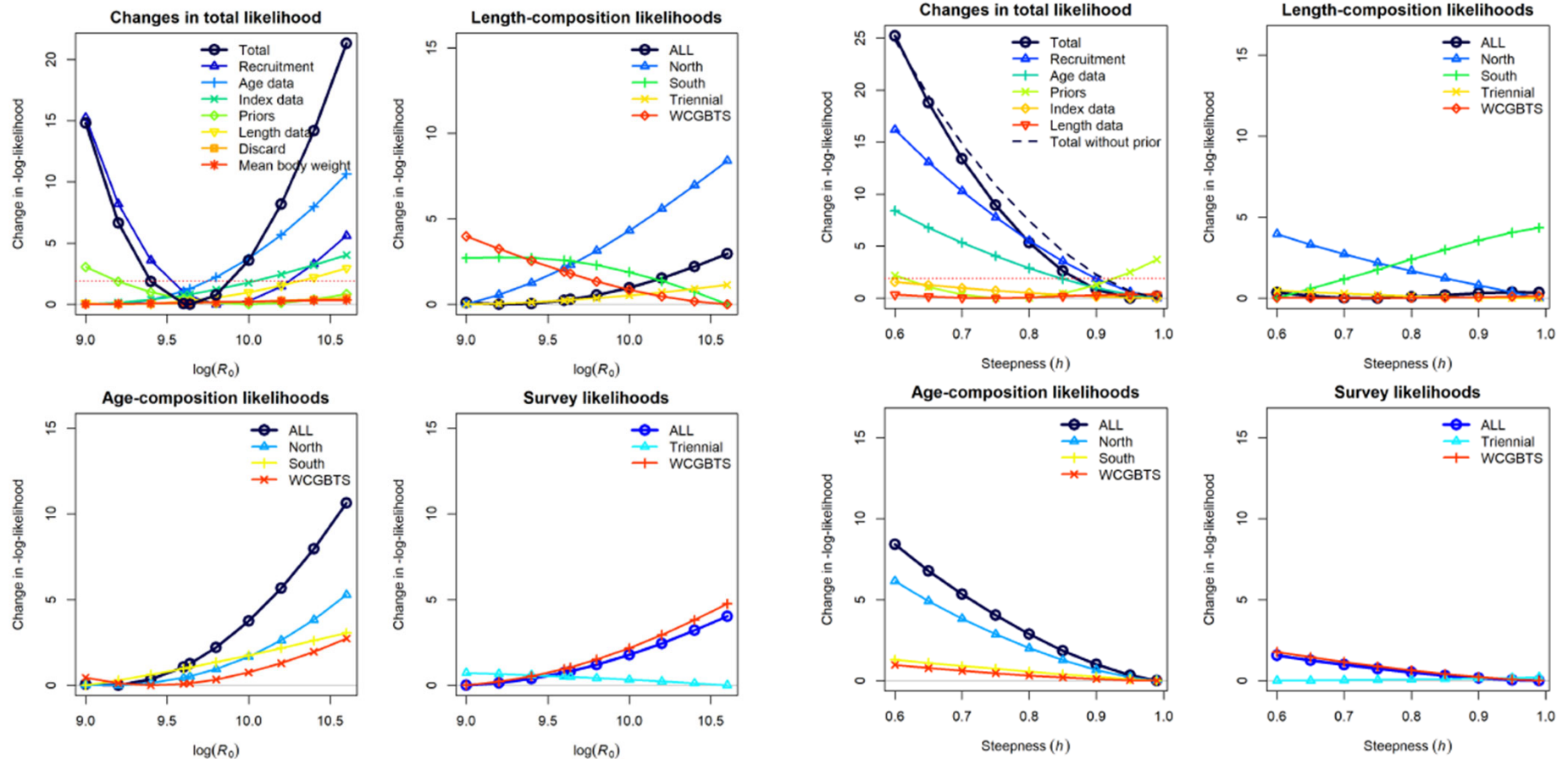
More likelihood profiles
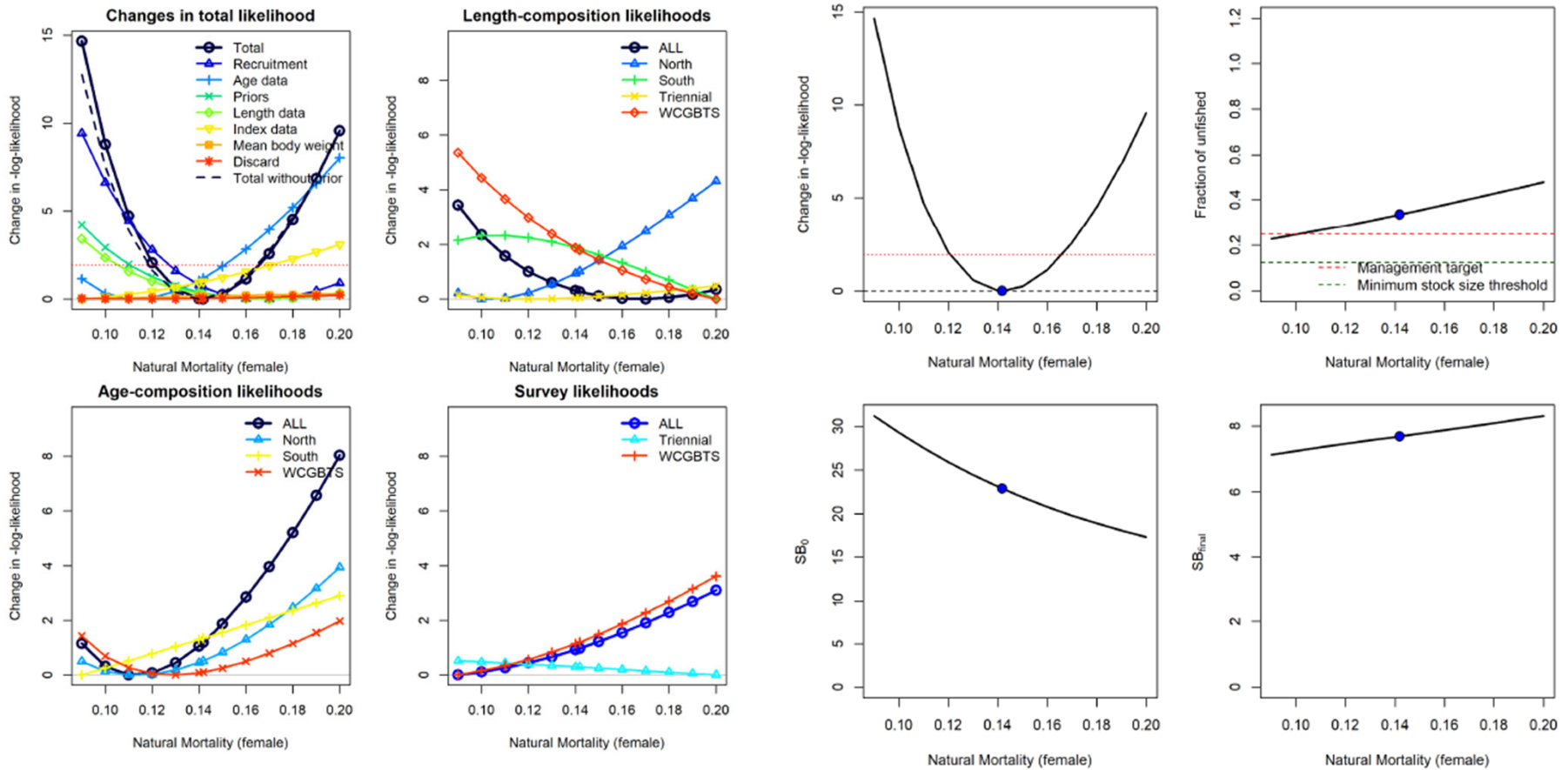
STAR Panel requests and responses

Requests 1, 7 and 8 were intended to better understand the main reasons for the decline in abundance and yield between this model and the 2019 model.

Results demonstrate that updating catches had substantially more influence on equilibrium MSY than other changes during the bridging analysis. Over half of the change can be attributed to the changes to WA historical landings and declines in recent discard estimates that resulted from pooling summer and winter fleets, while slightly lower steepness, natural mortality rate and reweighting also influential.

Model run	Dead_Catch_MSY
2019 model	3,157
updated catches	2,691
no CPUE	2,688
single triennial	2,679
updated indices	2,654
updated comps	2,652
switched Ninput	2,641
annual model	2,656
re-weighted	2,408
blocks updated	2,523
SR updated	2,475
MG updated	2,485
maturity updated	2,501
fecundity updated	2,482
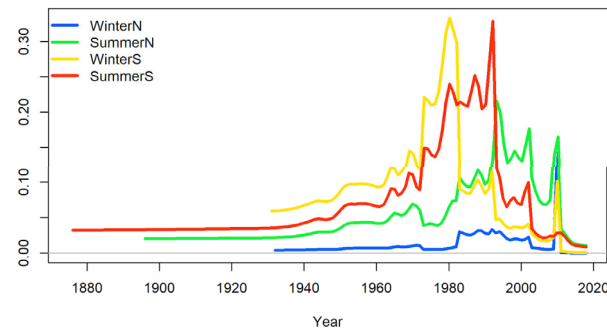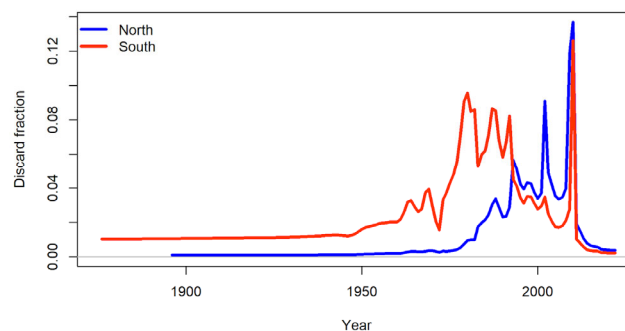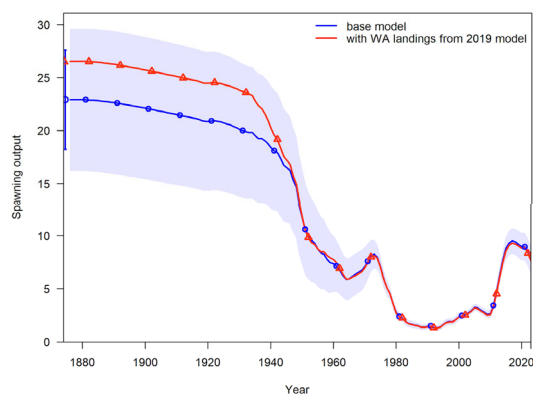
STAR Panel requests and responses

Request 2 was to provide plots of the fits to the West Coast Groundfish Bottom Trawl Survey (WCGBTS) index in the base model and in the sensitivity run that added the environmental recruitment index.

The environmental index suggests higher recruitment at the end of the time series, which leads to better fit to the final index value (2022) and a less steeply declining trend over the last five years. However, base model without the index had a slightly better overall fit to the Triennial and WCGBTS index. The Panel saw merit to considering the index in future assessments.
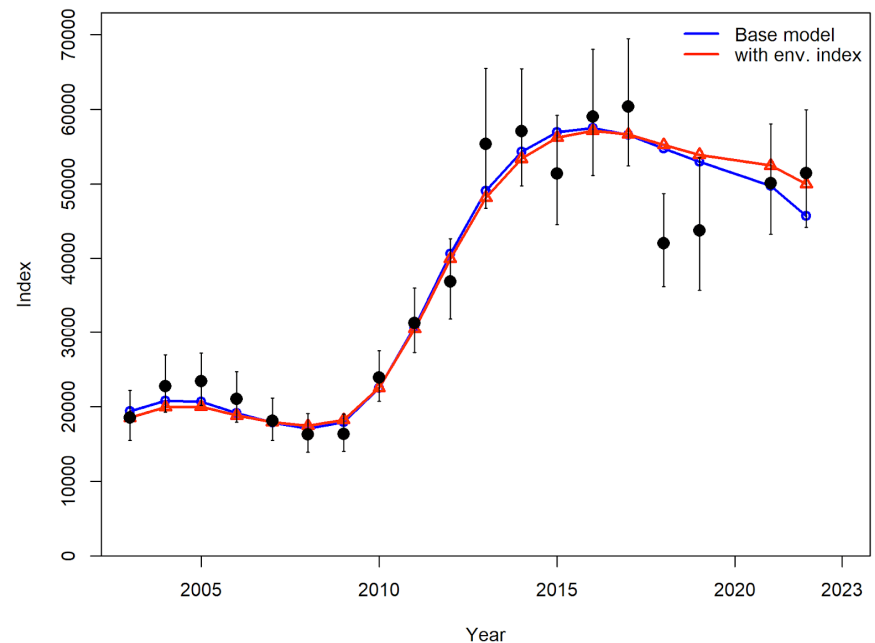
STAR Panel requests and responses

Request 3 was to profile over sigma R, including a model with no rec devs. Suggested that a fairly broad range of sigma R values are plausible, and that a deterministic recruitment model doesn't do all that badly either. The panel found the diagnostic useful, but saw no reason to suggest a change to the base model.
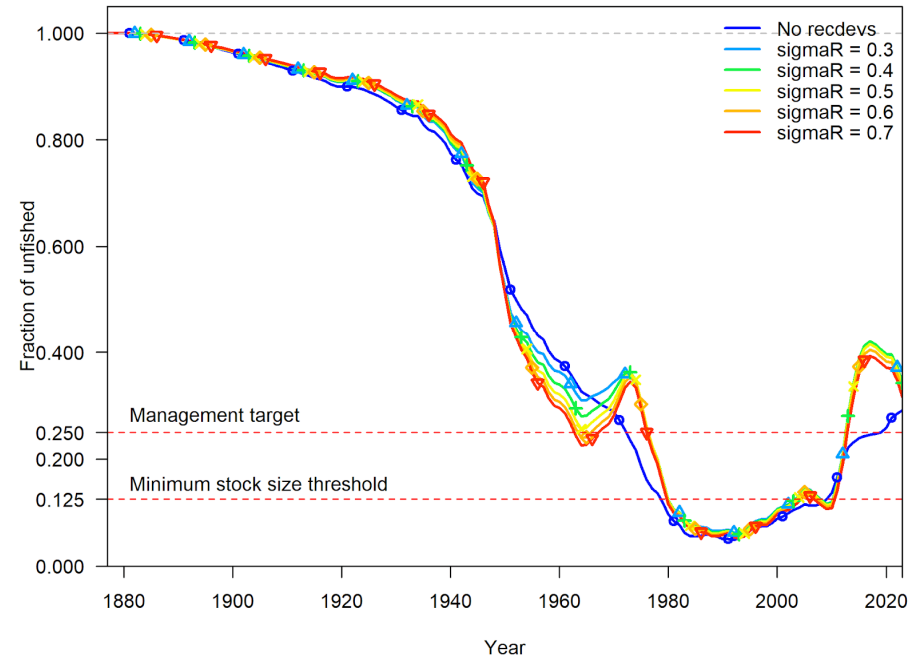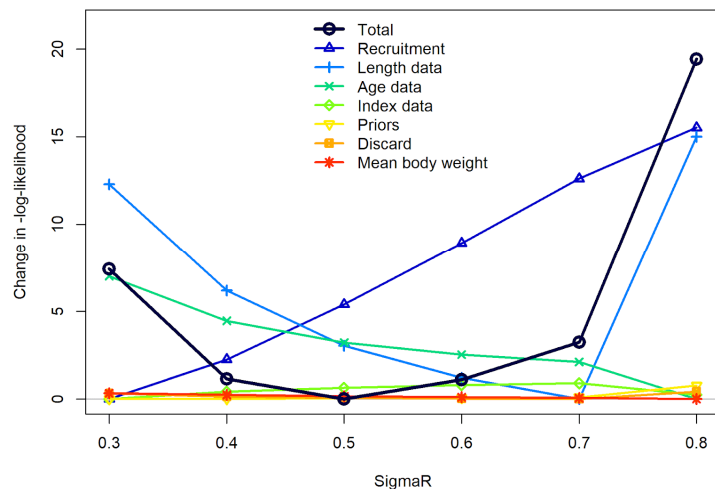
STAR Panel requests and responses

Request No. 4 was to upweight the triennial by both eliminating the extra SD on the Triennial survey, and do same while upweighting (lambda=10) the index, in order to see "if" the index 2004 data point could be fit. The panel also asked for fits to the Triennial survey index to other flatfish species.

The lambda=10 model was able to fit the index considerably better, but the results were not considered plausible. Comparing fits of other flatfish (and skates) support the conclusion that 1980 and 2004 are difficult to fit for other assessments beyond petrale sole.
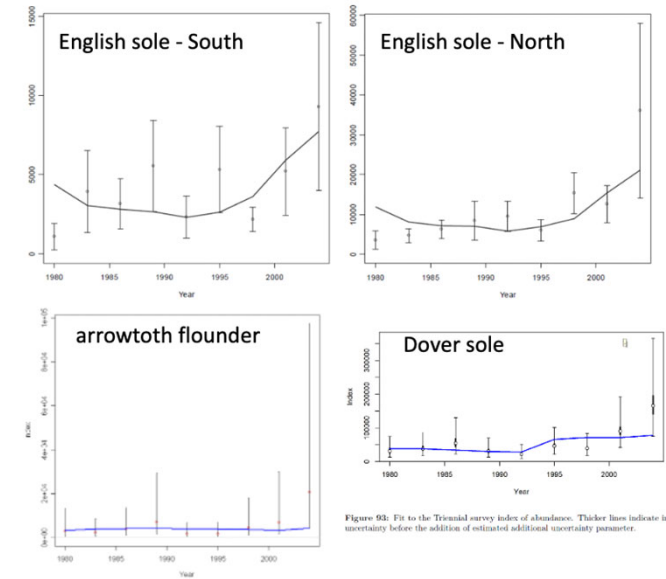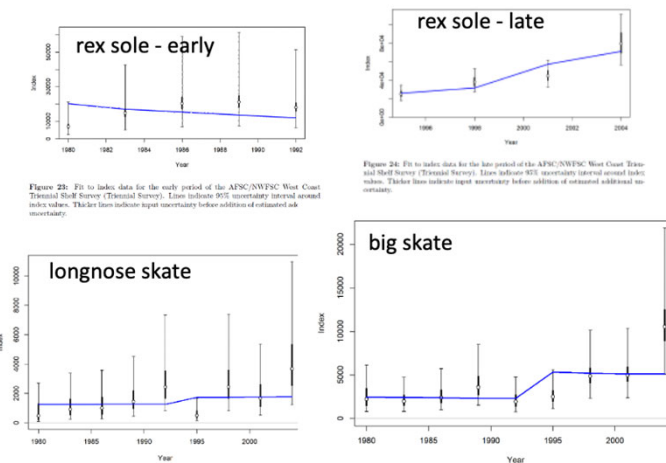
STAR Panel requests and responses

Panel and STAT agreed that natural mortality was a logical axis of uncertainty for the decision table, as this had the greatest influence on the perception of stock status and productivity. Female M for the low state of nature was 0.072, and 0.219 for the high productivity state of nature (relative to 0.142 in the base model).

Forecast trajectories using the default harvest control rule and a P*=0.45 led to continued declines in abundance for all three states of nature, based on the poor recruitments estimated by the model in recent years. Under the low productivity state of nature the stock approaches, but does not dip below, the MSST based on the assumption of full attainment of catches from the default harvest control rule.
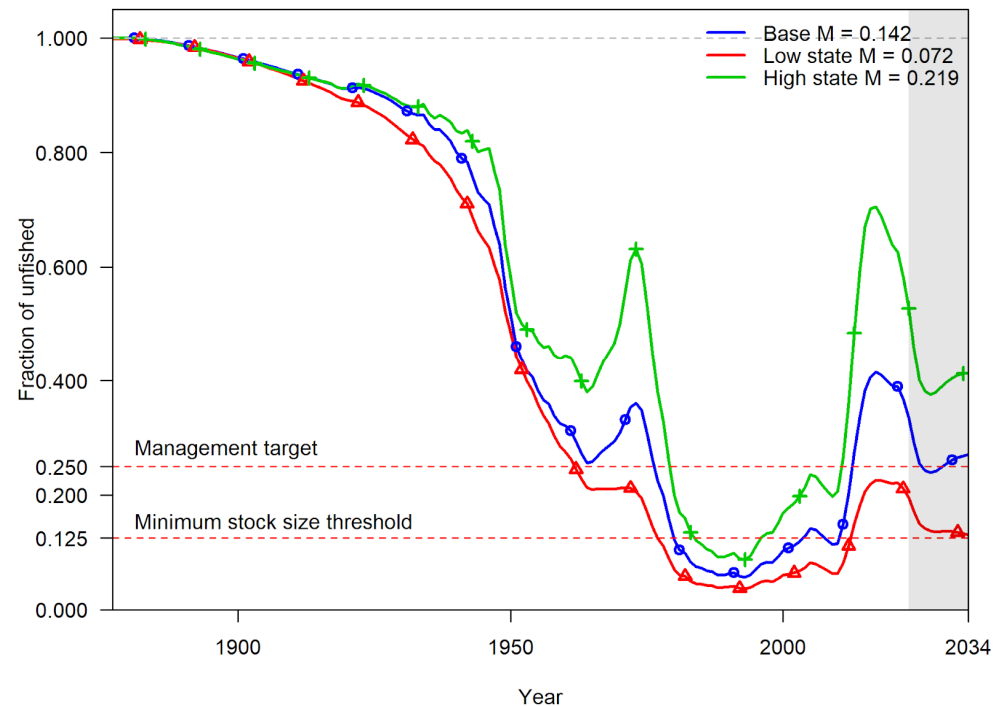
Other review highlights

- The final base model was unchanged from the draft assessment!

- Technical merits included considerable simplification of the model to remove unnecessary complexity, updating a broad suite of life history and reproductive ecology parameters, and removing datasets less influential in the model.

- The WCGBTS index appears to be highly informative for this stock. Compositional data are robust for the surveys and the northern fishery.

- There is considerable promise for including a version of the environmental index in future assessments.

- The Panel found no technical deficiencies within the data sources or modeling approach. There remains tension between length and age data in this model, which is typical of many U.S. West Coast groundfish stock assessments.

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Assessment team research recommendations

- Continued development of environmental indices to inform recent estimates of recruitment. The Panel also encouraged consideration of a risk table approach that could include environmental trends thought to influence productivity.

- Additional research into both spatial and temporal variability into productivity processes such as growth, recruitment and maturity.

- Continued discussion and research with Canadian researchers to exchange data and ideas regarding stock trends, demographic structure, movement patterns, dispersal, and recruitment dynamics between U.S. and Canadian stocks.

- Exploration of the mechanisms behind sex-specific selectivity patterns.

- Catchability in the WCGBTS is considerably greater than 1, research into the effects of herding or other responses to survey gear would help to understand the mechanisms behind these high values.

Additional research recommendations

- The pattern of above average abundance estimates for not only petrale sole, but many other flatfish and skate species in 2004 (triennial survey) suggest a systematic change in how the survey was conducted. One could evaluate the location data associated with 2004 trawls relative to those from earlier years.

- Improved age data from California ("south") would improve the model and allow for a better ability to evaluate spatial differences in growth, productivity and population dynamics.

- If available, historical age structures (otoliths) that were surface read and not used should be read using contemporary methods for future assessments.

- The forecast values derived from Stock Synthesis suggested some minor discrepancies when control rule buffers were applied to OFLs to arrive at ACLs, such that some ACLs were greater than the ABCs after application of the harvest control rule. These should be resolved

Panel recommendations

- The Panel recommends that this be considered a Category 1b assessment, as there are robust compositional data to inform year class strength and growth, and there is robust trend information from surveys.

- Panel recommends using the default sigma value of 0.5 for category 1 assessments.

- The Panel recommends the next assessment be an update, unless an environmental index or other substantive change/improvement were developed that would warrant a full assessment.

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