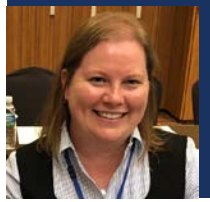
D2 NPFMC SSC
SABLEFISH ABC APPORTIONMENT ANALYSES

KARI FENSKE, 2 JUNE 2020



RECENT APPORTIONMENT HISTORY

2000-2013	ABC Apportionment via weighed moving average of fishery and survey data
2010-2013	Apportionment becoming more variable between years
2014 - 2020	Apportionment to management areas 'fixed' for 2014 and onward at the 2013 apportionment proportions
2015 - 2020	On-going analyses of spatial stock assessment and apportionment. Plan Team and SSC recommendations that the fixed apportionment be re-visited.

Draft analysis presented to Plan Teams September 2019 for incorporation into 2020 Sablefish assessment. Any modifications to ABC should be reviewed by the Plan Teams, SSC, Council and stakeholders to allow the Council to weigh in on ABC apportionment if there is not a solely biological rationale for these apportionments.

GOALS FOR THIS PRESENTATION

1. Summarize apportionment simulation methods
2. Receive feedback from SSC on methods
3. Brief overview of preliminary results and the February stakeholder meeting

Two documents with greater detail that were provided:

1) Sablefish apportionment summary (summary of Feb meeting)

2) Apportionment strategy evaluation methods

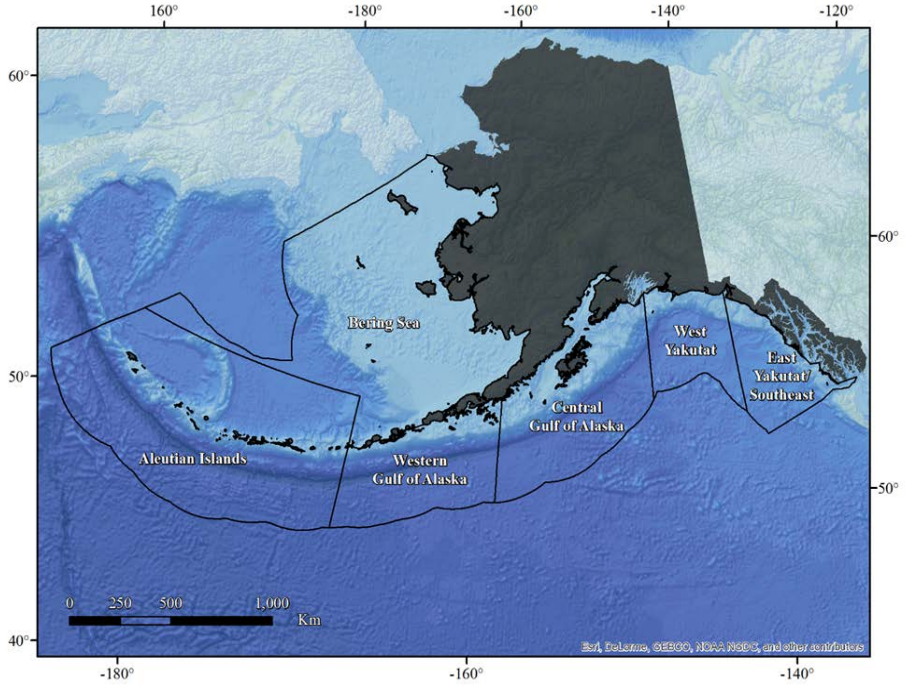
APPORTIONMENT

These analyses are about:

- Apportionment – how we divide ABC (Allowable Biological Catch) among management areas

Not analyzing or making changes to:

- Allocation – splitting between sectors (like fixed gear and trawl)
- NPFMC harvest control rule or Tier system



APPORTIONMENT TYPES

1. **Equal:** Each region receives 1/6 of the ABC.
2. **Fixed**: Apportionment proportions from the 2013 assessment that have been fixed for 2014-2020.
3. **Equilibrium**: Proportions in each area are based on mean proportions apportioned to each area from years 2005-2013.
4. **NPFMC**: A 5-yr exponentially weighted moving average of fishery and survey indices; survey weight is 2x fishery weight
5. **Exp_survey_wt**: Similar to 'NPFMC' option but using survey index only; BS and AI survey contain latest five years of longline survey data.
6. **Blended**: Half of ABC is apportioned using Equilibrium type, half apportioned using NPFMC.
7. **Non-Exp_NPFMC**: A 5-yr moving average of fishery and survey indices, all years equally weighted; BS and AI survey contains five years survey data.
8. **Age_based**: Based on the proportions of fish at age of 50% maturity in each area - i.e. areas with greater proportion of fish at age of 50% maturity or greater will be apportioned a greater proportion of ABC. Results shown in this document are for an age at 50% = 6.
9. **Term_LLsurv**: Index proportions from terminal year of longline survey.

SIMULATION OVERVIEW

Conditioning period population 1976-2018

OM: Input apportioned ABC from previous year's EM, estimate F

OM: Calculate population abundance next year using recruitment, F, input M, move fish

OM: Sample population for indices, age comps with obs. error; build data file

Pass data file to ADMB and run EM

OM: Extract EM output & ABC, apply apportionment method

Run OM-EM feedback loop for 200 replicates, and 20 years forward (2019 -> 2038)

EM is similar to 'Management' model

SIMULATION METHODS

Operating model (OM)

- 6 spatial areas
- 30 ages, 2 sexes
- M=0.1
- Conditioning period 1976-2018
- Forward projection period 2019-2038

Estimation model (EM)

- 1 area, 'panmictic'
- 30 ages, 2 sexes
- M=0.1 (fixed)
- 1977 data start
- 2019-2038 EM is run each year

PRIMARY DIFFERENCES IN ESTIMATION MODELS

Simulation EM

- Begins in 1977
- No length comps
- Age comps for fishery and survey, but survey comps have no y-1 lag in availability

Management EM

- Begins in 1960
- Length comps for fisheries and surveys
- Age comps have a 1-year lag in availability

METHODS – RECRUITMENT IN CONDITIONING PERIOD

$N_{init,y=1976}$ is input (93.4 million fish)

- 1977 estimate from management EM

$N_{a=1,\,y=1977:2017}$ is input

- From management EM recruitment estimates for 1977-2017

$N_{a=1,\,y=2018}$ is input

- mean recruitment 1995-2017 from management EM

$N_{a=1}$ divided to areas using mean proportion age-2 longline survey abundance by area

Recruitment inputs are the same for all apportionment types, and replicates in the conditioning period.

METHODS – RECRUITMENT IN PROJECTION PERIOD

$N_{a=1, y=2019:2038}$

- Draw 200 replicates of total recruitment with normal distribution ($\mu=0$, $\sigma_r=0.8$), no autocorrelation
- Divide recruitment into 6 OM areas using multinomial distribution based on mean proportions age-2 longline survey abundance by area, effective N=100.

- Recruitment is same across apportionment types
- No stock recruitment relationship assumed
- Future sensitives may examine this assumption

FISHING MORTALITY, CATCH, AND ABC

- Estimate the F required to catch ABC
- Assume $\sum_{area} Catch_{y,area} = \sum_{area} apportioned\ ABC_{y,area}$
- Use the F we've solved for to calculate abundance:

$$\widehat{N}_{y,h,a,m} = N_{y-1,h,a-1,m} e^{-(F_{y-1,h,a-1,m} + M_{h,a-1})}$$

Plus group

$$\widehat{N}_{y,h,a=A,m} = N_{y-1,h,a-1,m} e^{-(F_{y-1,h,a-1,m} + M_{h,a-1})} + N_{y-1,h,a=A,m} e^{-(F_{y-1,h,a=A,m} + M_{h,a=A})}$$

OBSERVATION ERROR

Survey index and Fishery CPUE

- Lognormal error
  - σ=0.3 for BS and AI areas,
  - σ=0.15 for WG, CG, WY, EY

Age compositions

- Multinomial distribution for error
- Effective N = 200

METHODS - QUESTIONS, DISCUSSION

Questions or discussion on methods

Next: Preliminary results, conclusions

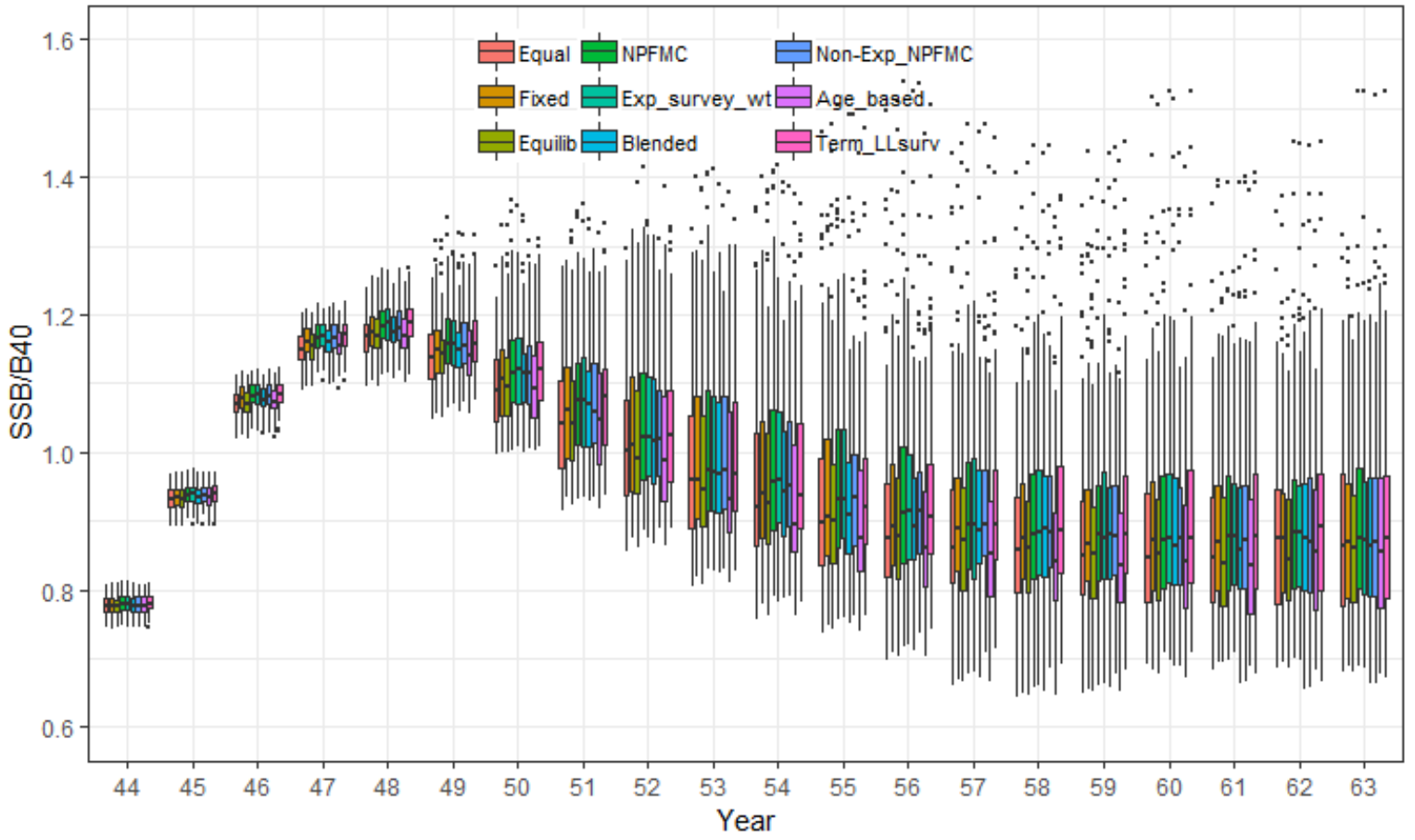
RESULTS

Summary document presents results in 3 categories:

- Sustainability
- Stability
- Other

RESULTS – SUSTAINABILITY SSB/B_{40}

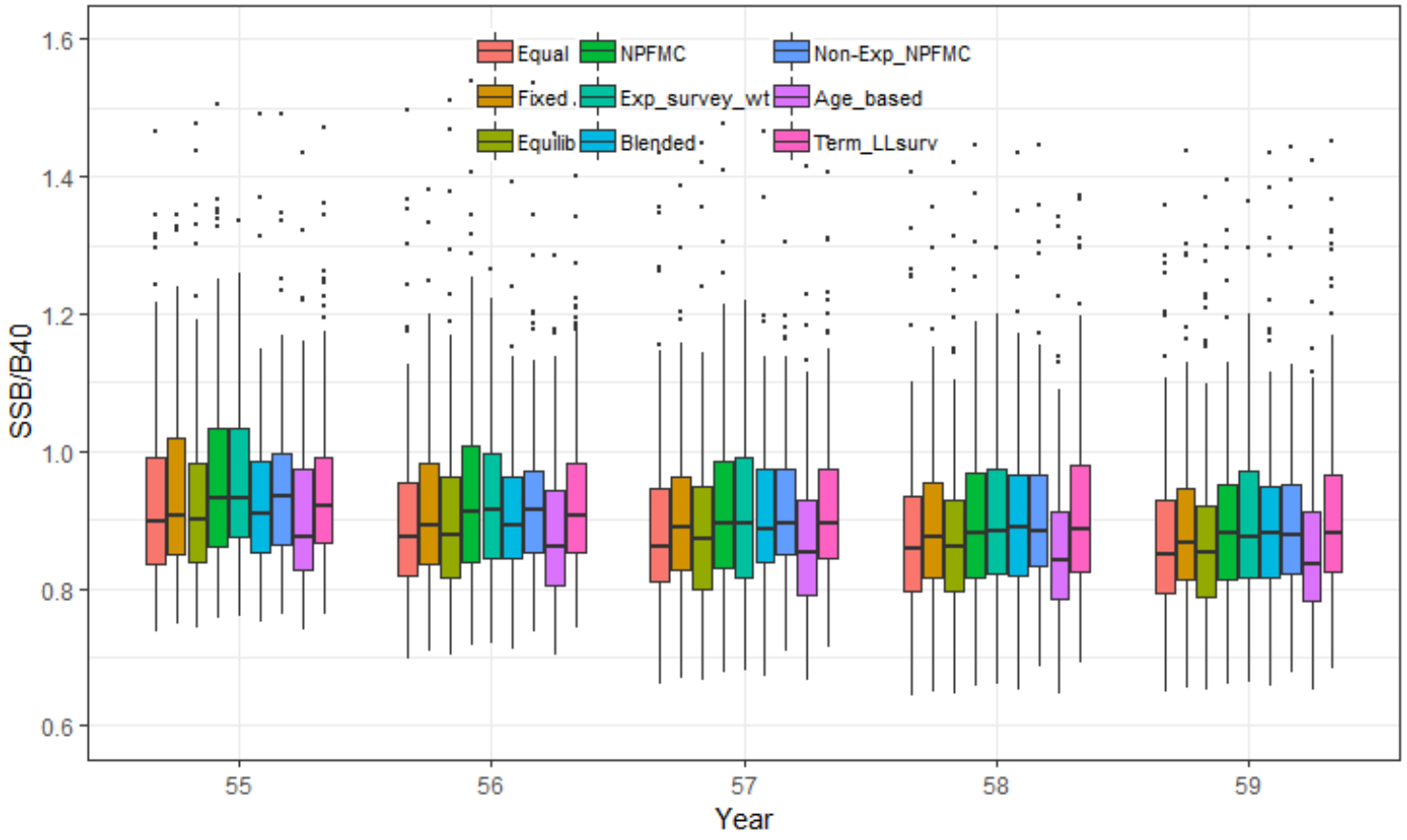
- NPFMC harvest control rule (tier system) appears to drive results



RESULTS – SUSTAINABILITY SSB/B_{40}

Zoom in on years 2030-2034

- Minor differences in median outcome, range for apportionment types with respect to this metric of sustainability



RESULTS - STABILITY

Proportion of years and replicates with absolute change in ABC < 15% *

Apportionment types:

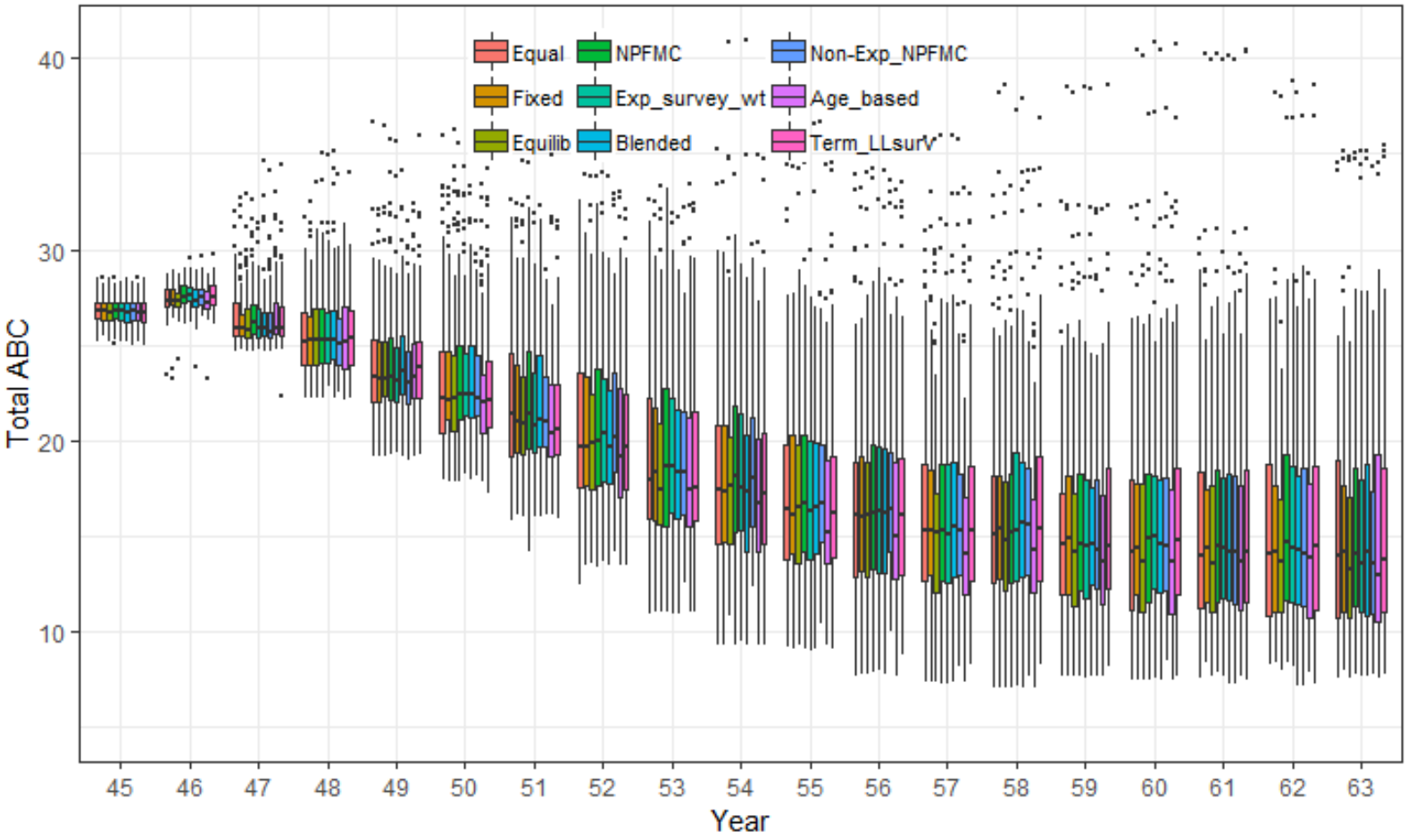
Area:	Equal	Fixed	Equilib	NPFMC	Exp surv_wt	Blended	Non-Exp NPFMC	Age-based	Term LLsurv
BS	0.88	0.89	0.90	0.77	0.82	0.87	0.87	0.55	0.72
AI	0.88	0.89	0.90	0.64	0.11	0.83	0.35	0.59	0.10
WG	0.88	0.89	0.90	0.86	0.85	0.87	0.88	0.70	0.76
CG	0.88	0.89	0.90	0.89	0.89	0.89	0.92	0.78	0.84
WY	0.88	0.89	0.90	0.90	0.90	0.89	0.92	0.81	0.84
EY/SEO	0.88	0.89	0.90	0.91	0.90	0.90	0.92	0.82	0.87

- Colored across all rows and columns
- BLUE = more stable, RED = less stable

RESULTS - OTHER

Total ABC

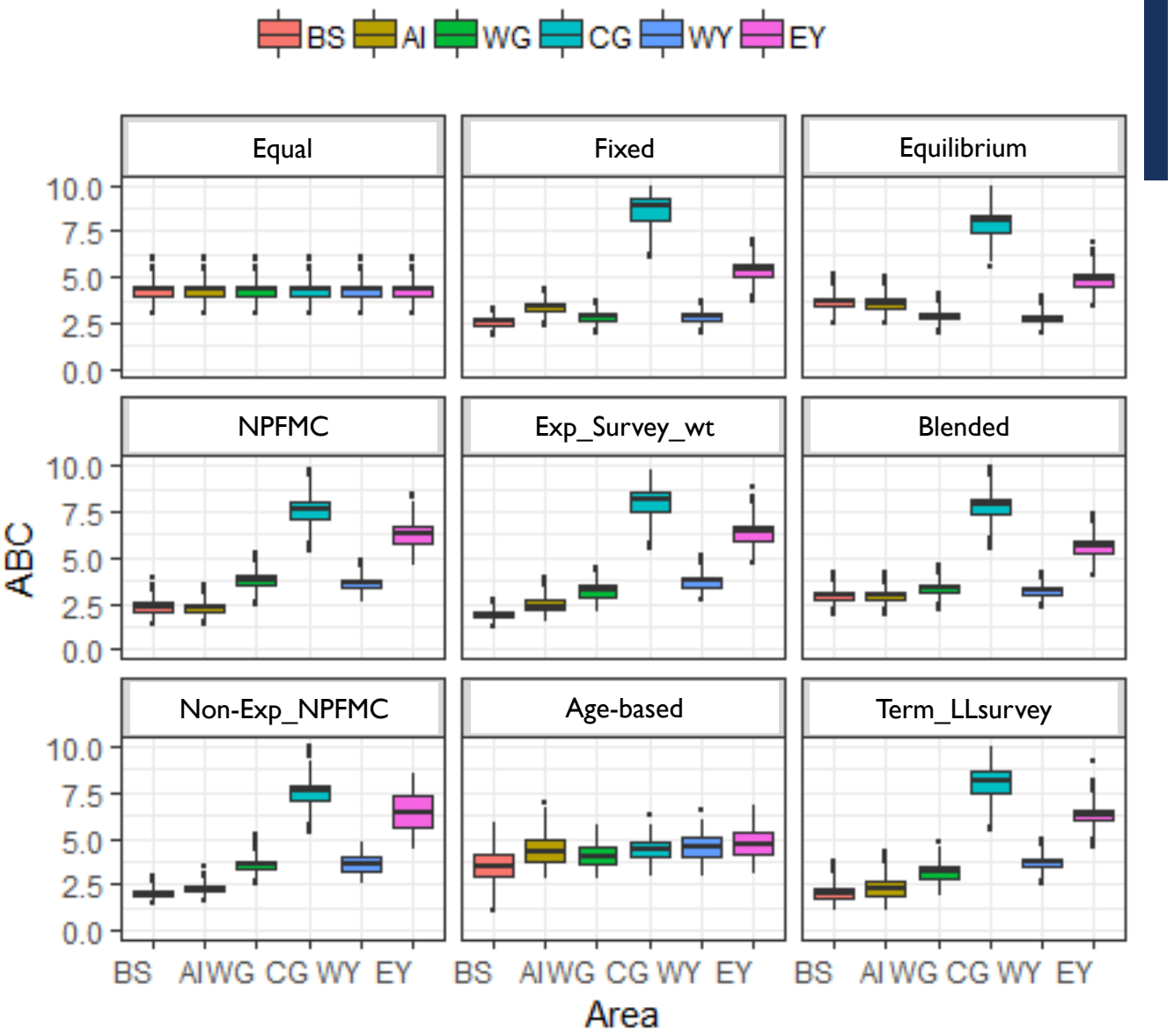
- Similar central tendencies (median)
- Large potential range of ABCs over all the years and replicates, and for all apportionment types.



RESULTS - OTHER

Apportioned ABC

- Can vary widely among management areas depending on apportionment type



PRELIMINARY CONCLUSIONS

- There is very little difference among apportionment types from the perspective of ensuring sustainability.
- If there are benefits to maintaining spawning biomass in all spatial areas, an apportionment type with more similarity to the population distribution would be preferable.
  - e.g., if there were spatial differences in fecundity about which we are unaware, if spawning occurs in specific areas
- There are differences in stability between the apportionment types, and lack of stability is a concern voiced by stakeholders
- Total ABC has a wide range of potential values for all apportionment types and replicates, and the central tendency shows some differences between the apportionment types.

STAKEHOLDER FEEDBACK

The meeting was successful in gathering feedback identifying four primary, and potentially conflicting, areas of concern about apportionment that will be important to consider:

1. Inter-annual stability in ABC is important and desired
2. An apportionment method that doesn't lead to apportionment proportions-to-areas that are very different from observed sablefish spatial distribution over time was important
3. Concerns remain about the potential to harvest too many immature fish
4. There are concerns about the 'transition' year as we move from the current 'fixed' apportionment method to a new method and suggestions that if the change in apportionment to regions is large, it may require a multi-year plan to make the change gradually

NEXT STEPS

- Incorporate any final model structural changes
- Run final models
- Write up results, conclusions for September Groundfish Plan Team
- Work with assessment lead author to produce any desired ABC apportionment types to be considered for November.

CONSIDERATIONS FOR 2021 SPECIFICATIONS CYCLE

- Preliminary indications that apportionment results do not differ in biological sustainability
- Previous final ABC determination strategies considered both fishery considerations and biological data, therefore economic considerations with stakeholder/Council input should be considered in 2020 specs process to determine final ABCs (amongst a range of acceptable choices) by area
- SSC may wish to therefore consider recommending a range of acceptable ABCs in proposed (October) and final (December) specifications
- Council would then select among recommended range of ABCs by area to recommend final ABCs by area for the 2021 specifications prior to establishing the TAC by individual area

QUESTIONS?

Presentation prepared with input from:

- *Curry Cunningham*
- *Dana Hanselman*
- *Chris Lunsford*

KARI FENSKE

KARI.FENSKE@NOAA.GOV

907-789-6653