FOR PDT USE ONLY

VIMS CAII SHMW Analysis

October 27, 2020

Methods

Shell height meat weight relationships (SHMW) were estimated for the 2020 SAMS Areas for Closed Area II (CAII) and the Southern Flank (SF) with data collected during the VIMS 2016-2020 surveys. Survey station data from the 2016-2019 survey was reassigned to 2020 SAMS Areas for comparisons. Several different SHMW relationships were developed. Analysis 1 estimated a SHMW relationship for just stratum 60, which includes portions of the SF and CAII Ext SAMS Areas. This relationship was estimated for 2016-2020. Analysis 2 was completed with the same dataset ,excluding 2020, after the term Year was included in the optimal model for Analysis 1. Analysis 3 estimated relationships by SAMS Area and year for 2016-2020. VIMS SHMW predicted curves were compared to curves estimated with the SARC 65 SHMW equation for all analyses.

SHMW mixed effect models were developed with forward selection and variables were retained in the model if the AIC was reduced three or more units. The model with the lowest AIC was selected as the preferred model and used to predict SHMW relationships by SAMS area. If models were within three units of each other, a likelihood ratio test was used to test for significant differences between model. If there was no significant difference between the models, the more parsimonious model was selected as the preferred model. Variables considered were: ln shell height, ln depth (average depth for a station), SAMS Area, latitude (beginning latitude of a station), an interaction term of shell height and depth, year, and maturity stage. Maturity stage was included to account for the delay of the 2020 survey. Models with and without maturity stage were compared to assess the need to include this variable. Post-hoc multiple pairwise comparisons for the levels of maturity stage were also completed. The interaction term was not considered in model development if the term was not significant in the individual model.

Results

Survey spatial coverage differed for 2016 and 2017 compared to 2018-2020. The VIMS surveys in 2016 and 2017 did not cover the SF (Figure 1). Beginning in 2018, VIMS survey coverage was expanded to include all of stratum 60, which includes portions of the CAII Ext and SF SAMS Areas. The number of stations where samples were collected for Analysis 1 is included in Table 1. The number of stations where samples were collected for Analysis 2 is included in Table 2. The number of stations where samples were collected for Analysis 3 is included in Table 3.

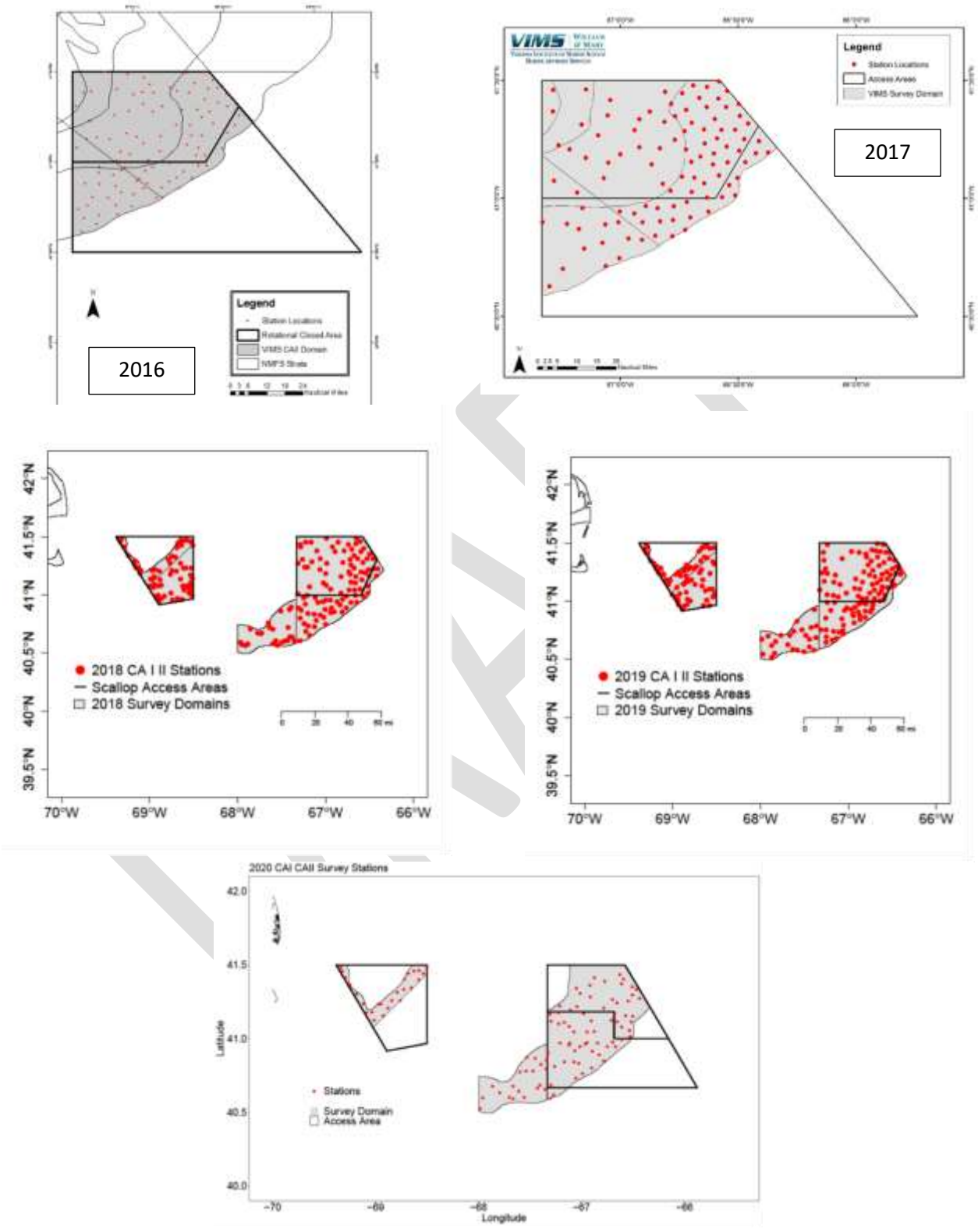

Figure 1. VIMS survey domains and station locations by year.

Table 1. Number of stations where SHMW samples were collected by year and SAMS Area for Analysis 1.

Year	SAMS_Areas	Number of Stations
2016	CAII_Ext	12
2017	CAII_Ext	10
2018	CAII_Ext	14
2019	CAII_Ext	11
2020	CAII_Ext	10
2018	SF	21
2019	SF	21
2020	SF	18

Table 2. Number of stations where SHMW samples were collected by year and SAMS Area for Analysis 2.

Year	SAMS_Areas	Number of Stations
2016	CAII_Ext	12
2017	CAII_Ext	10
2018	CAII_Ext	14
2019	CAII_Ext	11
2018	SF	21
2019	SF	21

Table 3. Number of stations where SHMW samples were collected by year and SAMS Area for Analysis 3.

Year	SAMS_Areas	Number of Stations
2016	CAII_Access_SE	34
2017	CAII_Access_SE	51
2018	CAII_Access_SE	44
2019	CAII_Access_SE	44
2020	CAII_Access_SE	27
2016	CAII_Access_SW	15
2017	CAII_Access_SW	12
2018	CAII_Access_SW	11
2019	CAII_Access_SW	18
2020	CAII_Access_SW	11
2016	CAII_Ext	23

2017	CAII_Ext	20
2018	CAII_Ext	29
2019	CAII_Ext	28
2020	CAII_Ext	23
2018	SF	21
2019	SF	21
2020	SF	18

Overall results from all three analyses indicate there is a year effect for observed SHMWs, even when 2020 is removed from the analysis. For Analysis 1, the optimal model included shell height, latitude, and year as fixed effects. Years 2018 and 2019 were significantly different from the reference year of 2016. Year 2020 was not significantly different from the reference year; the effect size was small and negative (Table 4). Predicted SHMW relationships by year for the SARC model and the VIMS model were compared in Figure 2. The VIMS curve is lower than the SARC curve for all years except 2018, where curves are comparable. Removing year 2020 from the analysis yielded similar results in Analysis 2. The optimal model had shell height, depth, an interaction of shell height and depth, latitude, and year as fixed effects. Years 2018 and 2019 were significantly different from the reference year of 2016 (Table 5) and predicted curves followed a similar trend (Figure 3). With the exception of 2018, all VIMS predicted curves are lower than the SARC curves. For Analysis 3, a year effect was also observed, but only 2020 was significantly different from the reference year of 2016 (Table 6). The effect size (-0.24) was negative and larger than the parameter estimate of -0.5 for year 2020 in Analysis 1. The optimal model had shell height, an interaction term of shell height and depth, depth, latitude, SAMS Area, and year as fixed effects. When comparing SARC and VIMS predicted curves by year and SAMS Area (Figure 4), several SAMS Area curves were comparable across the two treatments. For the CAII_Access_SE, CAII_Access_SW, and CAII_Ext curves were similar across all years with the exception of 2020. SHMW curves were also similar in the SF SAMS Area in 2018. There is a small divergence observed in 2019, followed by a larger divergence in 2020.

Table 4. Optimal model parameters and parameter estimates for Analysis 1. Bold parameter estimates indicate significance.

Parameter	Parameter Estimate
Intercept	-32.92
logsh	**2.77**
beglat	**0.56**
Year2017	0.13
Year2018	**0.29**
Year2019	**0.17**
Year2020	-0.05

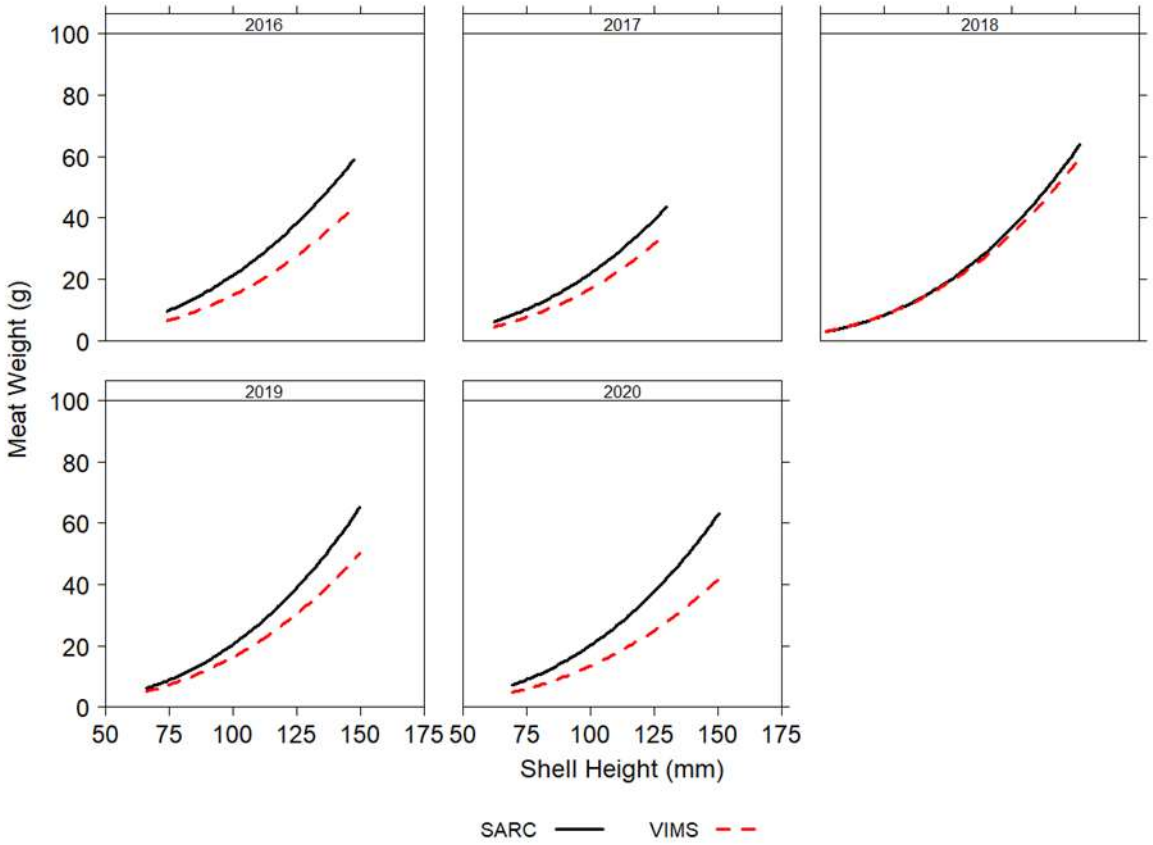

Figure 2. Predicted SHMW curves by year using the SARC and VIMS models for Analysis 1.

Table 5. Optimal model parameters and parameter estimates for Analysis 2. Bold parameter estimates indicate significance.

Parameter	Parameter Estimate
Intercept	-60.56
logsh	**7.00**
logdepth_cor	**4.68**
beglat	0.74
Year2017	0.14
Year2018	**0.31**
Year2019	**0.21**
logsh:logdepth_cor	**-0.97**

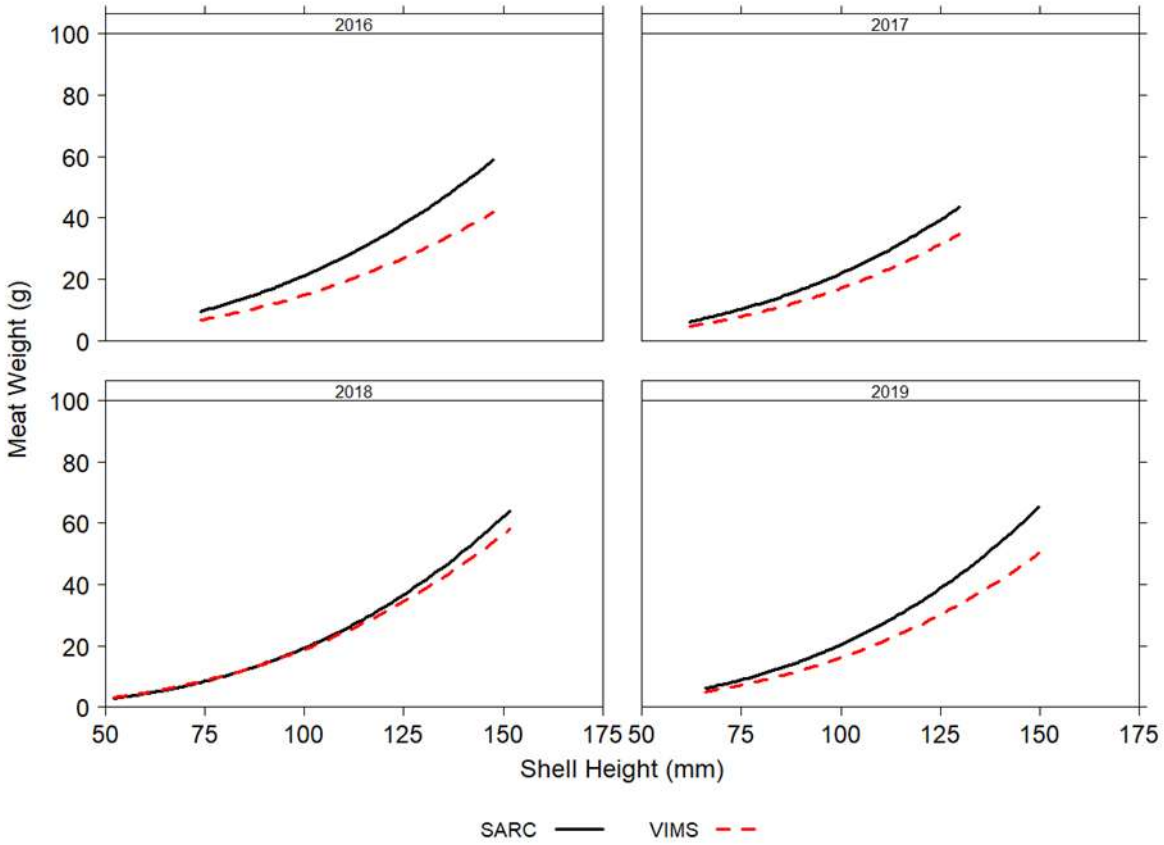

Figure 3. Predicted SHMW curves by year using the SARC and VIMS models for Analysis 2.

Table 6. Optimal model parameters and parameter estimates for Analysis 3. Bold parameter estimates indicate significance.

Parameter	Parameter Estimate
Intercept	-36.46
logsh	**3.77**
logdepth_cor	**0.98**
SAMS_AreasCAII_Access_SW	**0.18**
SAMS_AreasCAII_Ext	**0.11**
SAMS_AreasSF	**0.24**
beglat	**0.54**
Year2017	0.02
Year2018	0.02
Year2019	-0.01
Year2020	**-0.24**
logsh:logdepth_cor	**-0.22**

Figure 4. Predicted SHMW curves by year and SAMS Area using the SARC and VIMS models for Analysis 3.