Meeting Report

Follow-up to Scallop Survey Peer-Review – 2017 Council Work Priority
April 13, 2017
Conference Call
10am – 11:30am

Participants: Sam Asci (NEFMC), Dr. Bill DuPaul (Independent), Dr. Dvora Hart (NEFSC), Dr. Cate O'Keefe (MA DMF), Jonathon Peros (NEFMC), Dr. David Rudders (VIMS)

Next Steps/Planned Work:

1. The NEFSC may have a student with time to look at paired tows between the HabCam and the dredge. Results could be available by this Fall. – NEFSC, Dr. Dvora Hart
2. For survey biomass estimates, Dr. Hart has an R script that can be used to plot the mean, quartiles, 5% - 95% confidence intervals. – NEFSC, Dr. Dvora Hart
3. In addition to simple mean of survey estimates, NEFSC to generate biomass estimates using geostatistical methods (GAM + Ordinary Kriging) that incorporate data from all surveys. This would be presented to the SSC this fall if time allows. The PDT's main focus will continue to be on providing all analyses needed for FW29 within the Council's timeline. – NEFSC, Dr. Dvora Hart
4. Comparison of results from the survey dredge in Y0 could be compared with commercial dredge results in Y1 to track recruitment into the fishery. – VIMS, Dr. Dave Rudders
5. Sensitivity analyses with a range of dredge efficiencies as a way to characterize uncertainty, particularly in high density areas. –VIMS, Dr. Dave Rudders
6. Develop a new set of growth parameters for animals in NLS using the same approach as 2016 (checking on SAMS areas in NLS) – VIMS, Dr. Dave Rudders
7. Document PDT work and process for upcoming SSC meeting and benchmark assessment. –NEFMC, Jonathon Peros with other sub-group members

Recommendations:

1. The group thought that dredge efficiency in high density areas could be a specific term of reference (TOR) at the upcoming benchmark assessment.

Follow-up:

1. Continued discussion around the issues of uncertainty and management advice by sub-group and PDT.
2. Ongoing VIMS work on dredge efficiency in high density areas, results expected by 2018 benchmark.
3. O'Keefe/Hart: Connect re: SMAST/DMF RSA project on LPUE estimates.
4. Update the group on progress of LPUE project supported through RSA. Results expected by 2018 benchmark. – Dr. Cate O'Keefe

Opening Discussion:

Council staff explained that several issues emerged in 2016 following the scallop survey season and during the process of updating scallop models. Many of these areas are related to areas where surveys (both dredge and optical) encountered high densities of scallops. Given the substantial crossover of these issues with TORs covered during the scallop survey peer-review, the Council has identified follow-up to the 2015 Scallop Survey Peer-Review (March 17 – 19, 2015) as a work priority for Atlantic sea scallops in 2017. With a benchmark assessment planned for the spring of 2018, a sub-group of the Scallop PDT plan to address a sub-set of the issues raised at the scallop survey peer-review. Many of this these topics will be relevant to the 2017 specification setting process

The group felt that some follow-up to the survey peer-review could be accomplished this year, and that the benchmark is the time to revisit the assessment models and assumptions. The benchmark process lends itself to the follow-up of some issues identified at the survey review panel. The issue of dredge efficiency in high density areas is important – and could be a specific TOR at the benchmark. Dr. Hart thought that the TORs for the 2018 benchmark would likely be out in late 2017 or early 2018.

The meeting covered issues relevant to TOR #4, TOR #5, and preparation for SSC meeting later this year.

TOR #5: Explore ways to combine survey estimates, including situations when there may be a large divergence between estimates (ex: dredge and HabCam in NLS-NA, related to dredge efficiency in high density areas, and variance estimates)

The sub-group discussed the performance of mean estimates from surveys with two questions in mind: 1) How well is the mean performing? 2) How reliable are mean values to extrapolate up? Dr. Rudders began this discussion, explaining that the survey data is zero inflated in some areas, while they see high observations in other places. With autocorrelation in some areas, an additional question is whether or not the mean is a good measure of central tendency. Dr. Hart explained that the mean represents an unbiased estimate, but is not always the most robust measures depending on the distribution of data. One member suggested that delta approaches could be used to deal with excess zeros. It was also suggested that a bootstrapping stratified mean R package (by Stephen Smith) could be used to explore these issues.

The group noted that the PDT had explored other ways of combining estimates, including the inverse weighted mean. In 2016, the PDT has discussed various ways to combine survey estimates during the past two Framework/specification cycles. The group noted that the (SE) standard error of model based approaches is likely underestimated, which could cause these estimates to be weighted higher than other estimate (ex: dredge). The PDT did not support using an inverse weighted mean for this reason during the development of earlier FW actions.

Dr. Hart explained to the group that when the survey biomass estimates are calculated, the initial conditions are bootstrapped (1000 runs). Dr. Hart has an R script that can be used to plot the mean, quartiles, 5% - 95% quartiles.

Dr. Hart suggested that the PDT could generate biomass estimates using geostatistical methods, as well as the mean of the surveys from each area. This would entail adding all data sets to the geostatistical model (GAM + Ordinary Kriging). Right now we just use the geostatistical approach for HabCam data. The group discussed comparing the results of a simple mean and a single model co-kriging approach over several years. Dr. Hart felt that this could be done for the benchmark assessment, but not sooner.

The group felt that this approach could be presented to the SSC for 2018/2019 OFL and ABC. Within the co-kriging model, each dataset would be considered, and the PDT could consider weighting each. For this year, the focus would be for exploratory purposes, and ensuring that all FW29 analyses are completed to meet the Council timeline. The benchmark could be the time to further refine this kind of approach.

The group also discussed using data gathered in 4" ring commercial dredge on the VIMS survey as comparative exercise with results from survey dredge and other optical methods. Dr. DuPaul noted that the performance of survey dredge varied when full with sand dollars vs. scallop catch. The group discussed looking at the biomass estimates from the commercial dredge as a way to double-check the results of the survey dredge, particularly in areas like the Nantucket Lightship or Elephant Trunk where there are known high densities of scallops. Dr. Rudders confirmed that exploitable biomass estimates are generated using the data from the commercial dredge, and that the expectation is that exploitable estimates from both dredges (survey/commercial could be close). Dr. O'Keefe suggested that results from the survey dredge in Y0 could be compared with commercial dredge results in Y1 to track recruitment into the fishery.

TOR #4: Explore dredge efficiency in high density areas

With respect to dredge efficiency in high density areas (TOR #4), the group discussed completed and ongoing analyses. The current situation of extremely high densities has not been seen in the dredge survey time series. For example, the 2016 VIMS survey dredge caught 40 baskets in 5 minutes in the Elephant Trunk.

Dr. Hart looked at HabCam/dredge comparisons as part of the FW28 specification setting process, and found that on average, estimates between the survey types were close. Her preliminary exploration of dredge efficiency at high densities was presented to the PDT on August 30, 2016. Dr. Hart compared over 280 Habcam/dredge pairs from 2016 (using instances when there were at least 50 square meters of Habcam photos within a 0.75 sq nm circumference of the dredge tow with at least minimal scallop densities. Her conclusion was that the efficiency of dredge tows in high density areas were all below the expected survey efficiency of 0.4, suggesting that the dredge operates at reduced efficiency when scallop density is very high.

Dr. DuPaul indicated that when catch includes sand dollars, the efficiency of the dredge changes, and suggested that this could be explored further by mining VIMS survey records. Work is planned to understand if the dredge is filling in high density areas, or if something else is happening (ex: bulldozing). Dr. Rudders explained that the VIMS will be completing dredge efficiency work this summer looking at the effect of shorter tow times. He thought that it would be unlikely that this work will be complete before the 2018/2019 specification setting process,

but that the work would be ready for review ahead of the 2018 benchmark assessment. Dr. Hart explained that the NEFSC may have a graduate student look at paired tows between HabCam and the survey dredge. Preliminary results could be ready as early as this fall.

The group discussed performing sensitivity analyses with a range of dredge efficiencies as a way to characterize uncertainty, noting the high biomass in the Elephant Trunk and Nantucket Lightship. With high biomass in these areas, fishing mortality is generally low.

The discussion evolved into a conversation about uncertainty and management advice. The key question that the group identified was "how does uncertainty change the management advice (from the PDT)?" The group felt that sensitivity analyses could be used to help characterize uncertainty, and that the PDT could focus on capturing the uncertainty in its work/reports. One option could be to have some discussions ahead of time about deviating from the benchmark, and outlining a process/procedure for situations when we (PDT) could consider if it is appropriate to deviate from the benchmark.

Preparation for SSC meeting re: OFL and ABC values for 2018-2019:

The group reviewed two recommendations from the SSC's November 10, 2016 report:

1. Growth data specific to the Nantucket Lightship Area should be used for the present analysis (2016), but additional research and monitoring should be conducted and presented to the SSC before the same approach is used in future specification setting (Recommendation #1).

VIMS will be conducting dredge surveys in the Mid-Atlantic, Elephant Trunk, and Closed Area II and surrounds in 2017. The group anticipates that additional information will be available for the 2018/2019 specification setting process. Appendix II shows the analysis that was used in 2016 to characterize the growth parameters in the NLS.

2. The PDT should continue to investigate alternate weighting scenarios for combining the three surveys used in the projections and report on these analyses during the 2017 specification setting process (Recommendation #4).

As noted above, Dr. Hart suggested that the PDT could generate biomass estimates using geostatistical methods, as well as the mean of the surveys from each area. This would entail adding all data sets to the geostatistical model (GAM + Ordinary Kriging). Right now we just use the geostatistical approach for HabCam data. The group felt that it could be constructive for the SSC to see biomass estimates generated through an alternative approach. The group also discussed performing sensitivity analyses with a range of dredge efficiencies as a way to characterize uncertainty.

LPUE Performance:

The PDT agreed to update the LPUE model as part of the FW28 process. Last fall the PDT talked about looking at the performance of the new LPUE model relative to the output of

pervious model. The sub-group received a copy of a 2017 RSA LPUE project narrative that Dr. O'Keefe is a co-PI on. This work will be looking into factors that influence LPUE. Dr. O'Keefe offered to keep the group updated on this work as it unfolds.

Appendix I:

Notes from Dr. Hart's presentation to the PDT on March 1, 2017 (From PDT meeting summary). This work is relevant to the part of TOR#4: Explore the likely under-estimation of biomass variance estimates from HabCam surveys

As part of the follow-up to the scallop survey peer-review, Dr. Dvora Hart gave a presentation to the PDT on recently published work focused on the design and population estimation for HabCam sea scallop surveys (refer to slides). The article, A comparison of methods to estimate abundance and biomass from belt transect surveys appeared in Limnology and Oceanography: Methods and was co-authored by Jui-Han Chang and Burton Shank, HabCam estimates employ geostatistical methods as opposed to basic statistics because they allow density estimates at specific locations (as opposed to just the overall mean), and because traditional statistical methods are not valid for continuous transect sampling. As opposed to traditional fisheries surveys, model-based surveys/methods (i.e. HabCam) do not require randomization, but do make assumptions about the population (i.e. spatial autocorrelations).

The geostatistical (kriging) methods used to generate estimates of population density use a weighted average from nearby observations. When observations are very far apart (and spatial information may not be relevant), the estimate is the simple mean of the data. Ordinary kriging is based on the assumption that there are no large scale trends in a population. This is not true for scallops, as the expected scallop density varies by depth, substrate type, etc. Generalized additive models (GAM) are used to address large scale trends (first order effects) in the HabCam data. However, the GAM model assumes that the underlying data is independent, though we know that HabCam data is autocorrelated (images are annotated every 50 meters). HabCam data is also zero inflated – almost 90% of the annotated images do not detect scallops as opposed to a normal distribution of data. HabCam biomass estimates are generated using a variogram, which is done through a two-step process where the results of a GAM model are combined with the small aggregation estimates (ordinary kriging). There are 14 variogram areas/models, some of the areas follow management areas such as Elephant Trunk and Hudson Canyon, though not all areas follow management boundaries.

Dr. Hart explained that several methods for estimating biomass were tested. The GAM model, which is used to generate biomass estimates for the assessment and management purposes, showed a slight bias, and performed better than the mixed effects GAM (GAMM) and ordinary kriging. In tests using simulated data and data from other scallop surveys (dredge, dropcam) the GAM model at 750 meter segments performed best.

The GAM with ordinary kriging method with data averaged over 750m segments to estimate scallop abundance and biomass for the GB and MAB stock in 2016. Stratified mean estimates with careful stratifications were also developed to provide a comparison to the model-based estimates. Population/biomass estimates are used in stock assessment models (SAMS and CASA) to estimate stock status, as well as setting total allowable catch for each management regions each year. These methods can also be used to develop maps of recruitment/exploitable biomass, which allow us to accurately determine boundaries of new rotational closures to protect

small scallops and areas to reopen (or keep open). Dr. Hart explained that when multiple HabCam surveys are done in the same year (ex: WHOI, Arnie's, NEFSC), all of the biomass estimates are generated by the NEFSC. Dr. Hart concluded the presentation with a discussion on survey design.

Appendix II:

VIMS SH/MW estimates for NLCA – 2016

Here are the parameter estimates for shell height meat weight relationships for the NLCA derived from our survey data using the updated region/zone designations. log = ln

Equation
Meatweight= intercept+(B1* logsh)+(B2*logdepth)+(B3*(logsh*logdepth)) + SAMS_zone_2015

Parameter	Parameter Estimate
Intercept	-25.7615
B1 logsh	6.7540
B2 logdepth	4.1120
B3 logsh:logdepth	-1.0054
SAMS_zone_2015NLS_AC_S	-0.4917
SAMS_zone_2015NLS_EXT	-0.2214
SAMS_zone_2015NLS_NA	-0.3743
SAMS_zone_2015VIMS_45	-0.2198