

Pacific halibut ABM

Model presentation / updates

- In Oct 2020 reviewed changes since preliminary review in October 2019:
 - Changes to alternatives (A80 only) and associated assumptions
 - Operating model changes as a result of SSC and Council requests
- April 2021 revisit main points; no reanalysis conducted (limited inferences)
 - Resolve/discuss other areas from operating model (OM)



INFORMATION INFERRED FROM PREVIOUS MODELING RESULTS TO INFORM ANALYSIS FOR THIS MEETING

- To provide some context on the relative probability of future combination of index values used in new alternatives
- Alternatives were not explicitly modeled/contrasted



SSC model recommendations from 2019

- Alternatives apply only to A80
- Ran the model for 100 years
- Previous control rule for directed halibut fishery is still based on historical estimated SSB:total mortality estimates, but:
 - some runs also including a 30:20 control rule
 - historical relationship focuses on recent history (shallower slope)
- PSC use:limit relationship incorporates uncertainty



SSC model recommendations from 2019

- Model shifted definition of B_0 to dynamic B_0
 - consistent with shift in IPHC management
- Updated model validation process to account for changes in IPHC assessments
 - Sex ratio data changed selex curves, for instance

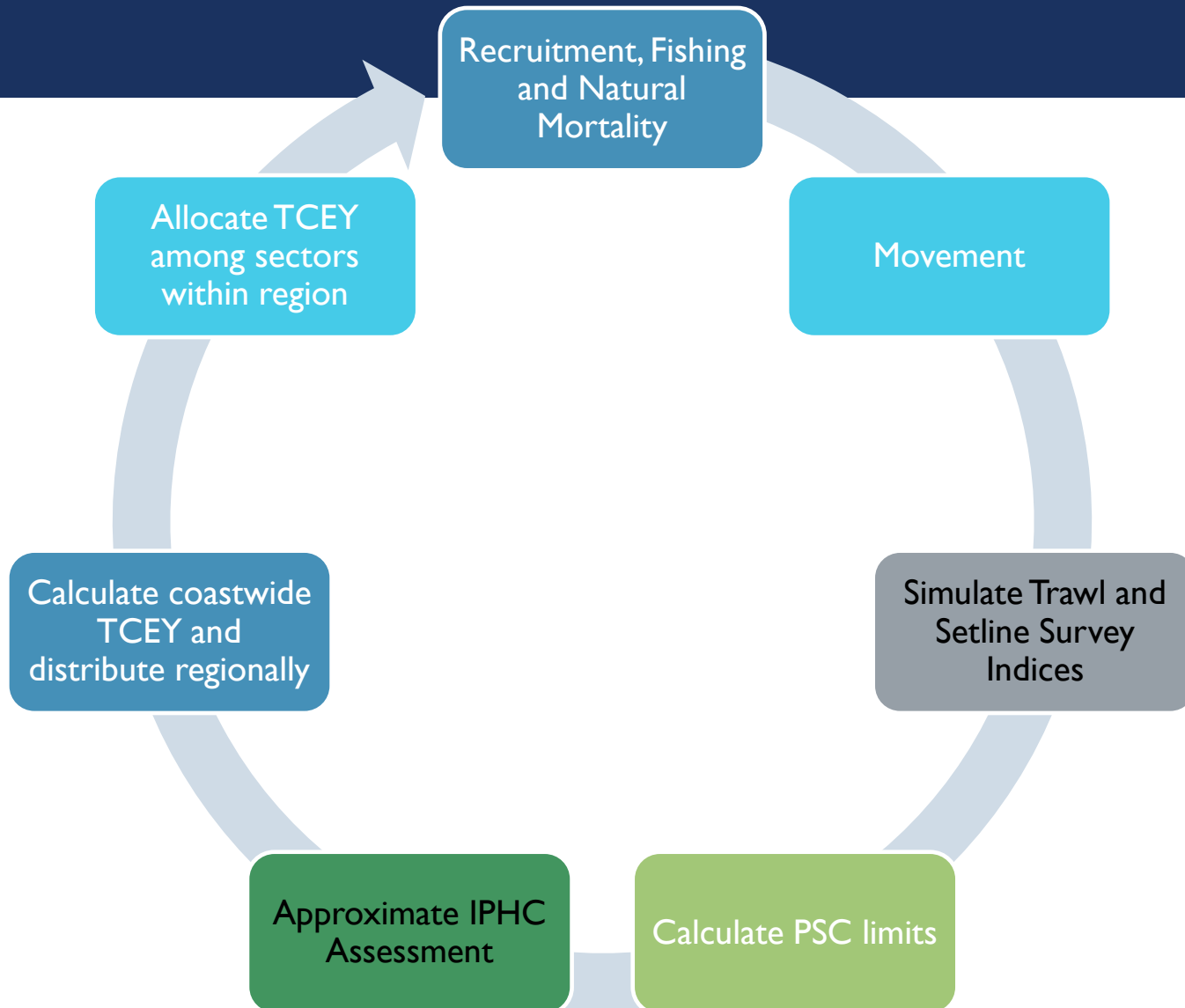


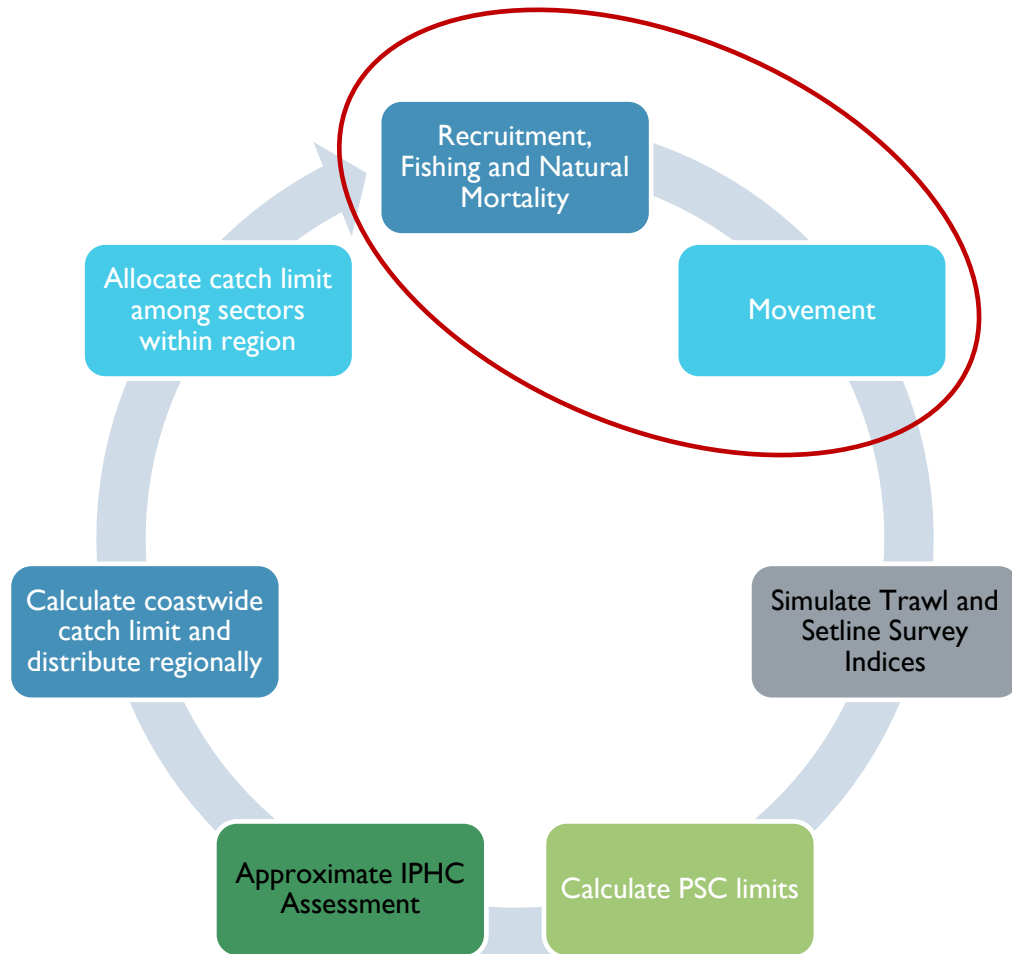
New in 2020

- Sensitivity analyses:
 - Low recruitment scenario,
 - Extreme low recruitment robustness test
 - Temporal autocorrelation in simulated “assessment” step
 - PSC use:limit relationship where use closer to limit as limit becomes low (also stochastic)
 - Two alternative trawl PSC selectivity curves



Closed-Loop Simulation Model Schematic



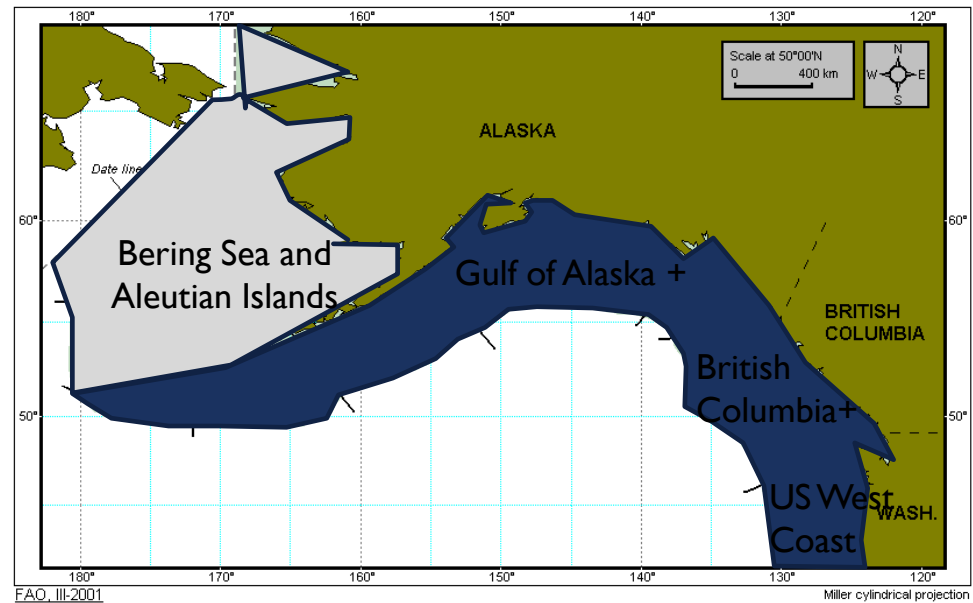


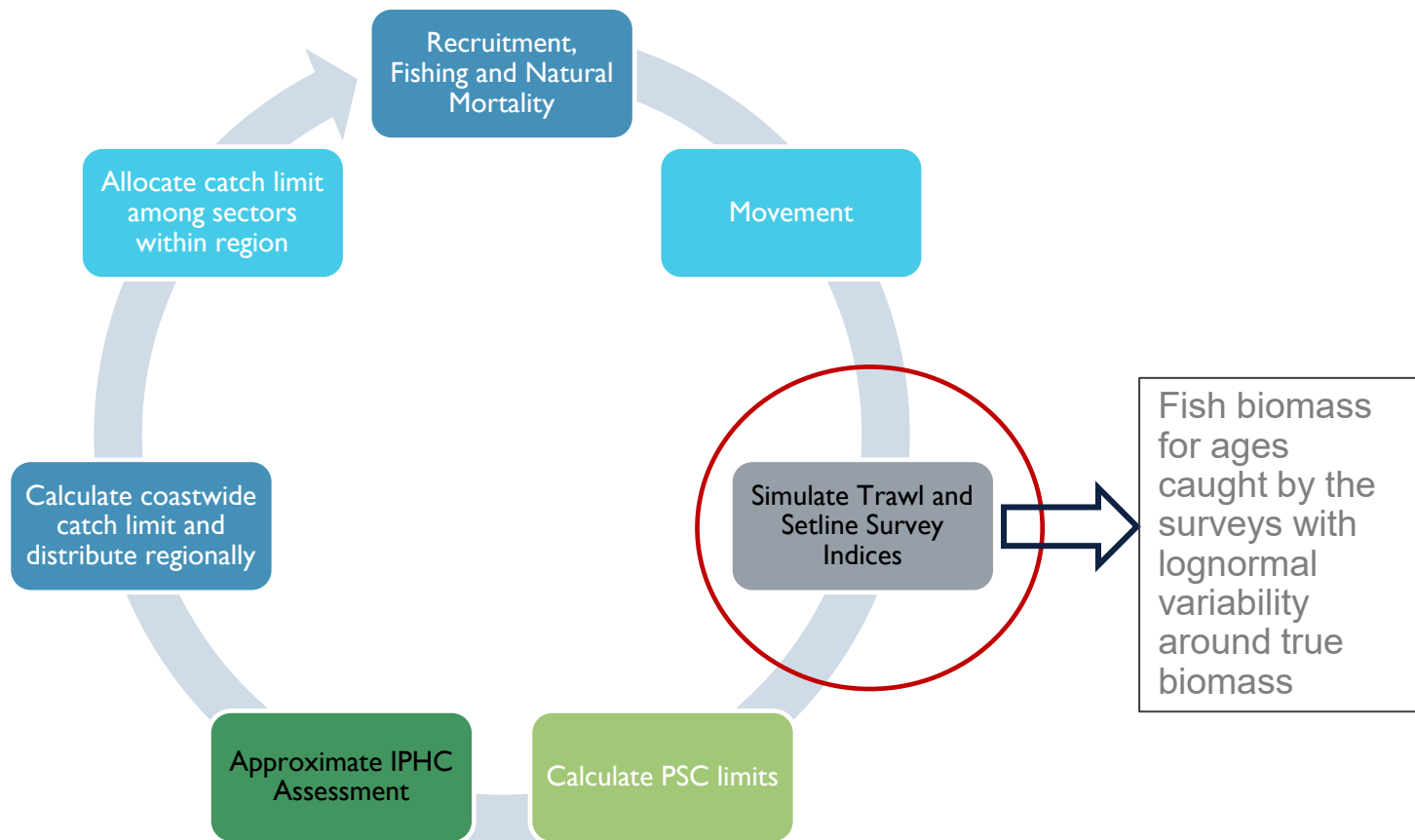
- 2 Area Model
 1. Bering Sea-Aleutian Islands
 2. Gulf of Alaska, British Columbia, US West Coast

- Recruitment of halibut
 - Allocated among areas, time-varying
 - Function of example Pacific Decadal Oscillation index

- Adult movement unchanged

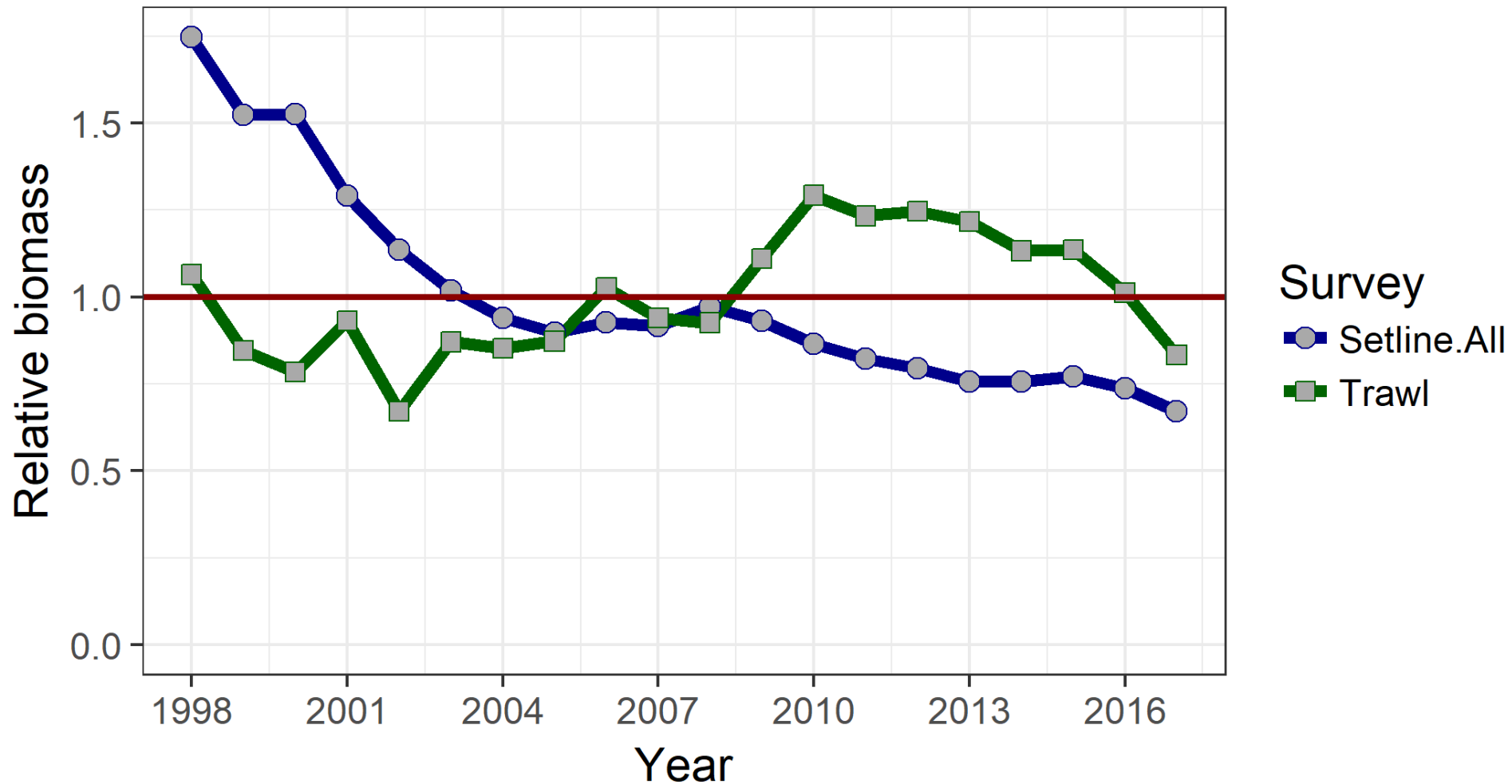
- Fleet structure unchanged, but selectivity updated according to new IPHC assessment results (trawl PSC fleet is still in aggregate)

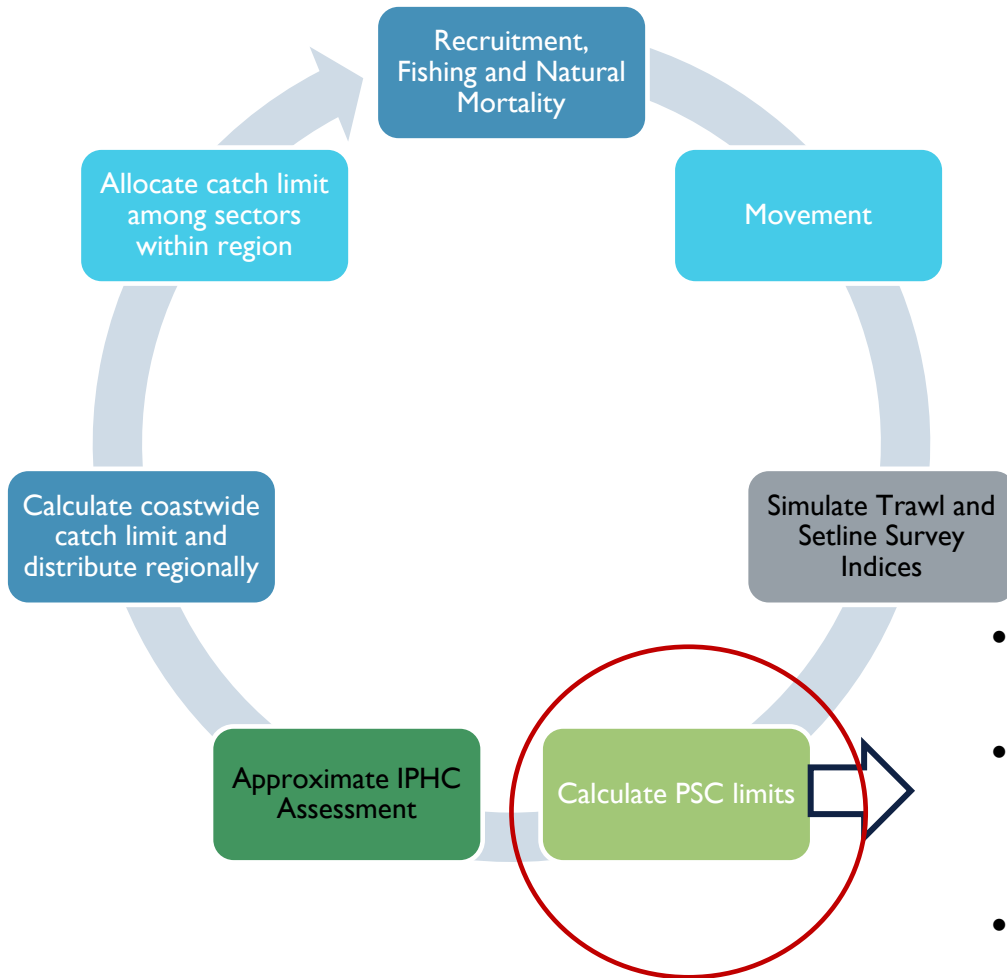




Surveys in the Eastern Bering Sea

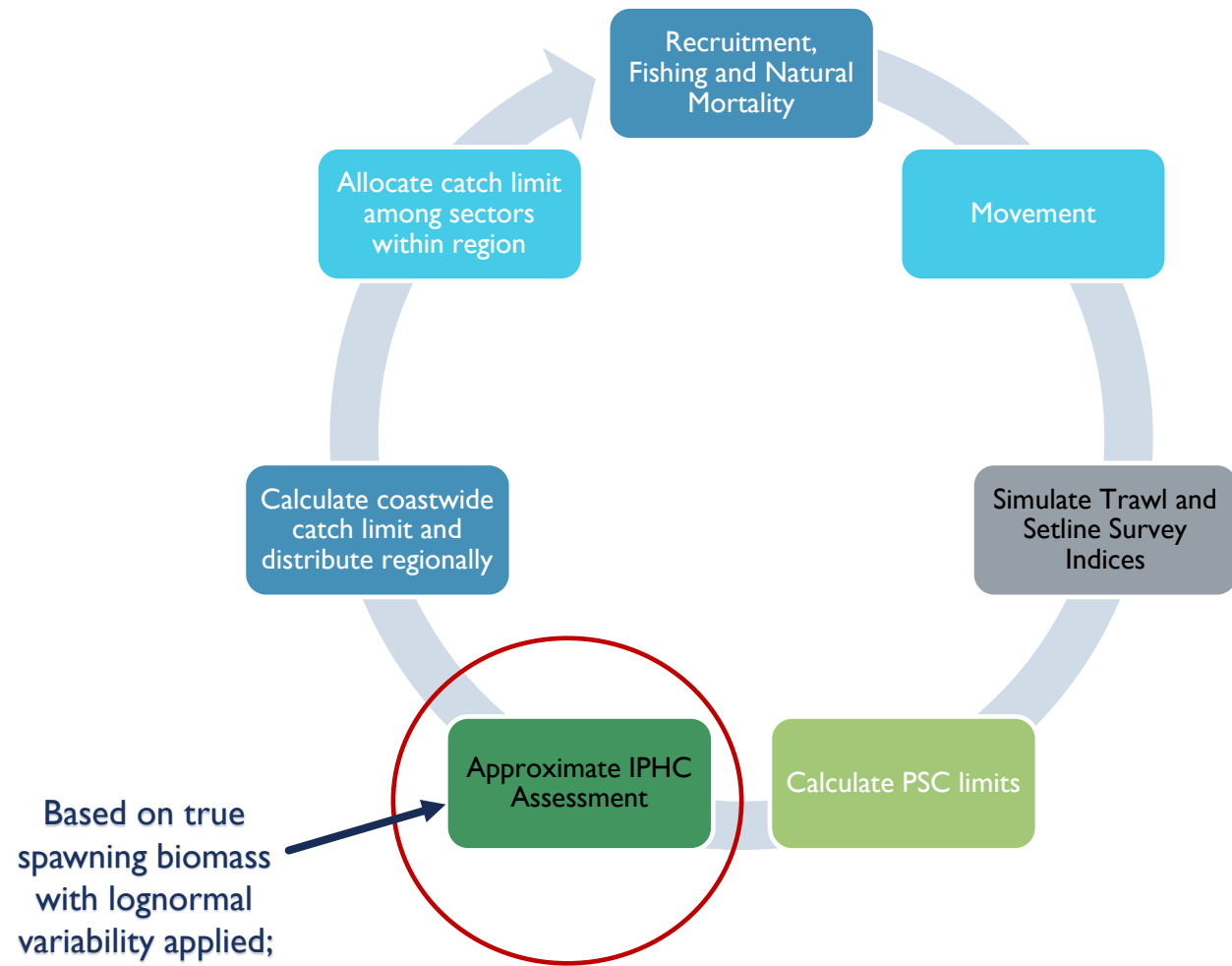
EBS Pacific halibut





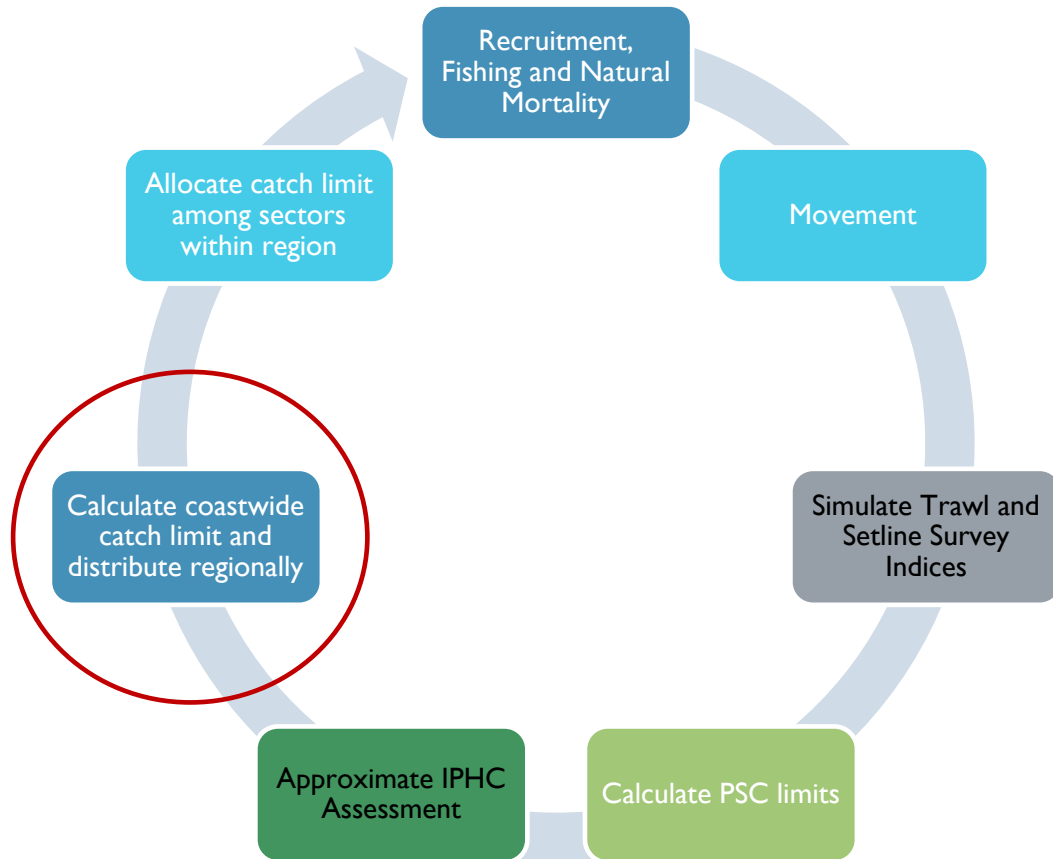
- A80 PSC limit calculated from alternatives
- Non-A80 static PSC added to A80 PSC limit to calculate aggregate BSAI trawl PSC limit
- Longline PSC limit static





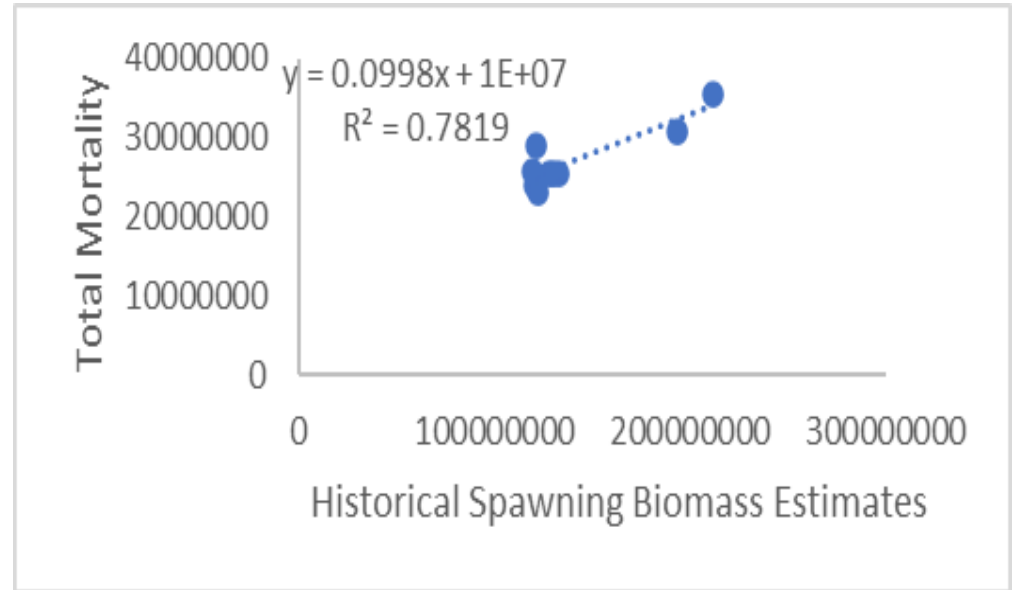
Based on true spawning biomass with lognormal variability applied; sensitivity analysis including temporal autocorrelation



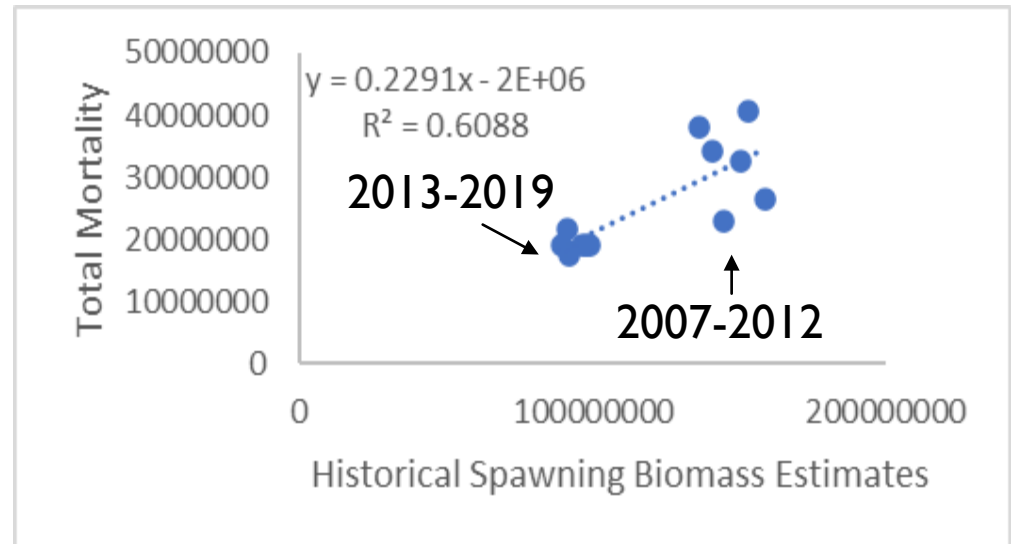


2020 ABM control rule for TCEY determination

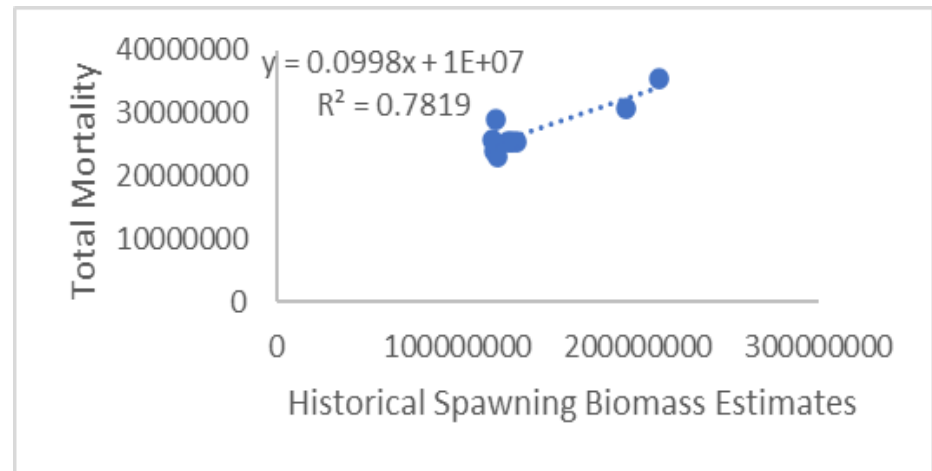
- Note shallower slope than for last year; SSC requested not including or downweighting some of the earlier years



2019 ABM control rule for TCEY determination

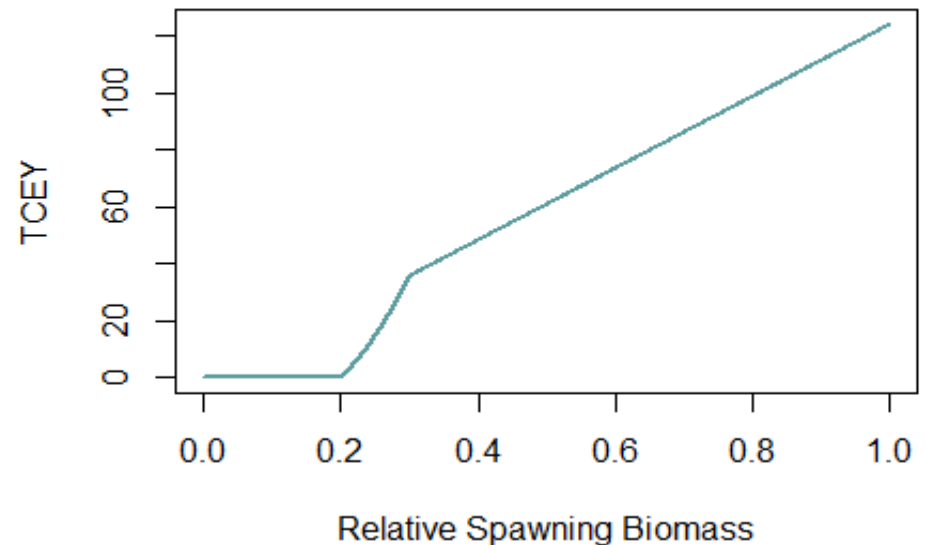


This year's control rule for TCEY determination before 30:20 rule applied



Application of 30:20 harvest control rule for TCEY determination:

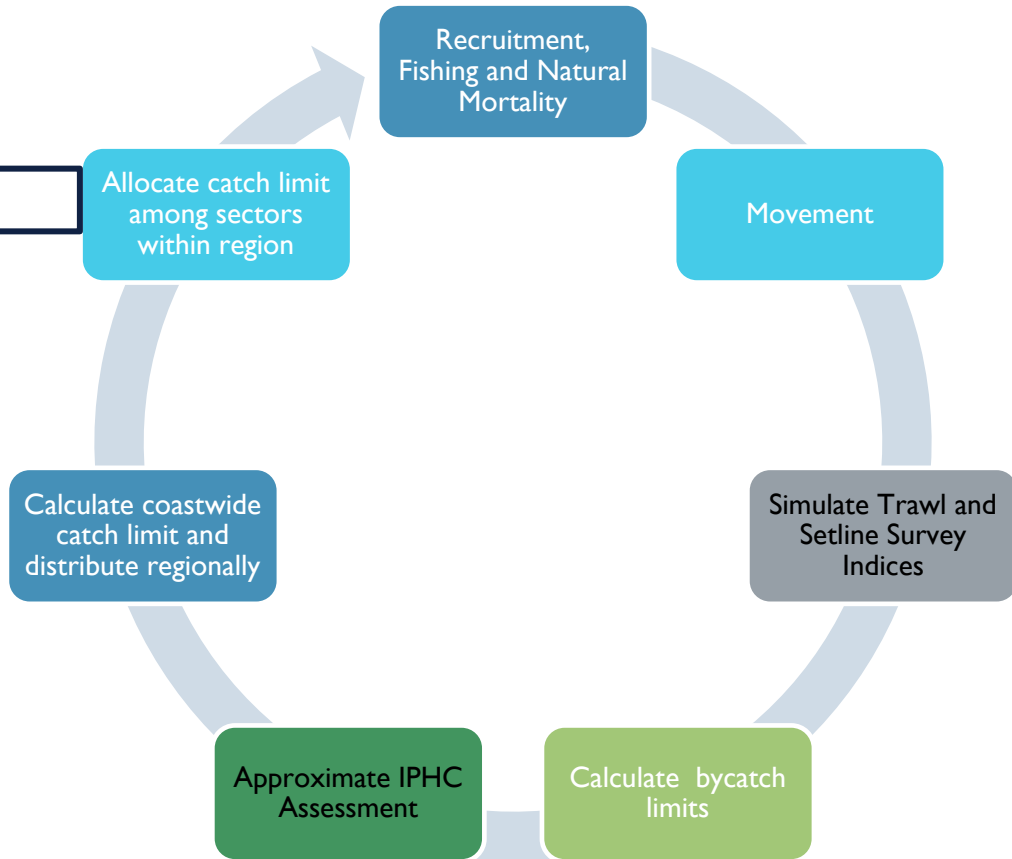
- Dynamic relative unfished spawning biomass definition

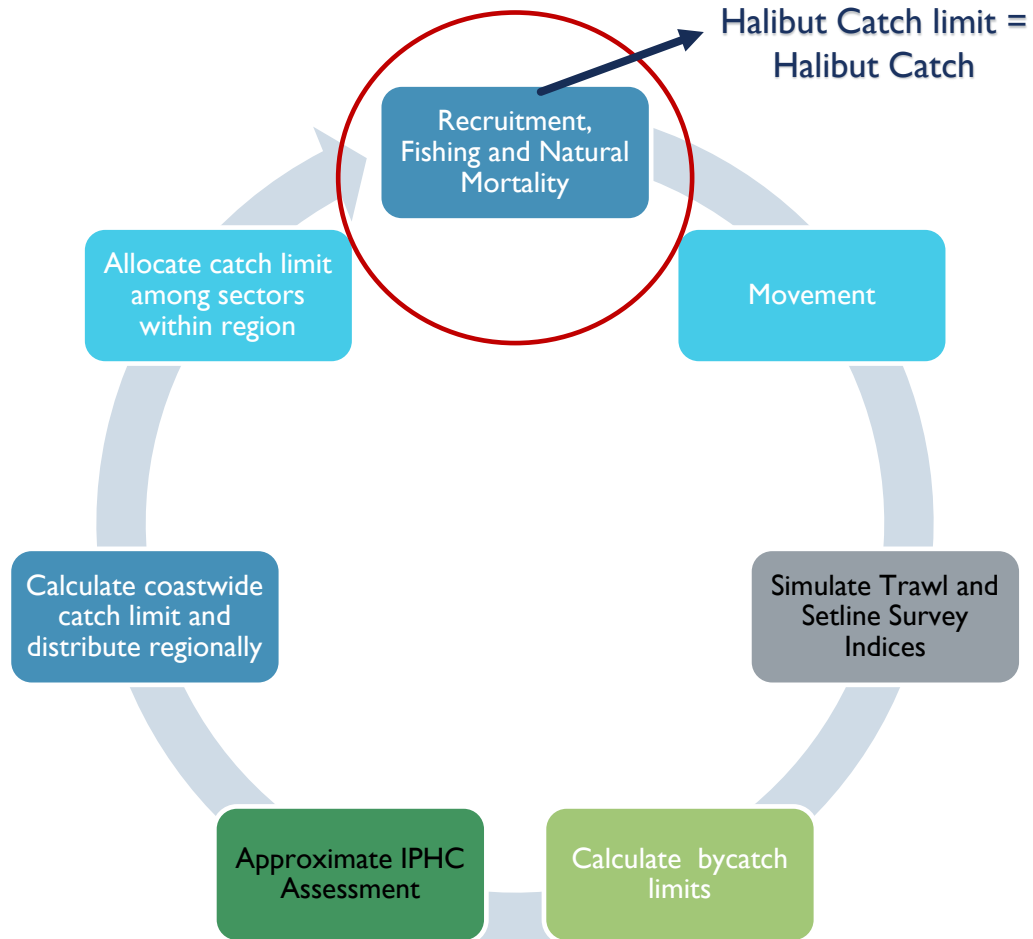


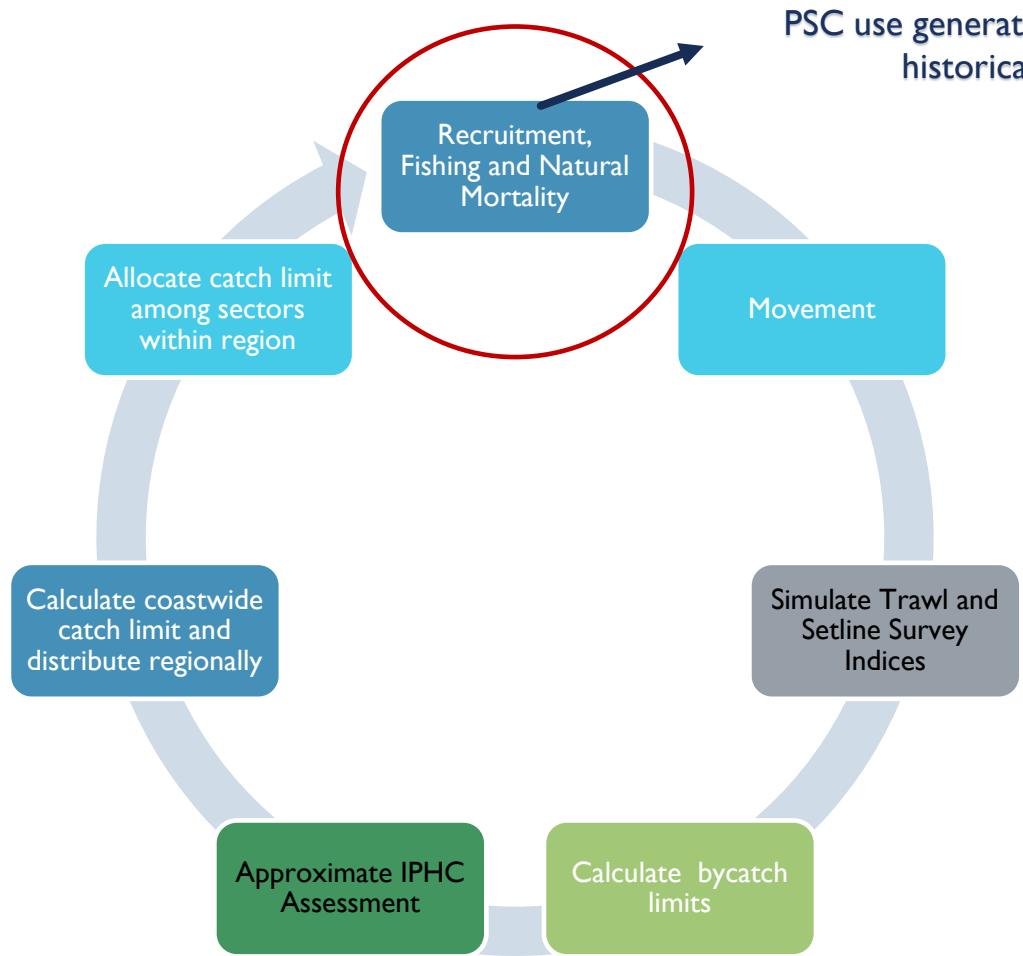
-
- Catch limit in the Bering Sea-Aleutian Islands = that year's proportion of modeled setline survey biomass in the BSAI
 - Allows for responsiveness of catch limit by area to changes in the distribution of biomass over time



Subtract last year's PSC of O26 fish from catch limit for that area



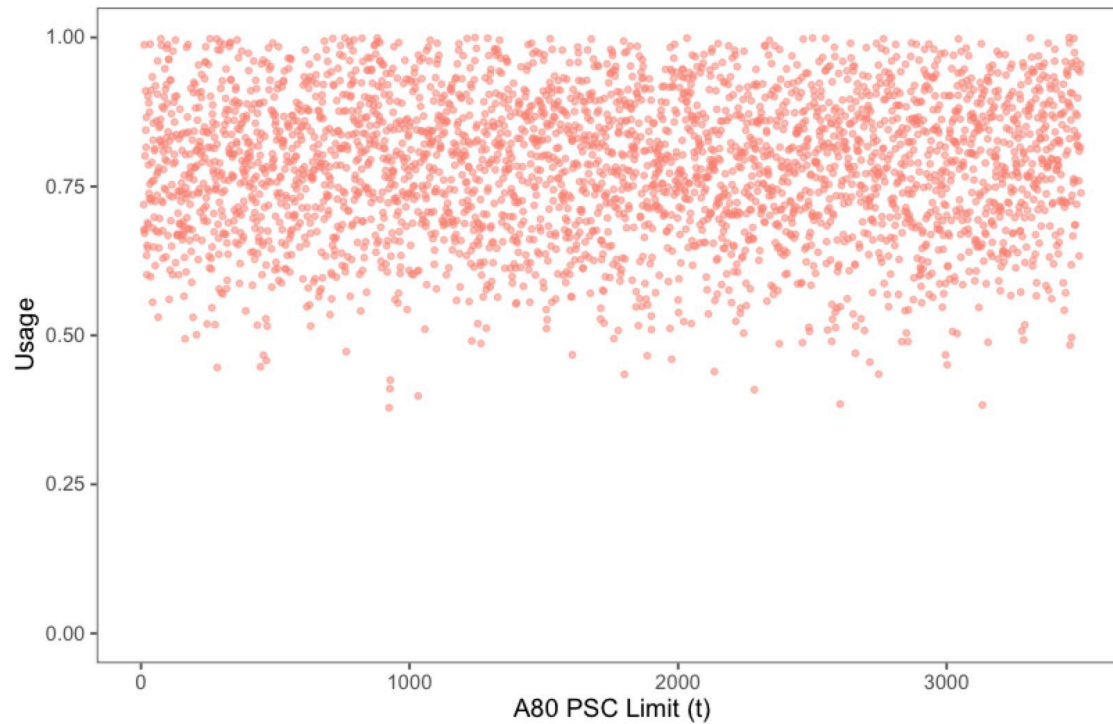




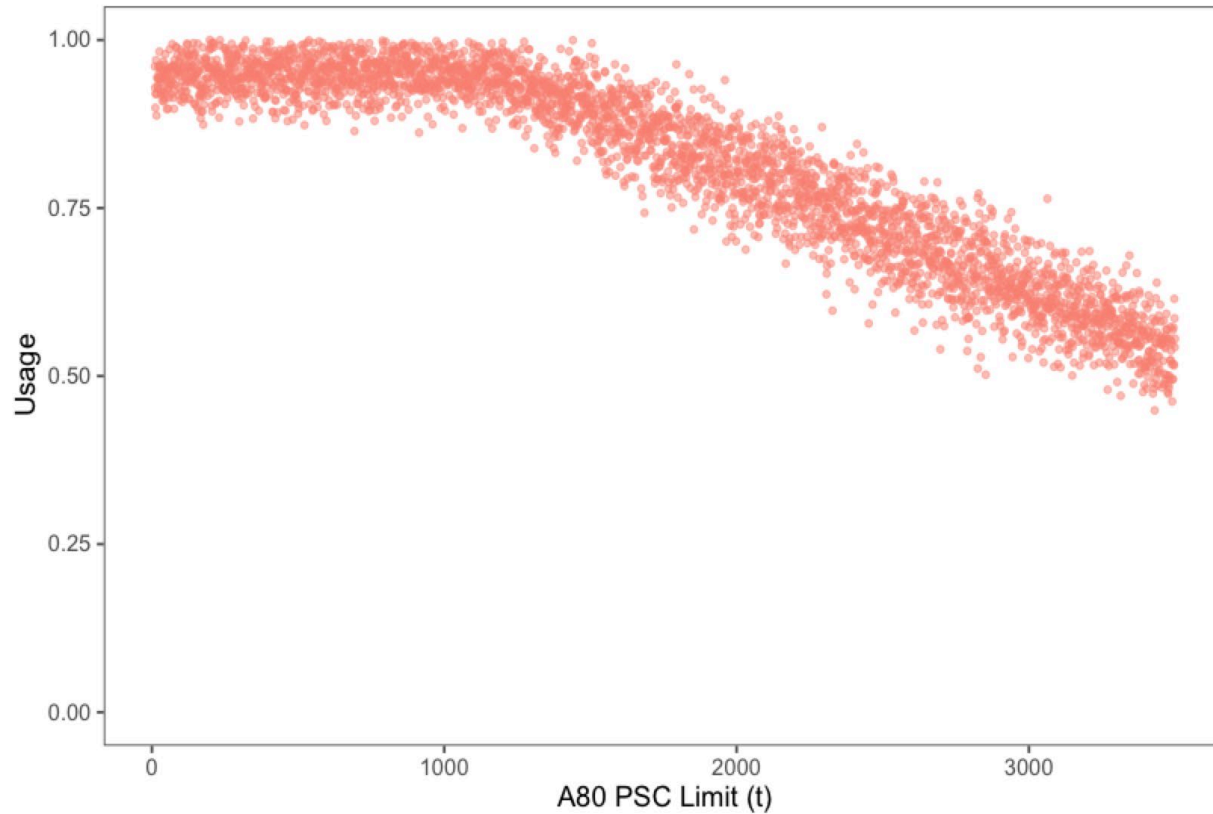
PSC use generated randomly based on historical distributions



PSC use: limit relationship generated randomly based on historical distributions



Sensitivity analysis explored alternative PSC use: limit relationship



Errata to address distribution error

- The original DEIS posted to the Council website for this meeting presented results that contained ~~conversion~~ **distribution** error that affected historical catches, including 2019 catch
- We corrected the error and re-ran the model, including all sensitivity analyses.
- The tables and figures from the original DEIS are presented in a side-by-side comparison with corrected tables and figures in the following slides for reference and discussion purposes.
- The conversion error impacted any calculation that was done to show results relative to 2019 halibut catches, in particular calculations involving directed halibut fishery catches relative to 2019.



Impact analyses **Unchanged** by error

- Impact analysis on groundfish
- Comparison across alternatives in figures and tables
- Ranking of alternatives according to performance metrics
- Modeled values and trends over time
 - Simulated halibut fishery catches in absolute terms
 - Spawning and total biomass
 - Indices
 - PSC limits and usage
- Social Impact Analysis



Differences in SSB in model demonstrations were undetectable

DEIS version (p.189)

Updated version

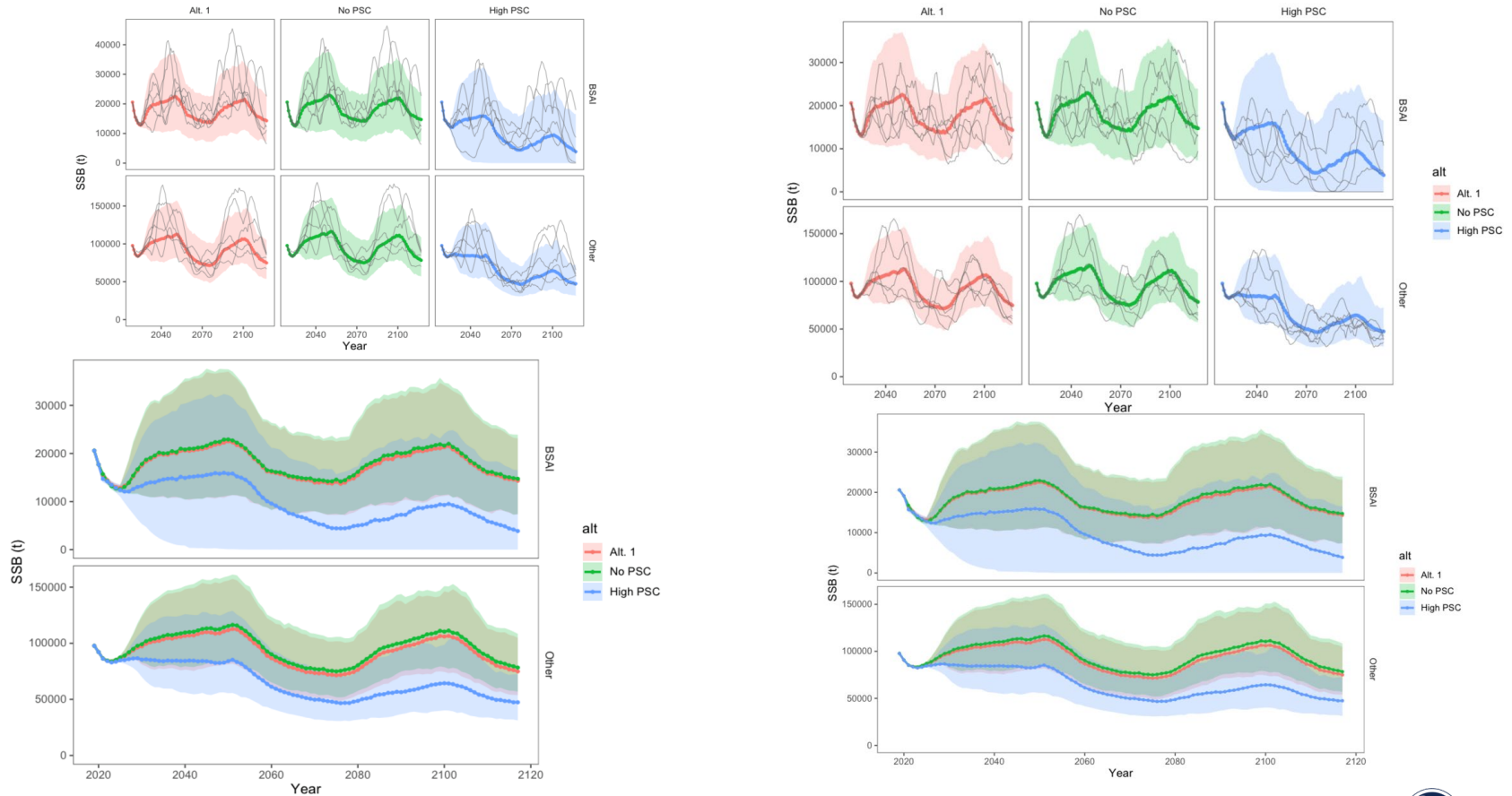


Figure 6-1 Demonstration of patterns in Pacific halibut SSB by region (note different vertical scales) over time for status quo, zero PSC Pacific halibut mortality, and 10,000 t of mortality. Solid lines are median values and 90 out of 100 model realizations fall within the shaded areas. The top and bottom panels show the same results, but the bottom panel shows the three demonstrations on the same scale. All results for the three demonstrations are identical when conducted with and without a 30:20 harvest control rule implemented for coastwide TCEY determination.



Directed halibut fishery catches relative to 2019 were higher in demonstrations (because 2019 catch was lower); trends and behavior across alternatives were unchanged

DEIS version (p.190)

Updated version

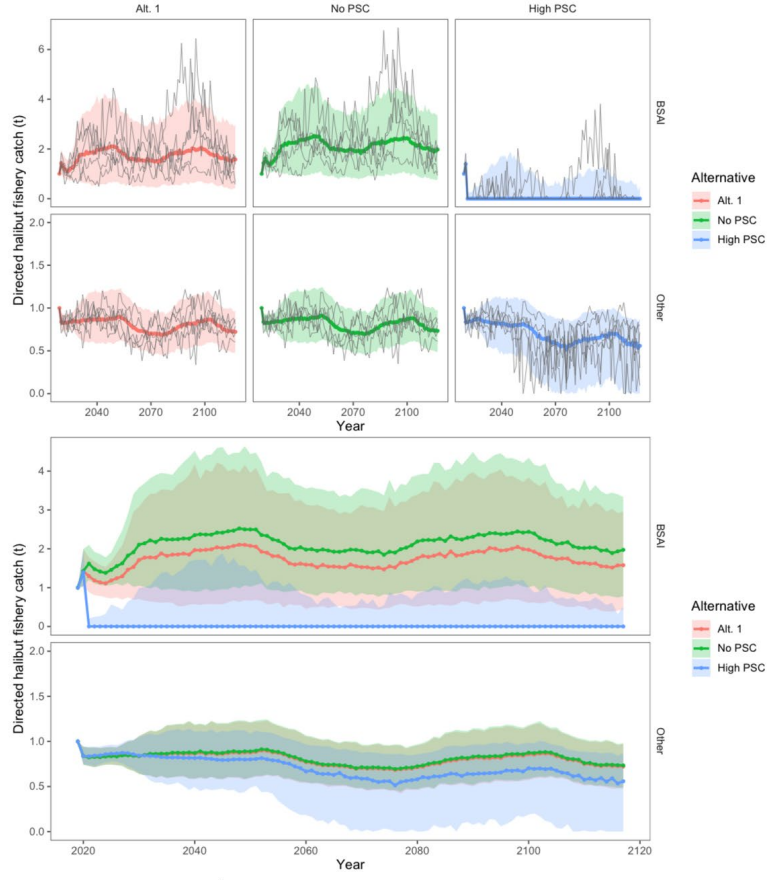
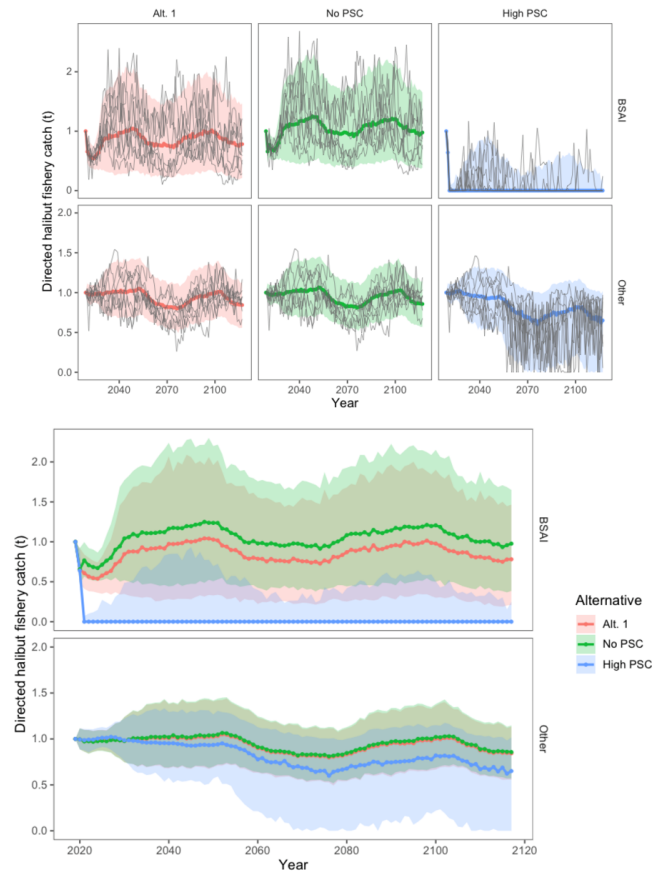


Figure 6-2 Demonstration of patterns in Pacific halibut directed fishery catch (by region and relative to 2019 values) over time for status quo, zero PSC Pacific halibut mortality, and 10,000 t of mortality. Solid lines are median values and 90 out of 100 model realizations fall within the shaded areas. The top and bottom panels show the same results, but the bottom panel shows the three demonstrations on the same scale. All results for the three demonstrations are identical when conducted with and without a 30:20 harvest control rule implemented for coastwide TCEY determination.



Indices for demonstrations were unchanged

DEIS version (p.191)

Updated version

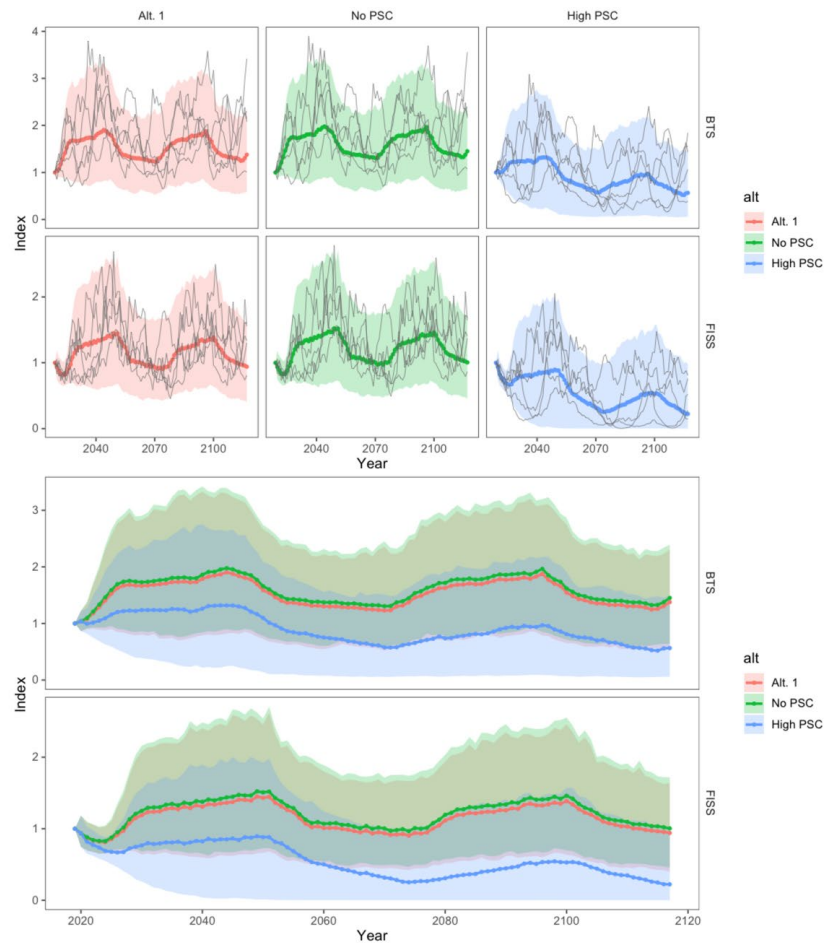
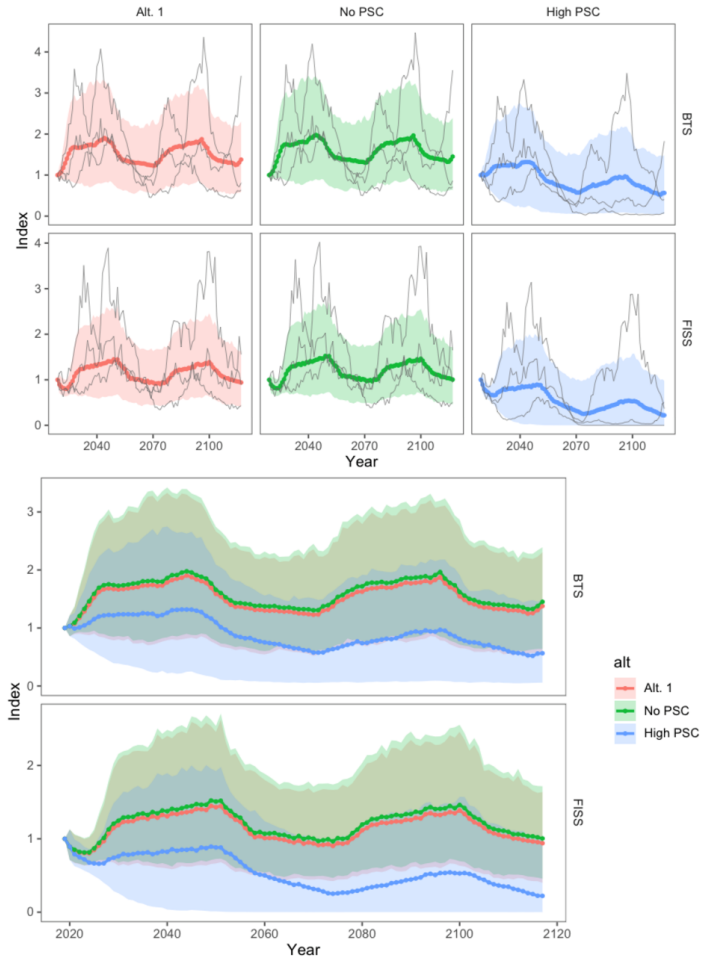


Figure 6-3 Demonstration of patterns in Pacific halibut indices (BTS and FISS and relative to 2019 values) over time for status quo, zero PSC Pacific halibut mortality, and 10,000 t of mortality. Solid lines are median values and 90 out of 100 model realizations fall within the shaded areas. The top and bottom panels show the same results, but the bottom panel shows the three demonstrations on the same scale. All results for the three demonstrations are identical when conducted with and without a 30:20 harvest control rule implemented for coastwide TCEY determination.

Indices for demonstrations were unchanged

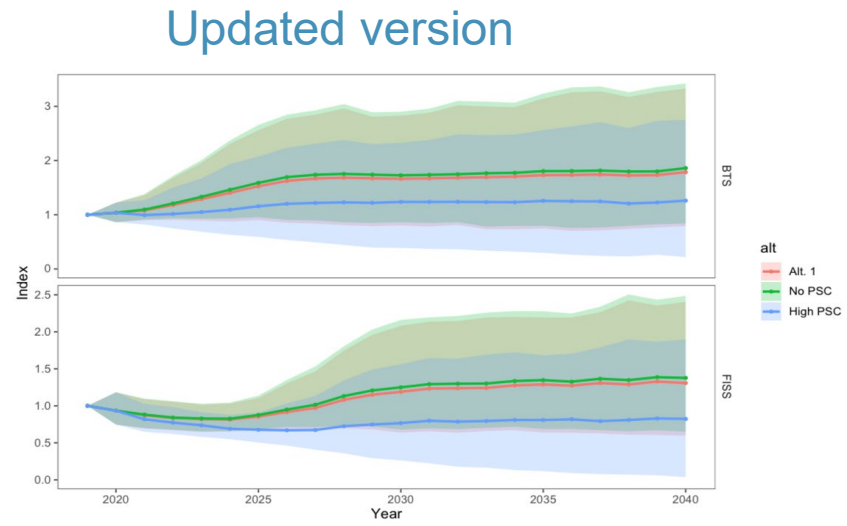
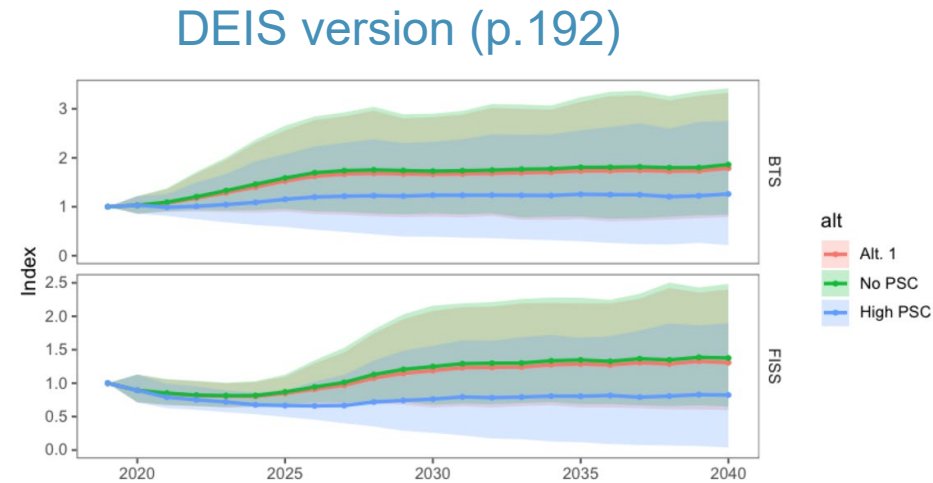


Figure 6-4 As for Figure 6-3, but showing results in more detail for initial years of simulation (2020-2040)

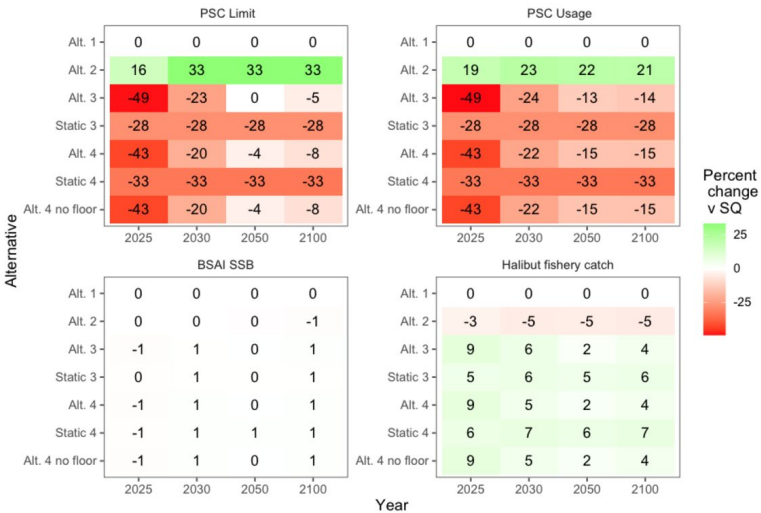
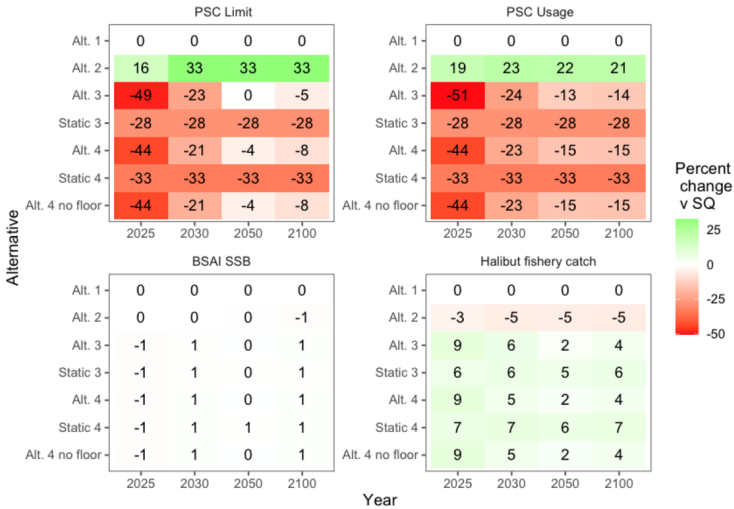
No changes greater than two percent in PSC limits, usage, BSAI SSB, and halibut fishery catch relative to the status quo (Shown here for runs without a 30:20 rule for TCEY determination; CR = 0)

DEIS version (p.194)

Updated version

Table 6-1 Projected relative median values of PSC usage, Pacific halibut spawning biomass, and Pacific halibut directed fishery catch, and PSC limit as estimated from the simulation model. Values are expressed relative to status quo (Alternative 1 in row 1). Red shading indicates a lower relative value within each measure. Rows labeled "Static 3" and "Static 4" are runs with PSC Limits fixed at their starting point values for alternatives 3 and 4, respectively (as requested by the SSC). "Alt. 4 no floor" is the same as Alt. 4 but with the floor removed. This first set of tables shows results for base case (B1) model runs without a 30:20 harvest control rule for TCEY determination (CR 0).

Scenario B1, CR 0



Changes from the conversion correction in model simulation results over time are undetectable, except that directed halibut fishery catch relative to 2019 is larger because 2019 catch is lower.

DEIS version (p.196)

Updated version

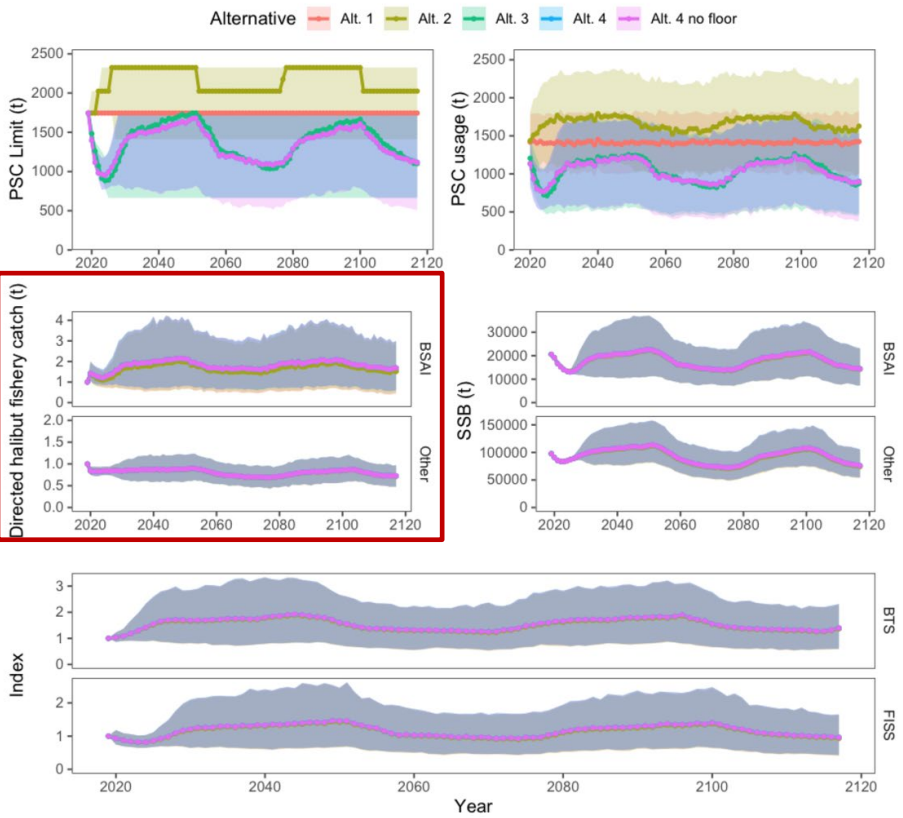
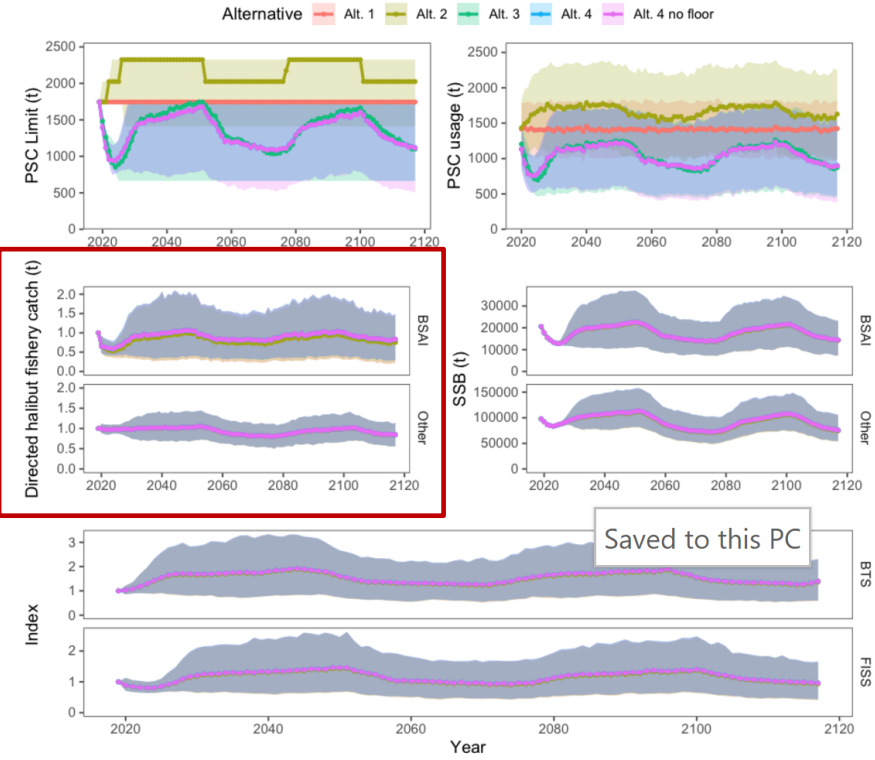


Figure 6-5 A comparison of projected PSC limits, usage, spawning biomass (SSB), and halibut fishery catch for the status quo (Alternative 1), and the 3 other alternatives, with uncertainty bounds. Solid lines are median values and 90 out of 100 model realizations fall within the shaded areas. In nearly all presentations the shades and lines are overplotted.



Oct 2020 SSC minutes

- *“On further investigation, errors were found in the estimation of 2019 and 2020 directed halibut fishery catch in the operating model, which affects all outputs from the simulation model.”*

Response:

- Clearly had no effect on contrasting among alternatives (as demonstrated above)



Oct 2020 SSC minutes

- *“The simulation may be overestimating the proportion of the coastwide TCEY in BSAI, because it appears to be using the stock distribution and not correcting for the 0.75 relative harvest rate applied by the IPHC.”*

Response:

- Possibly. Other factors include imperfect match between areas
- Only applies to 4B
- Can apply in future



Oct 2020 SSC minutes

- *“By using the correct directed halibut fishery catch levels in the model, the alternatives are now evaluated within a context of increasing directed halibut fishery catch, not declining. This raises the question of whether the comparison of the alternatives within this context is even relevant. The SSC believes that careful consideration of the relative impacts within this new context is important, and thus, a thorough review of the revised DEIS is warranted.”*

Response:

- Projected Pacific halibut BSAI catches are consistent with historical



Review of model validation

Appendix 3 from October 2020

- Purpose: match closed-loop simulation model over historical years to IPHC stock assessment
- IPHC stock assessment models changed since last October:
 - Commercial sex ratio data showed higher proportion of older fish (mostly female)
 - Definition of unfished spawning biomass changed to be dynamic
- Closed-loop simulation model updated to reflect IPHC assessment changes



Review of model validation

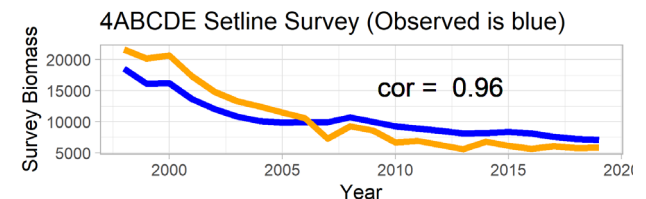
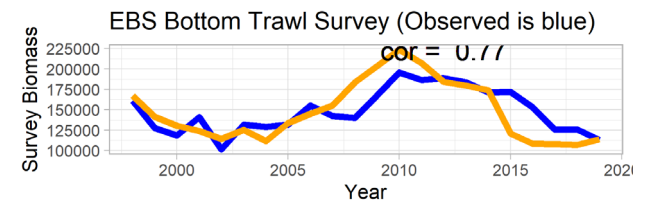
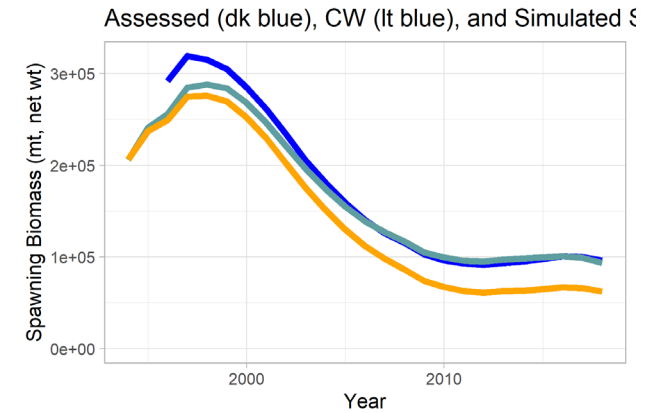
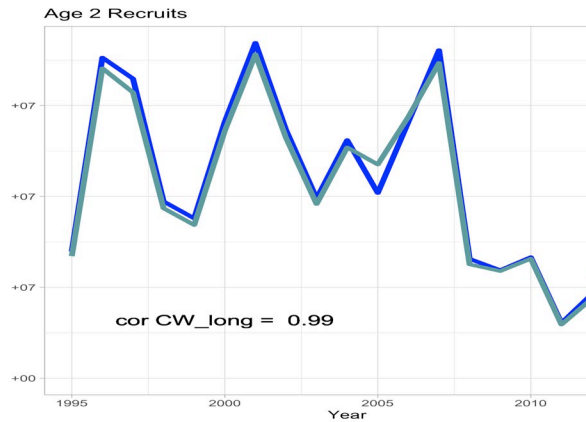
Appendix 3 from October 2020

- Re-ran model validation after distribution error fix
 - Results were unchanged
 - Total historical catches in the model were always correct.
- No changes to movement parameters or average recruitment allocation
- Some fundamental differences occur between models
 - Addressed with sensitivity analyses



Review of model validation Appendix 3 from October 2020

- Incorporating time-varying spatial allocation of recruitment into model important for mimicking trawl survey



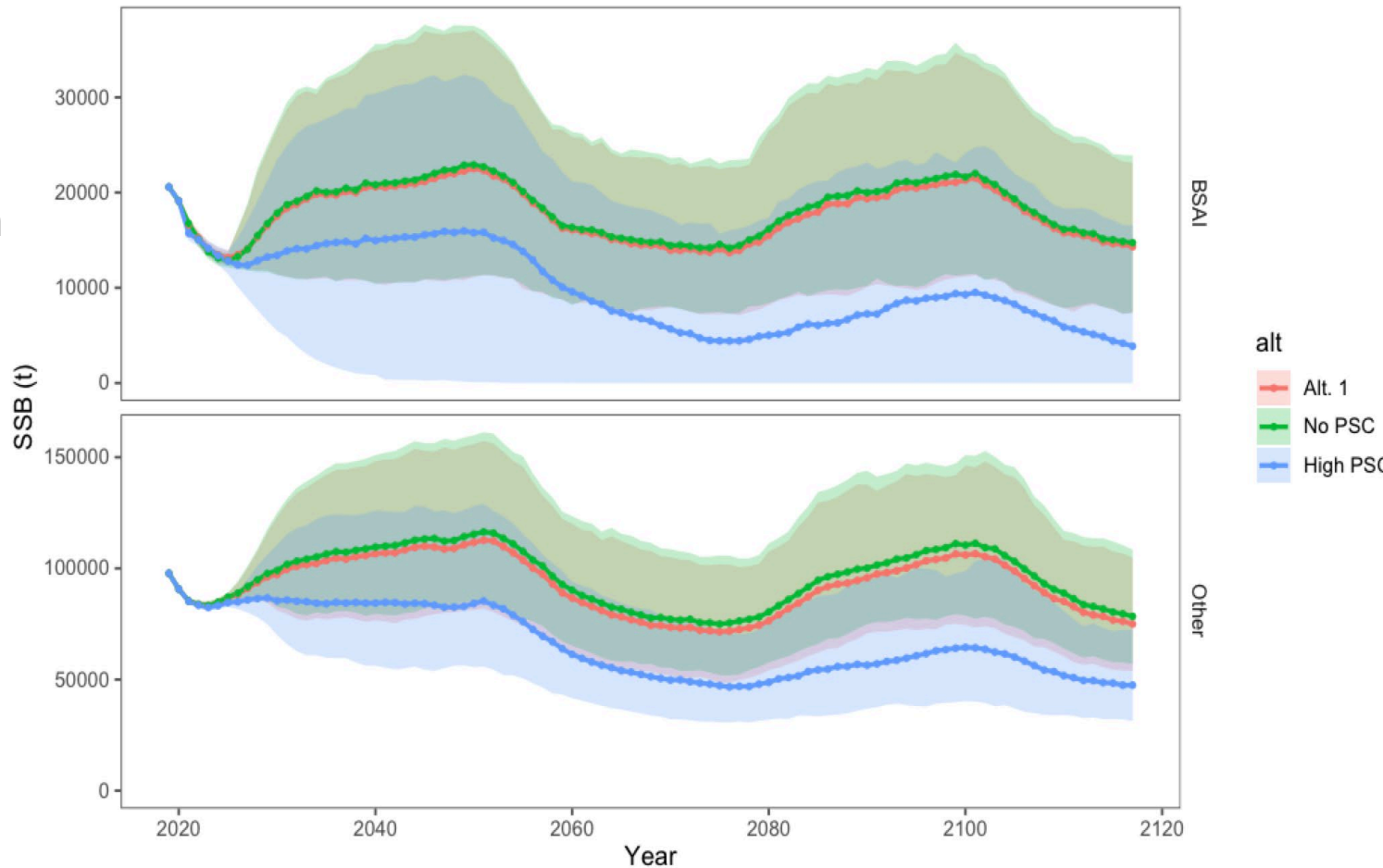
From October 2020

Model results



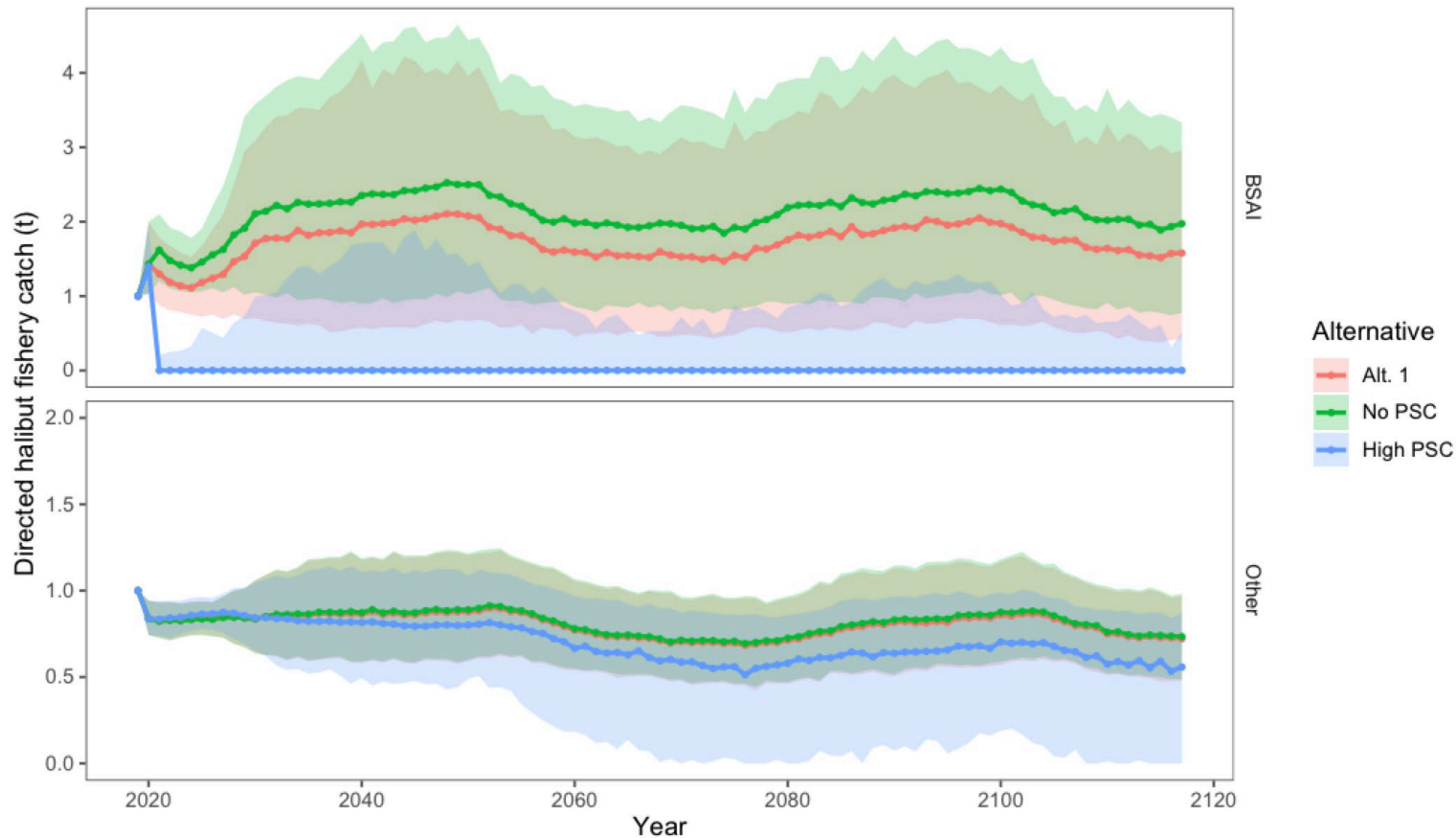
Demonstrations

- SSB similar with or without PSC
- SSB declines in both areas with extreme high PSC (outside of range of alternatives)



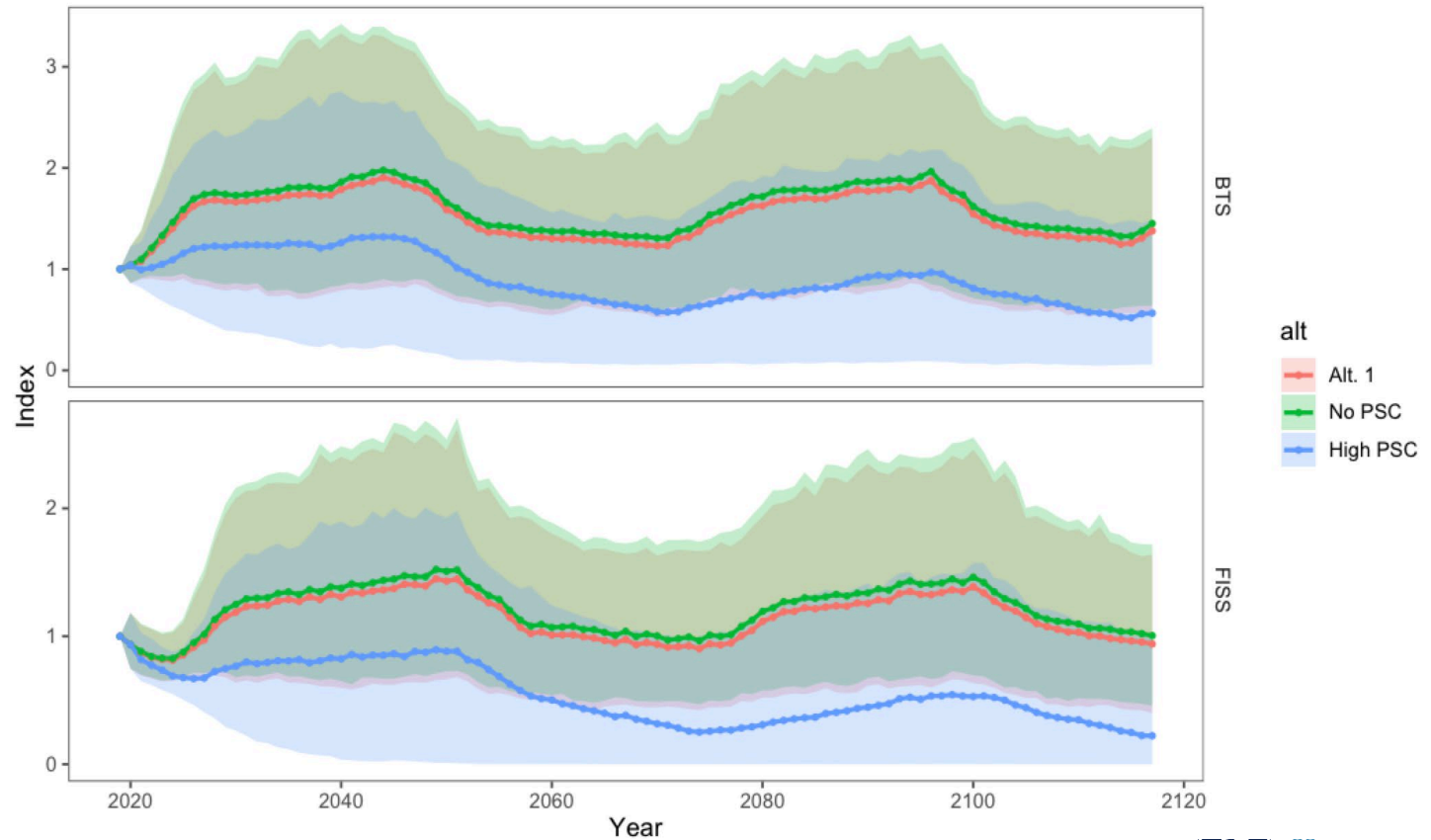
Demonstrations

- Halibut fishery catches a little larger with no PSC
- Halibut catches in the BSAI are 0 if PSC limits are very high



Demonstrations

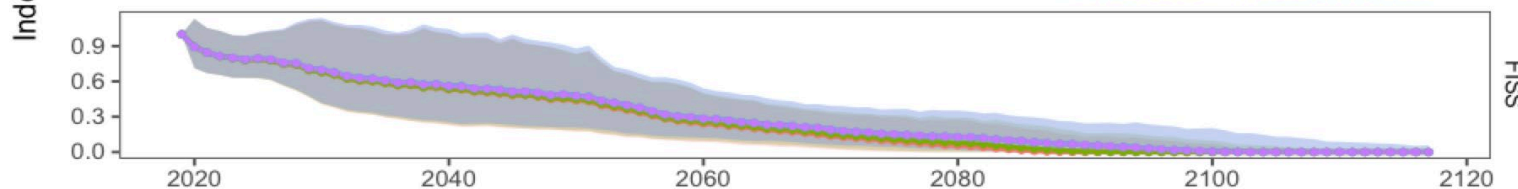
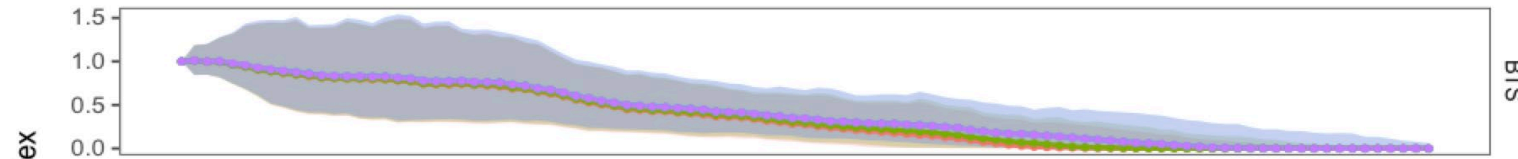
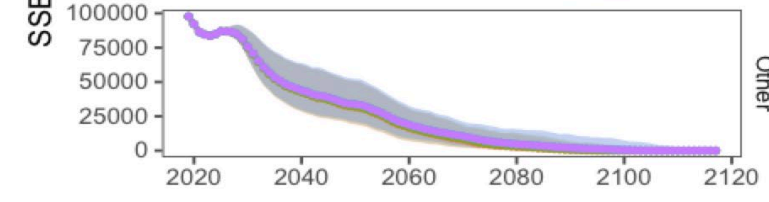
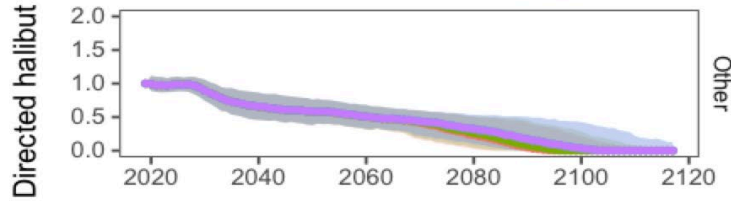
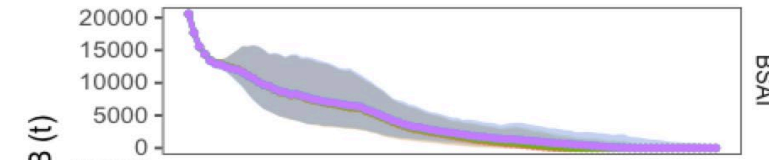
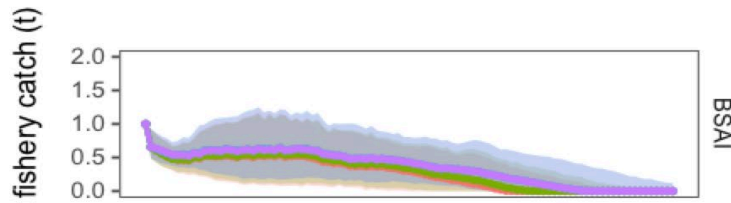
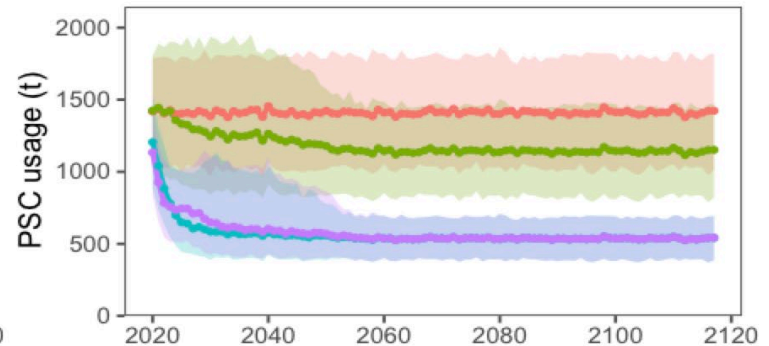
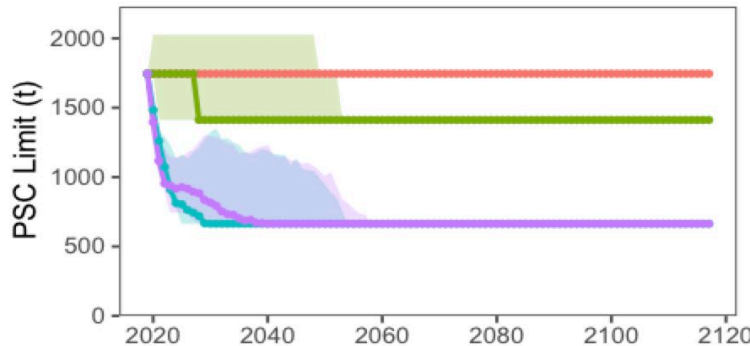
- Indices for no PSC and Alt 1 are similar
- Indices for high PSC are lower



Sensitivity Analyses Appendix 2 from Oct 2020

- Low recruitment scenario:
- Extreme low recruitment scenario (recruitment 50% of expected every year)
- PSC use: limit increases at low PSC limits
- Trawl selectivity shifted towards younger or older fish
- Temporal autocorrelation in estimated SSB





Extreme Low Recruitment
50% of expected recruitment in each year



From October 2020

Main Points from Modeling Analysis

- **No meaningful differences** in SSB trajectories between alternatives for the range of alternatives and expected population dynamics
- **T**rawl PSC selectivity impacts how much larger changes in PSC limits are in relation to changes in directed halibut fishery limits
- Effects of 30:20 harvest control rules cannot be seen unless the population dynamics are pushed **outside of expectations**



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Other points of clarification

- Projected weight-at-age
- PDO application
- “Low recruitment” options
- Consistency of directed halibut fishing projections versus history



Projected somatic body weight-at-age

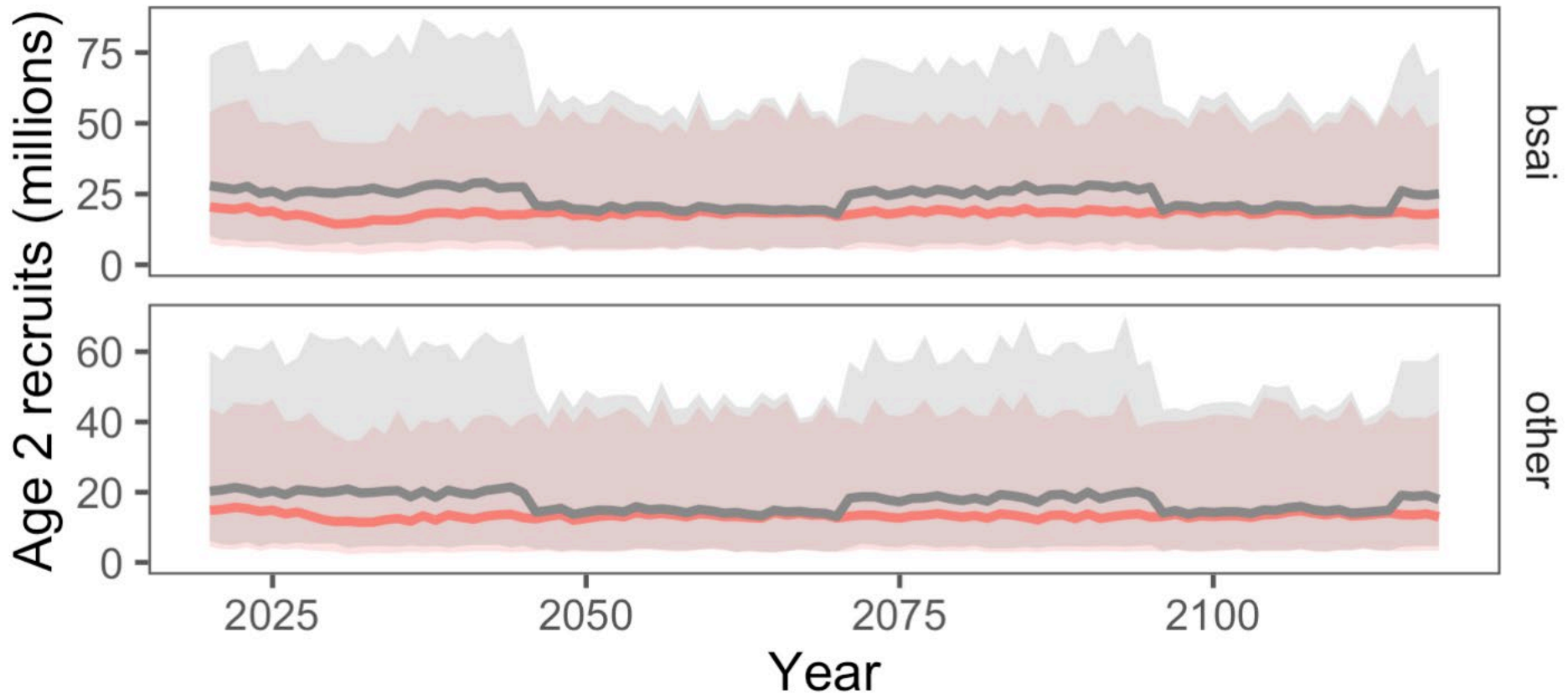
Model configured to have stochastic or alternative values

- Since 2019 has been set at fixed values in line with the assessment
- Some interpretation of impact potential
 - Lower degree of uncertainty, especially for aspects in area 3 (part of “Other”) where changes have been the most extensive
 - SSB and future sex ratios (e.g., lowering the size limit) also missed
 - Considerations for BSAI region (for PSC, directed fishing) may be less important



PDO relative to original “Low recruitment” and recruitment variability

- Two periods of good PDO implemented

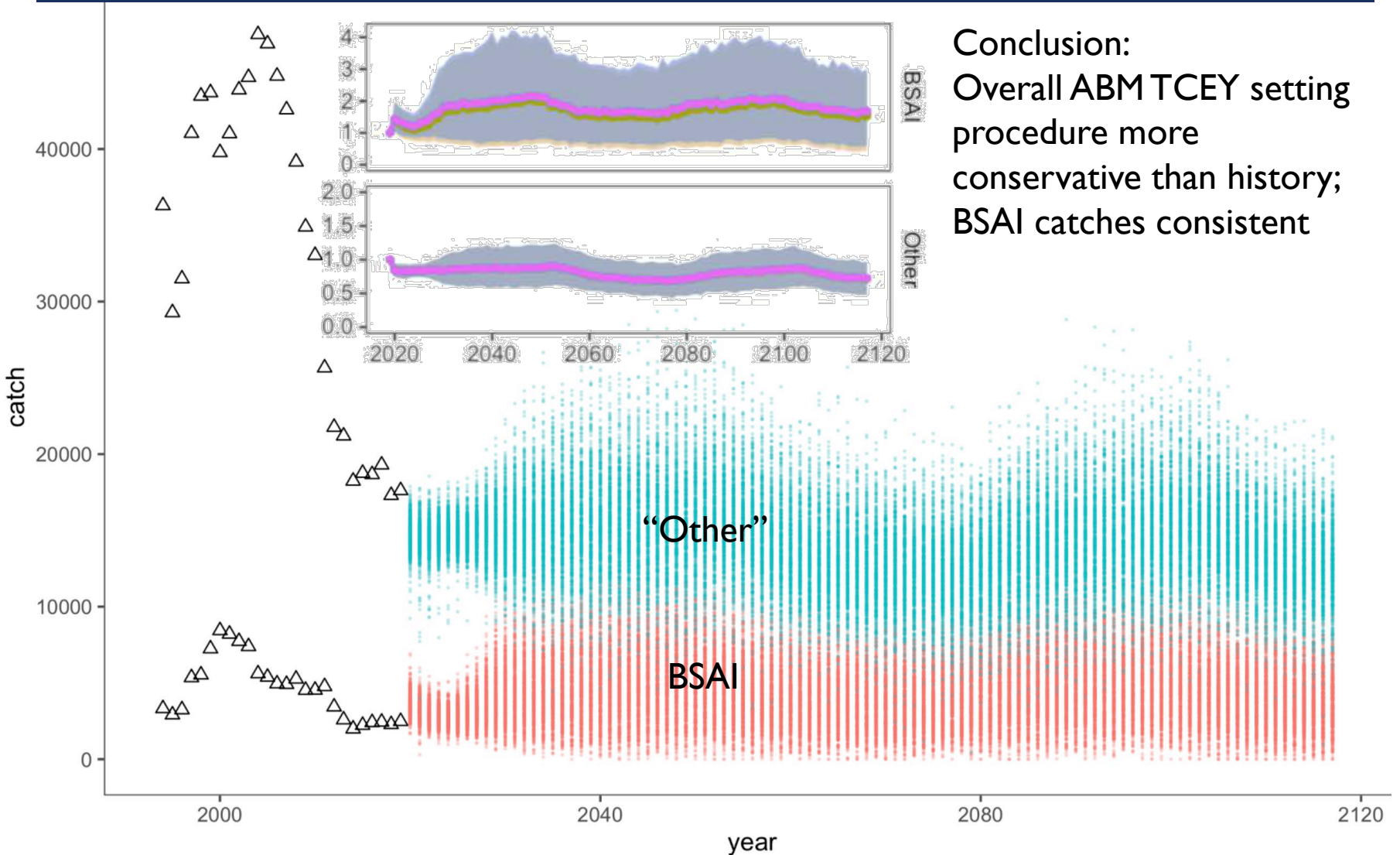


Original “Low recruitment“ scenario:

- PSC and directed fishery (and SSB) drop
- Showed that index in BTS increases...unusual
 - Issue arose with initial age structure
 - Adopted a different approach which was sensible



Historical versus future Pacific halibut fishery catches



Conclusion:
Overall ABM TCEY setting procedure more conservative than history; BSAI catches consistent