Scallop SAFE Report Appendix 1: Response to comments from SSC

SSC comments and recommendations to the Scallop Plan Team (SPT) were developed at the June 2020 SSC meeting and are shown in bold, below, followed by SPT responses from their February 2021 meeting. The SSC typically reviews the Scallop SAFE and SPT Report in April each year, but cancellation of the April Council meeting in 2020 delayed SSC review until the June meeting.

The SSC requests further documentation of the methods used to standardize the time series that are used to inform Minimum Performance Standards and to infer relative stock trends. **Consideration should be given to the fraction of the beds actually accessed by the fishery each year, including potential thresholds for when CPUE data may be informative about the abundance/density on that bed versus simply reflecting fishery conditions and practices in light of current low levels of fishery participation.**

Response: Under the FMP, statewide scallop OY and MSY are set for a single unit stock. ADF&G establishes GHRs, sets GHLs, and manages weathervane scallop harvest in each fishing area. The combined total GHL is set below the statewide stock ABC/ACL to prevent overfishing. The SPT reviews management practices regularly and the SAFEs will continue to be updated with recent ADF&G survey information and fishery performance data, as well as other information relevant to managing the fishery. Reference timeseries for minimum performance standards are standardized by filtering fishery CPUE data to only include vessels larger than 80 ft that deploy two 15 ft dredges. Within the reference time series, these criteria have excluded only one vessel that fished intermittently. This method is consistent with the limited in-season daily observer reports managers receive during the fishery (i.e., nominal catch/CPUE of shucked meats and crab bycatch by statistical area) to make decisions relative to fishery performance and crab bycatch limits. Model-based standardization of the reference timeseries will not be possible until observer data prior to the 2009/10 season becomes available, since individual dredge data are not available for reference years at this time. Fishery managers have emphasized to the SPT that the minimum performance standard is intended to be used as an *approximate* reference for when in-season management action (i.e., full or partial fishery closure) *may* be warranted. It is not a targeted management quantity, or a 'hard' threshold for closing a fishery in-season. For that reason, the SPT believes the current methods for establishing a minimum performance standard are appropriate.

The authors will add additional detail on the methods used to standardize round weight CPUE for the purpose of ADF&G's GHL setting and assessment development in future SAFEs. CPUE standardization includes terms for both bed and location within a bed. In an effort to quantify the proportion of the fishing grounds being utilized by the fleet, beginning with the 2020/21 season GHL determination process, managers considered an index of the relative 'fishery extent' (i.e., spatial footprint) of fishery catch within a district. This index is defined as the mean, pairwise graphical distance among dredge locations which account for 90% of the total fishery catch within a district. The index can be used to infer whether fishery catch is achieved from a small, or large, proportion of the fishing grounds relative to previous seasons, thus providing added context to information on fishery performance. For instance, when the catch is tightly clustered from a fragment of the bed, the index is small, relative to years when the fishery catch is achieved from a broader area.

The SSC appreciates the responses to previous SSC comments since 2017, but notes that several of these requests remain outstanding and should be addressed in subsequent analyses…These specific requests include:

- **Provide details for bootstrapping methods used to generate confidence intervals for abundance and biomass.**
- **Provide details on how the two-stage estimator for calculating meat biomass differs from that used by Williams et al. (2017).**

Response: The bootstrapping procedure has been dropped, in exchange for confidence intervals based on the design-based estimators of abundance and biomass. Based on 2019 survey data, variance in abundance and biomass based on bootstrap and design-based estimators are very similar (see below). The design-based estimator was recommended by the SPT since it is more computationally simple and utilizes the survey design.

Table A1. Estimates of 2019 survey abundance (top) and biomass (bottom) by bed and size group using both the design based and bootstrap estimator of standard error.

Size group	Bed	Abundance	σ	CV	$\sigma_{bootstrap}$	$CV_{bootstrap}$
≥ 100 mm	WK1	4,827,241	1,791,698	0.37	1,730,964	0.36
	YAK3	10,494,551	1,975,521	0.19	1,936,397	0.18
	YAK4	9,138,029	1,206,116	0.13	1,219,487	0.13
	YAK5	2,295,146	508,701	0.22	511,840	0.22
	YAKB	635,589	120,686	0.19	112,888	0.18
< 100 mm	WK1	840,254	306,718	0.37	299,034	0.36
	YAK3	4,813,146	1,528,948	0.32	1,507,047	0.31
	YAK4	5,399,349	1,233,169	0.23	1,288,014	0.24
	YAK5	820,044	355,687	0.43	348,738	0.43
	YAKB	78,809	22,201	0.28	21,412	0.27

Size group	Bed	Biomass (kg)	σ	CV	$\sigma_{bootstrap}$	$CV_{bootstrap}$
≥ 100 mm	WK1	864,517	317,536	0.37	315,760	0.37
	YAK3	1,928,081	335,706	0.17	324,561	0.17
	YAK4	1,320,399	157,812	0.12	157,636	0.12
	YAK5	347,012	73,575	0.21	69,254	0.20
	YAKB	181,102	31,628	0.17	29,846	0.16
< 100 mm	WK1	52,199	22,540	0.43	22,108	0.42
	YAK3	162,783	49,086	0.30	50,436	0.31
	YAK4	158,560	34,448	0.22	34,222	0.22
	YAK5	27,936	11,270	0.40	11,064	0.40
	YAKB	1,784	535	0.30	512	0.29

The estimator for meat weight biomass reported in Williams et al. (2017) (MW_1) uses the meat and round weights (g) recorded from individual scallops to estimate mean meat weight to round weight ratio for a bed, $\bar{r}$, which was applied to either estimated abundance, or round weight biomass. Variance is then estimated via a non-parametric bootstrap resampling on abundance (or biomass) and $\bar{r}$. The two-stage estimator of meat weight biomass used here ($\hat{B}_M$) is defined as

$$\hat{B}_M = A \cdot \frac{1}{n}\sum_{i=1}^{n} u_i \quad (1)$$

u_i = the meat weight density (catch per unit effort) within sample tow *i,* in which

$$u_i = \frac{\hat{w}_i}{a_i} \quad (2)$$

$$\hat{w}_i = c_i \bar{w}_i \quad (3)$$

$$\bar{w}_i = \frac{1}{m_i}\sum_{j=1}^{m_i} w_{ij} \quad (4)$$

a_i = the area swept by the dredge in sample tow *i*.
c_i = the total number of scallops caught in sample tow *i*.
m_i = the number of scallops subsampled from sample tow *i* (i.e., m_i = 10),
w_{ij} = the meat weight (g) of scallop *j* subsampled from the catch of tow *i*.

Variance in $\hat{B}_M$ is then estimated as

$$\widehat{Var}\left[\hat{B}_M\right] = A^2\widehat{Var}[\bar{u}] + \frac{A}{n}\sum_{i=1}^{n} c_i^2\widehat{Var}[\bar{w}_i] \quad (5)$$

$$\widehat{Var}[\bar{w}_i] = \frac{1}{m_i(m_i-1)}\sum_{j=1}^{m_i}\left(w_{ij} - \bar{w}_i\right)^2 \quad (6)$$

$$\widehat{Var}[\bar{u}] = \frac{1}{n(n-1)}\sum_{i=1}^{n}(u_i - \bar{u})^2 \quad (7)$$

The two-stage estimator is recommended by the SPT, as it reflects the sampling design. Each tow represents a primary sampling unit, while individual scallops (m_i = 10) subsampled from the total catch in tow *i* of *n* represent secondary sampling units. Full details of survey estimation methods can be found in the current operational plan (Burt et al. *in prep*).

Add a single summary table to the SAFE showing region-specific survey results next to region specific harvest totals and long-term averages in the same units (e.g., round weight).

Response: A table has been added to the 2021 SAFE Executive Summary

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The SSC is heartened to hear efforts at age validation continue and that an age-structured model has been developed for Kamishak Bay. The SSC would appreciate having an opportunity to review this model and also looks forward to seeing such models.

Response: Age-structured model development is continuing. Updates will be made to the SPT and SSC as progress continues.

Calling the current assessment survey "statewide" is a misnomer given that the current plan is to alternate annual surveys between only two of the nine fished regions. In future SAFEs, consider using the term "state" or "ADF&G" survey.

Response: The term "statewide" refers to the involvement of all the state's administrative regions that are included in the ADF&G survey effort (i.e., Westward, Central, Southeast). To prevent confusion, this has been clarified in the current SAFE.

The SAFE raises the issue of small meats in 2019 and implicates temperature, or possibly pH, as the putative cause. The GOA ecosystem report is mentioned as containing information that might inform this assertion, but no attempt at making a more formal linkage is made. In future SAFEs, the SSC requests the authors explore such linkages and bring forward what data are available to better understand biological variation that affects fishery performance.

Response: Research is on this subject is ongoing and information considering the effects of ecosystem trends on scallop biology and fishing performance will be included in future SAFEs when available.

"Clapper" isn't defined anywhere and is conflated in Table 2-5 with weak meat. This table effectively shows "unharvestable scallops" not just those with weak meat. Please separate these data.

Response: The caption of Table 2-5 was incorrectly stated and should not include mention of clappers. Table 2-5 only includes the percentage of shucked large scallops per bed that had "weak" meats. For reference, a "clapper" is an empty scallop shell, with the hinge still intact.

The SSC supports the initiative to update scallop Essential Fish Habitat (EFH) information, which is overdue, given new available information and improved modeling approaches.

Response: This effort is ongoing and the SPT is currently looking for collaborators interested in working on this initiative.

Patterns of changing abundances and biomass in the survey data from the Yakutat region implies an increase in average size and weight in recent years. However, the length-frequency distribution

in the fishery does not show an increase in the size of landed or discarded scallops over the same period. This apparent discrepancy should be explored.

Response: Provided size composition data from the 2017 - 2019 dredge surveys in Yakutat, the SPT does not attribute increases in survey biomass in beds YAKB, YAK3, and YAK4 to increased average size and weight of the population, rather increases in biomass is consistent with an increase in abundance of individuals across the range of sizes caught. Size compositions of fishery catch over this time period align with the size range present in the corresponding survey data. In contrary, within the YAK5 bed, survey abundance decreased, while biomass increased. Alone, these data may suggest an increase in individual size and, or weight, though size composition data from the survey and fishery do not support that notion. Changes in abundance and biomass are minor relative to the associated levels of uncertainty, so its possible difference in survey estimates between 2017 and 2019 could in part reflect sampling error.