Vessel Calibration Coefficient Discussion

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1 Calibration Coefficient Discussion

1.1 Background

Excerpted from Wertheimer et al. 2010:

"From 1997 to 2007, SECM used the NOAA ship *John N. Cobb* to accrue an 11 year time series of catches with a Nordic 264 rope trawl fished at the surface… (Orsi et al. 2000, 2008)… In 2007, in anticipation of the decommissioning of the *John N. Cobb*, the *Medeia* and the *John N. Cobb* fished synoptically for 28 pairs of trawl hauls to develop calibration factors in the event of differential catch rates between the two vessels (Wertheimer et al. 2008). In 2008, the *Medeia* fished synoptically with the chartered research vessel *Steller* to determine relative fishing efficiency so that *Steller* catches could then be compared and calibrated to the SECM data series from the *John N. Cobb* (Wertheimer et al. 2009). In 2009, the commercial trawler *Chellissa* was chartered to fish the SECM transects in the northern and southern regions of Southeast Alaska. The *Medeia* was again fished synoptically in the northern region transects to determine relative fishing efficiency (Table 1)."

Table 1: Estimated fishing power coefficients for juvenile salmon catches by the different vessels used during the Southeast Alaska Coastal Monitoring survey (Wertheimer et al. 2008, 2009, and 2010). *Chellissa:Cobb* was calculated from pink salmon estimates for *Chellisa:Medeia* and *Medeia:Cobb*. *Mixed Chellissa:Cobb* was a mixture of species estimates for *Chellisa:Medeia* and a pooled species estimate for *Medeia:Cobb*. One of the primary trawl vessels, F/V *Northwest Explorer*, has not been calibrated and it is assumed to have the same fishing power as the *Chellissa*.

Species	Medeia:Cobb	Chellissa:Cobb	Steller:Cobb	Medeia:Steller	Chellissa:Medeia	mixed Chellissa:Cobb
Pink	1.13	1.44	0.96	1.18	1.27	1.51
Chum	1.21	1.44	1.16	1.04	1.19	1.42
Sockeye	1.19	1.18	1.05	1.13	0.99	1.18
Coho	1.26	1.32	0.85	1.48	1.05	1.25
Total Salmon	1.19	1.36	1.05	1.13	1.14	1.36

For the 2021 SEAK pink salmon forecast, there was a discussion as to which vessel calibration coefficient to use going forward. Using the four potential vessel calibration coefficients (pink_cal_mixspecies, pink_cal_mixpool, pink_cal_species, pink_cal_pool; Table 2), the corresponding index of juvenile abundance was slightly different (i.e., CPUE; standardized pink salmon catch based on a 20 minute trawl set by year; Table 3). Performance metrics (Akaike Information Criterion corrected for small sample sizes; AICc values; Burnham and Anderson 2004; mean and median absolute percentage error (MAPE, MEAPE); mean absolute scaled error (MASE) (Hyndman and Kohler 2006)) were used to evaluate forecast accuracy of alternative vessel calibration coefficients (Table 4) using the same model. Statistical analyses were performed with the R Project for Statistical computing version 3.6.3 (R Core Team 2020). The model used for the comparison of the vessel calibration coefficient model was:

$$E(y) = \alpha + \beta_1 X_1 + \beta_2 X_2,$$

where X_1 is CPUE, juvenile pink salmon abundance index based on the different vessel calibration coefficients, and X_2 is the average temperature in Icy Strait in May, June, and July at eight stations in Icy Strait. CPUE data are log-transformed catches that are standardized to an effort of a 20 minute trawl set. The four potential vessel calibration coefficients are defined as:

pink_cal_mixspecies is a mixture of pink-specific (*Chellisa:Medeia*) and pooled-species (*Medeia:Cobb*) coefficients for the *Chellissa* and the *N/W Explorer*, and a pink salmon coefficient for the *Medeia*. This ends up with a time series that is based on coefficients that vary with species, but are partially derived from a mixture of species-specific and pooled-species coefficients.

pink_cal_mixpool is a mixture of pink-specific (*Chellissa:Medeia*) and pooled-species (*Medeia:Cobb*) coefficients for the *Chellissa* and the *N/W Explorer*, and a pooled-species coefficient for the *Medeia*.

pink_cal_species…

pink_cal_pool…

Table 2: Calibration coefficients used to convert vessel-specific catches to *Cobb* units. Direct calibrations with the *Cobb* are estimated for the *Steller* and *Medeia*, therefore mixed coefficients are only applied to the *Chellissa* and *NW Explorer*. Species-specific or pooled-species coefficients could be used as the mixed coefficients for the *Steller* and *Medeia*.

Vessel	pink_cal_mixspecies	pink_cal_mixpool	pink_cal_species	pink_cal_pool
Cobb	1.00	1.00	1.00	1.00
Chellissa	0.66	0.66	0.70	0.74
NW Explorer	0.66	0.66	0.70	0.74
Steller	1.04	0.95	1.04	0.95
Medeia	0.88	0.84	0.88	0.84

Table 3: The data for the variable CPUE (index of juvenile pink salmon abundance based on log-transformed catches that are standardized to an effort of a 20 minute trawl set) using different vessel calibration coefficients.

year	pink_cal_mixspecies	pink_cal_mixpool	pink_cal_species	pink_cal_pool
1997	2.477744	2.477744	2.4777444	2.4777444
1998	5.622380	5.622380	5.6223800	5.6223800
1999	1.597723	1.597723	1.5977233	1.5977233
2000	3.729985	3.729985	3.7299847	3.7299847
2001	2.868826	2.868826	2.8688260	2.8688260
2002	2.784664	2.784664	2.7846641	2.7846641
2003	3.077820	3.077820	3.0778204	3.0778204
2004	3.899407	3.899407	3.8994067	3.8994067
2005	2.040345	2.040345	2.0403454	2.0403454
2006	2.572781	2.572781	2.5727807	2.5727807
2007	1.167639	1.167639	1.1676386	1.1676386
2008	2.555111	2.323473	2.5551107	2.3234731
2009	2.094192	2.094192	2.2053878	2.3330031
2010	3.687782	3.687782	3.8835930	4.1083181
2011	1.305918	1.305918	1.3752584	1.4548381
2012	3.161036	3.161036	3.3288788	3.5215052
2013	1.923429	1.923429	2.0255583	2.1427677
2014	3.426619	3.426619	3.6085629	3.8173733
2015	2.201588	2.201588	2.3184867	2.4526465
2016	3.905705	3.905705	4.1130877	4.3510925
2017	0.310436	0.310436	0.3269194	0.3458366
2018	1.233765	1.171558	1.2337651	1.1715584
2019	1.202606	1.141971	1.2026065	1.1419709
2020	2.261529	2.147502	2.2615289	2.1475023
average	2.546210	2.526689	2.5949191	2.6313000

1.2 Conclusion

Based on *x,y,and z???*, the discussion was limited to the pink_cal_species and pink_cal_pool vessel calibration coefficients. There is a bit more statistical support for the pink_cal_pool coefficient. As the pool coefficients are currently used for sockeye, coho and Chinook salmon catches, the pink_cal_pool vessel calibration coefficient will be used moving forward for calculating the juvenile pink salmon abundance index.

Table 4: Comparison of the performance metrics for a model based on calculating a time-series of juvenile pink salmon abundance using different vessel calibration coefficients.

model	AdjR2	AICc	MAPE	MEAPE	MASE	forecast	lower_80	upper_80	index
CPUE+ISTI	0.811	16	0.079	0.061	0.262	31.3	20.9	46.9	pink_cal_mixspecies
CPUE+ISTI	0.820	15	0.077	0.060	0.256	29.8	20.1	44.1	pink_cal_mixpool
CPUE+ISTI	0.820	15	0.077	0.070	0.257	30.6	20.6	45.3	pink_cal_species
CPUE+ISTI	0.830	14	0.074	0.060	0.249	28.5	19.4	41.7	pink_cal_pool

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