Breakout Session 2(a): Discussion of tangible steps towards quantifying the risk of external changes in population conditions

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Aspects of population conditions to consider

- Age diversity (affects reproductive potential, population resilience)
- Recruitment uncertainty (affects perceived stock status/rebuilding, catch projections)
- Growth uncertainty (affects stock productivity, exploitation rates)
- Maturation uncertainty (affects reproductive potential, perceived stock status, catch projections)
- Interaction between perceived stock status and population risk category (uncertainty/variation in most of these factors will induce error in perceived stock status)

Guidance for population risk (from Dorn and Zador 2020): consider decreasing biomass trend, poor or atypical recent recruitment, inability of the stock to rebuild, abrupt increase or decrease in stock abundance, other unusual changes in stock age-structure or recruitment patterns

Potential other factors: spatial expansion/contraction; localized depletion; ontogenetic distributional shifts; abrupt changes in targeting/selectivity/availability; others?

Species with elevated population risk concerns: *Cases with ABC reductions*

Sablefish (2019,2020): **Level 3 (57% reduction from Max_ABC).** Truncated, uneven age structure; highly uncertain recruitment; reduced condition factors; uncertainty in maturity curves (increasing a50).

EBS pollock (2019): **Level 2 (43% reduction).** ‘Peculiarities’ in age structure; high variability in recruitment; apparent density-dependent growth; potential negative recruitment and survival impacts due to heat waves; recovery in age diversity over recent years (positive).

Species with elevated or unknown population risk concerns: *Cases without ABC reductions*

BSAI BS/RE (2020): **Level 2.** Unexplained decline of older fish; large exploitation rates and depletion in the western AI. No reduction in ABC due to inability of lowered ABC to reduced catch in this bycatch fishery.

BSAI sharks (2020): **Level 2.** Based on Pacific sleeper shark (‘weak’ link approach); potential vulnerability and low productivity; indices indicate decline from high levels that have remained consistently low for >15 years. Do not recommend reductions in ABC until assessment data and methods can be improved.

GOA sharks (2020) : **Level 2.** Low, and declining, abundance of Pacific sleeper sharks. Do not recommend reductions in ABC until assessment data and methods can be improved.

GOA Atka mackerel (2019): **Unknown.** Tier 6, with no reliable estimates of biomass. “ . . . *not able to set a meaningful ABC based on stock abundance levels and trends which are unknown*”

GOA Pacific cod (2019,2020): **Level 2.** Low abundance, recent poor recruitment. No reduction in ABC because depleted abundance limits the directed fishery.

GOA POP (2019,2020): **Level 2.** Unusual stock trend, with high survey abundance in recent years. No reduction in recommended ABC because the model underestimates the survey abundance.

Methods to Quantify Population Risk

- Specific population risk approaches:
    a. Age Diversity
        i) Calculate age diversity metrics under various projections for other categories (outlined below)
    b. Recruitment Uncertainty
        i) Alternate projections to account for recruitment variability (mean vs. median vs. draw from distribution vs. remove extreme recruitment events)
        ii) Evaluate a range of data weighting approaches to reveal data conflicts and help inform the most appropriate estimates for recruitment (and other model quantities)
    c. Growth Uncertainty
        i) Sensitivity runs with projections under alternate growth/weight-at-age values/assumptions
    d. Maturation Uncertainty
        i) Sensitivity runs with projections under alternate maturity values/assumptions
- How do we convert range of uncertainty from projections (or alternate methods) into risk level scores?

Discussion questions for assessing population risks

1) To what extent are some population factors (i.e., low recruitment and low biomass) already addressed by our control rule?
2) When risk scores are based on assessment results, how do we account for assessment error and/or model and data-weighting specifications?
    - To what extent is the population risk category already characterized within other risk categories?
3) Given uncertainties in our data, and inertia of populations, how stable should we expect population risk scores to be between years?
4) Are there additional population risk factors not mentioned in the original guidance (i.e., spatial stock structure, localized depletion)?
5) What are tangible steps for improving how we score population risk?
    - How should we prioritize/weight population risk factors?
6) Can we develop common approaches to quantify ABC reductions due to risk table concerns?
    - Should we consider alternate approaches for directed vs. non-target stocks?

Major General Issues

1. Overlap across risk table categories and how to avoid double counting risk scores
   a. Examples of overlap with population and ecosystem categories
      i. Recruitment uncertainty (population) vs. ecosystem impacts on recruitment strength

2. Quantifying risk
   a. Alternate projections (e.g., recruitment/maturity/growth)
   b. Do these methods differentiate among risk categories or should they be assumed to be ‘all encompassing’ reductions?

	Assessment-related Considerations	***Population Dynamics Considerations***	***Environmental/Ecosystem Considerations***	*Fishery Performance*
Level 1: Normal	Typical to moderately increased uncertainty/minor unresolved issues in assessment.	**Stock trends are typical for the stock; recent recruitment is within normal range.**	**No apparent environmental/ecosystem concerns**	No apparent fishery/resource-use performance and/or behavior concerns
Level 2: Substantially increased concerns	Substantially increased assessment uncertainty/ unresolved issues.	**Stock trends are unusual; abundance increasing or decreasing faster than has been seen recently, or recruitment pattern is atypical.**	**Some indicators showing an adverse signals relevant to the stock but the pattern is not consistent across all indicators.**	Some indicators showing adverse signals but the pattern is not consistent across all indicators
Level 3: Major Concern	Major problems with the stock assessment; very poor fits to data; high level of uncertainty; strong retrospective bias.	**Stock trends are highly unusual; very rapid changes in stock abundance, or highly atypical recruitment patterns.**	**Multiple indicators showing consistent adverse signals a) across the same trophic level as the stock, and/or b) up or down trophic levels (i.e., predators and prey of the stock)**	Multiple indicators showing consistent adverse signals a) across different sectors, and/or b) different gear types
Level 4: Extreme concern	Severe problems with the stock assessment; severe retrospective bias. Assessment considered unreliable.	**Stock trends are unprecedented; More rapid changes in stock abundance than have ever been seen previously, or a very long stretch of poor recruitment compared to previous patterns.**	**Extreme anomalies in multiple ecosystem indicators that are highly likely to impact the stock; Potential for cascading effects on other ecosystem components**	Extreme anomalies in multiple performance indicators that are highly likely to impact the stock

Dorn and Zador (2020)

- Develop standard reductions based on concern level or downgrade assessment tier

Table 2. Alternative procedures for reducing the ABC from the maximum permissible.

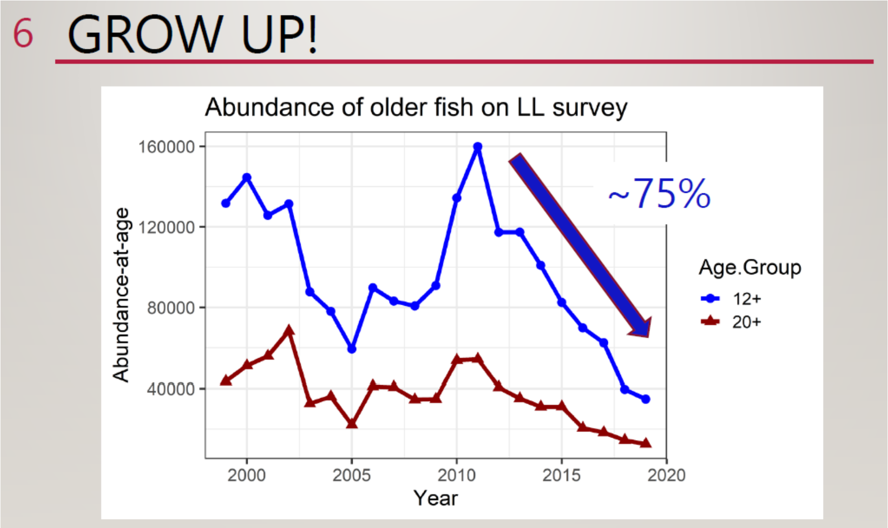
	Specified buffer, restrained response	Specified buffer, robust response	Suggested ranges for buffer	Increase SPR in HCR	Change the tier level
Level 1: Normal	No buffer	No buffer	No buffer	F40%	Tier 3
Level 2: Substantially increased concerns	5%	10%	5%-10%	F45%	Tier 4
Level 3: Major concerns	10%	20%	10%-25%	F50%	Tier 5
Level 4: Extreme concerns	15%	30%	15%-40%	F60%	Tier 6

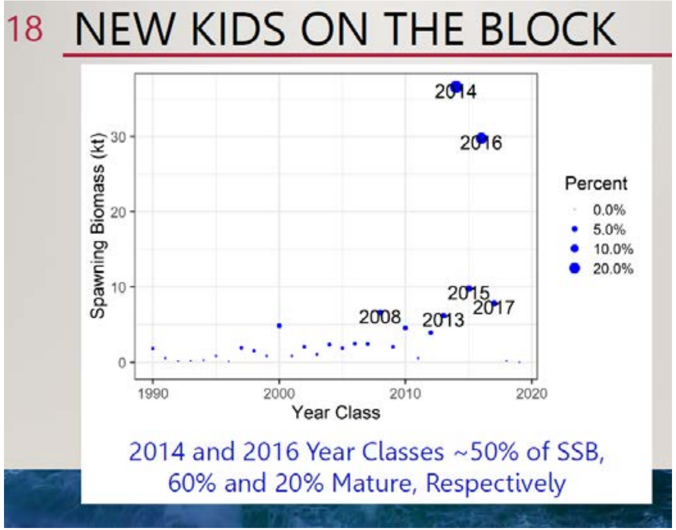
In their discussion of ways to make progress, SSC thought it preferable to base the ABC reduction on a calculation that showed how the proposed ABC reduction reduced the risk to the stock, and proposed using simulation testing to evaluate the performance of different ABC reductions under various scenarios, such as a long period of recruitment failure, or a stock dominated by a single very strong year class. While we agree that these simulations are likely to be helpful in evaluating the tradeoffs between harvest levels and undesirable events, it is unclear how generalizable these experiments would be.

Another approach to evaluating tradeoffs would be to prepare decision tables by running projections using different ABC reduction scenarios, and then evaluating projected stock status under different states of nature that represent the concerns identified in the risk table. For example, projections under periods of low and average recruitment might be done if a decline in recruitment was the concern. This would allow managers to evaluate tradeoffs between being too risk-adverse and losing fishing opportunities over the short-term versus long-term catch reductions that would occur if the Council did not buffer appropriately and the environment were to negatively impact the stock. However, we suspect that there will still be a need for general guidelines on ABC reductions, both as an interim approach and as a backstop to deal with unanticipated and novel situations.

Examples of Identifying Population Risk Factors

Addressing age diversity





Examples of Identifying Population Risk Factors

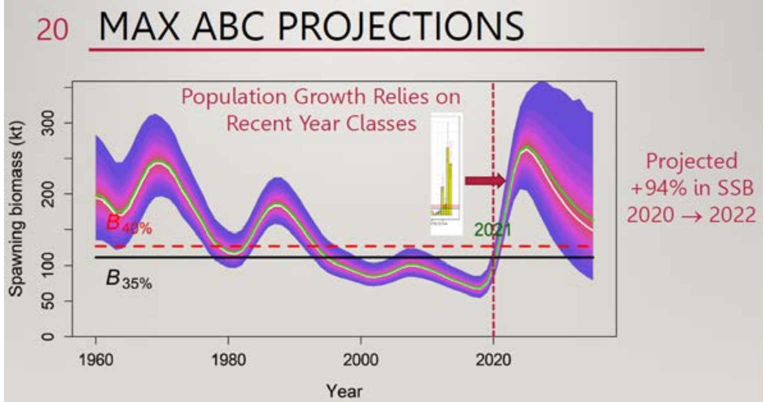
Addressing recruitment uncertainty

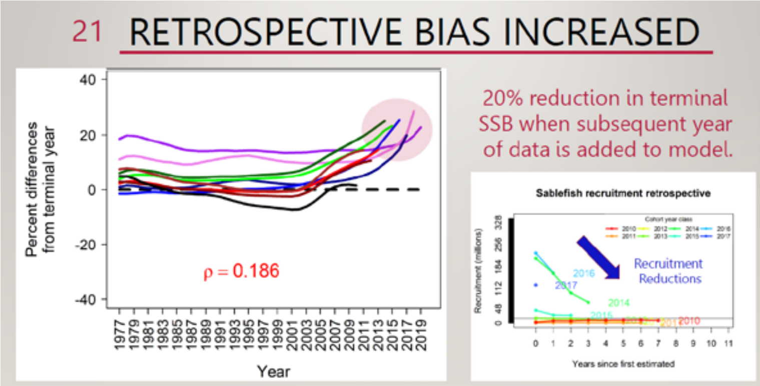
Use average recruit projections to demonstrate direct impact on ABC levels

22 POPULATION GROWTH COMPARISON

	2019 SAFE to 2020 SAFE 2019 to 2020 Population Growth	Maximum Historical Population Growth	Average Recruitment Projection 2020 to 2021 Population Growth*	2020 SAFE 2019 to 2020 Population Growth	Maximum ABC Projection 2020 to 2021 Population Growth
% Population Growth	10%	15%	17%	30%	43%
SSB (t)	104,000	109,000	98,000	122,000	134,000
ABC (t)	--	--	22,100	--	52,400

*2020 SSB was 83,000 t





Examples of Identifying Population Risk Factors

Addressing maturation uncertainty

Perform alternate assessment runs (and projections) with high and low a50