Observations on the Sea Scallop Resource in the Nantucket Lightship - South

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Scallop Growth

- Scallop growth is an import component of assessment models.

- On average, growth is fairly well understood across the range of the resource although it varies in time and space.

- Scallop management is predicated on assumptions regarding growth.

Growth under extreme conditions

- Current assessment/projection models have implicit assumptions about growth.

- Spatial management attempts to identify areas of high juvenile scallop density, close these areas to fishing and take advantage of fast growth.

- We assume that these high density areas perform according to the resource averages.

- Currently, two areas exist in the resource that contain densities rarely seen in the monitoring time series.

- These two areas (NL-S and ET Flex) currently contain ~55,000 MT of non-EFH biomass.
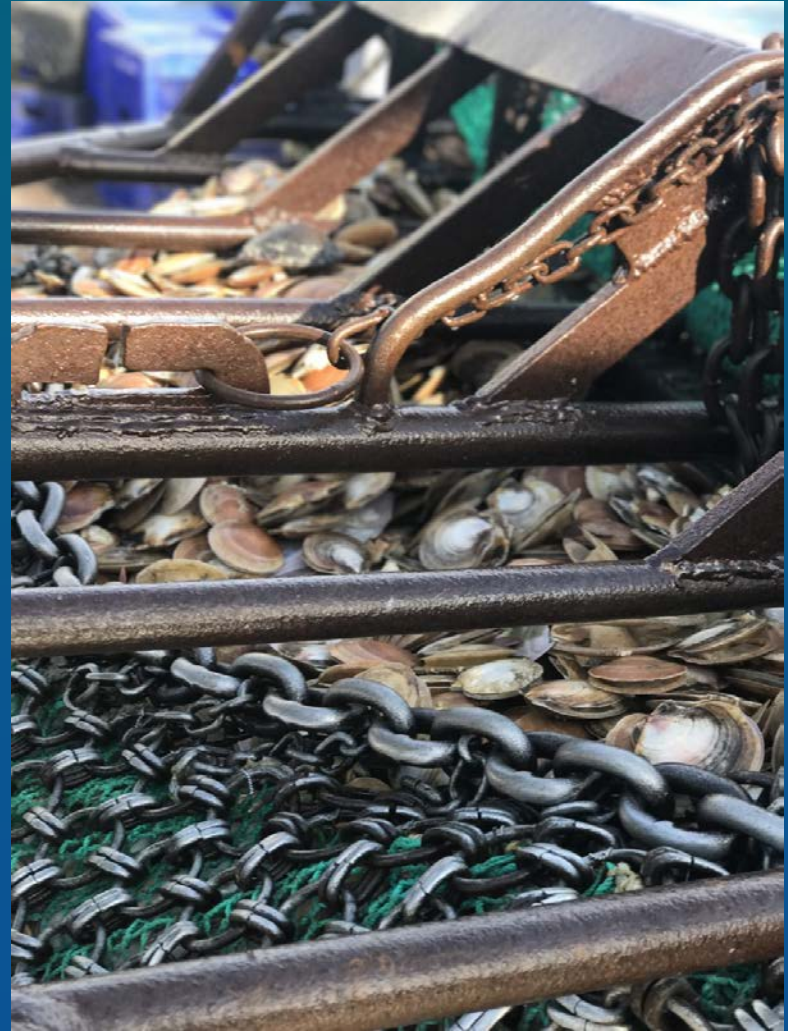
Potential for density dependence

- Can affect one or more vital rates (i.e. growth, survival, fecundity).

- Effect can get stronger as population grows and individuals compete for resources.

- Where is the threshold? It is likely complicated.

- NL-S and ET-Flex represent natural experiments
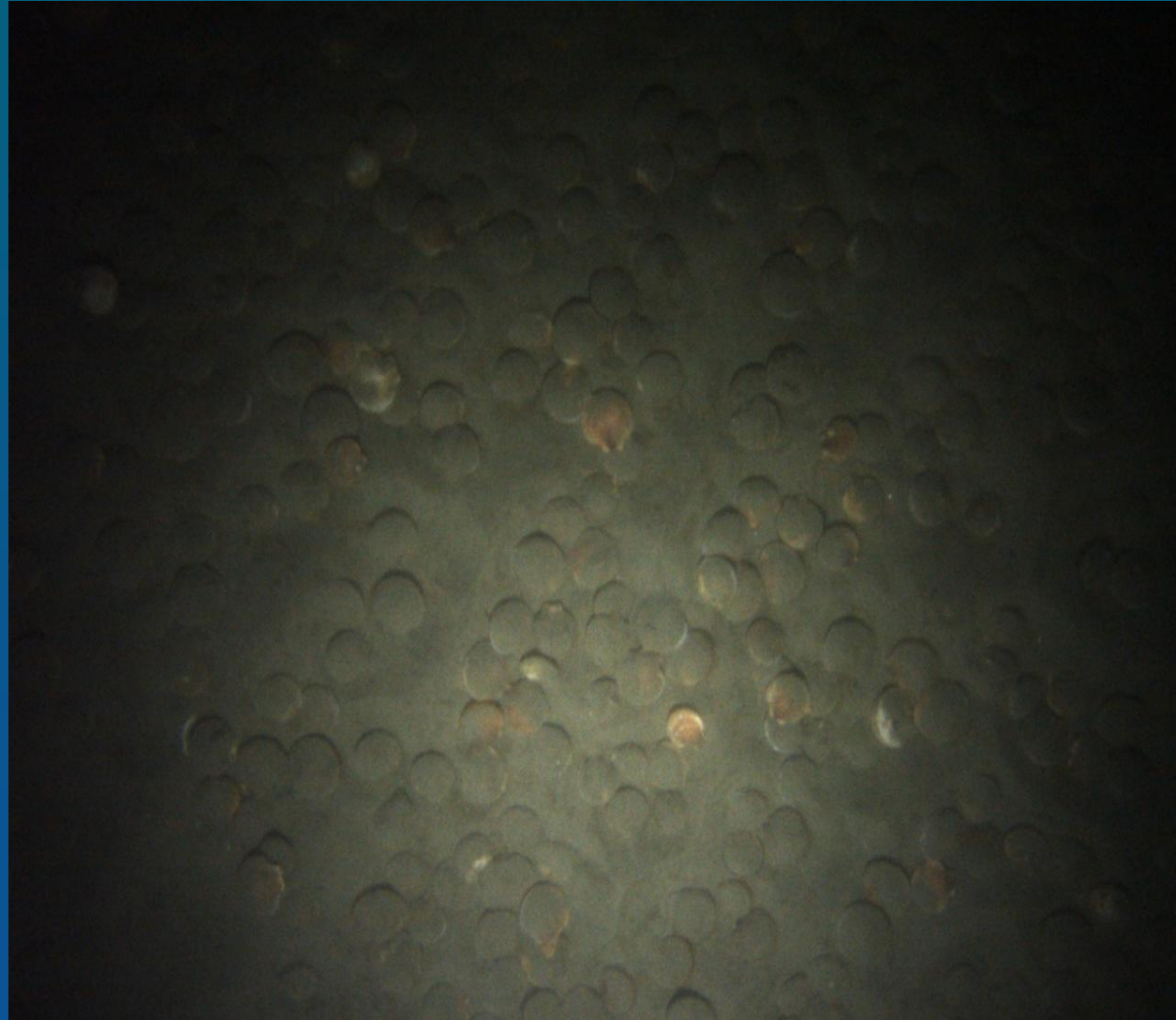
# Documenting the performance of scallops at high densities

- Follow a single cohort of scallops that settled at high densities in two very different habitats.
  - ET-Flex and NLS-South

- The study objective was to provide biological information for short term management decisions and also attempt to understand ecological processes that shape the small scale spatial characteristics of the sea scallop.

- Quarterly biological sampling across two years with an emphasis on growth, yield, reproduction
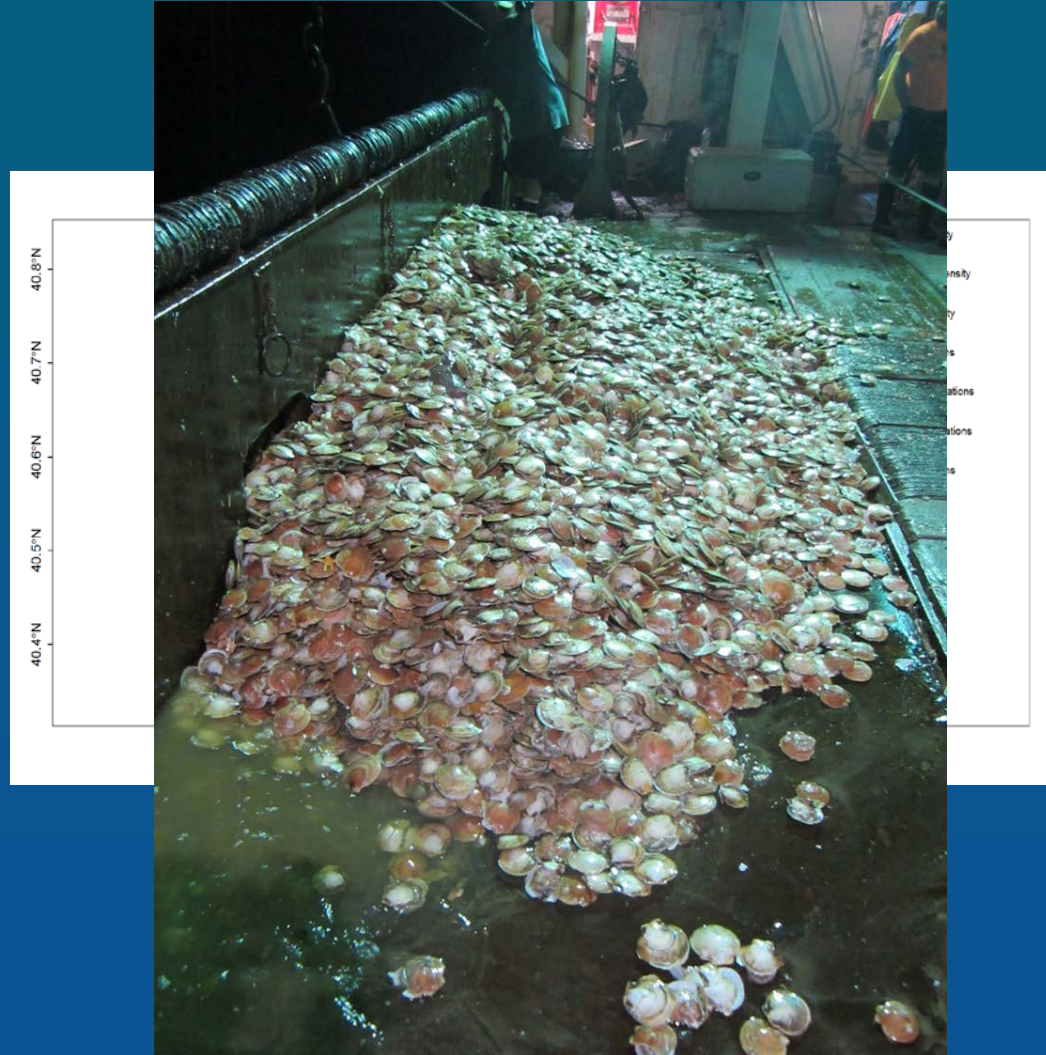
Characterizing growth in the NL-S
length frequency distributions

- For the NL in general, there is a large variation in the performance of this cohort across space.

- In the high density area where the majority of biomass is located, 7 YO scallops average 84 mm.

- YOY (July2018-May2019) growth of ~10 mm

- Reality is that there is a huge biomass (~35,ooo MT) of high count scallops (~50 MPP) with a finite scope of growth in marginal habitat.
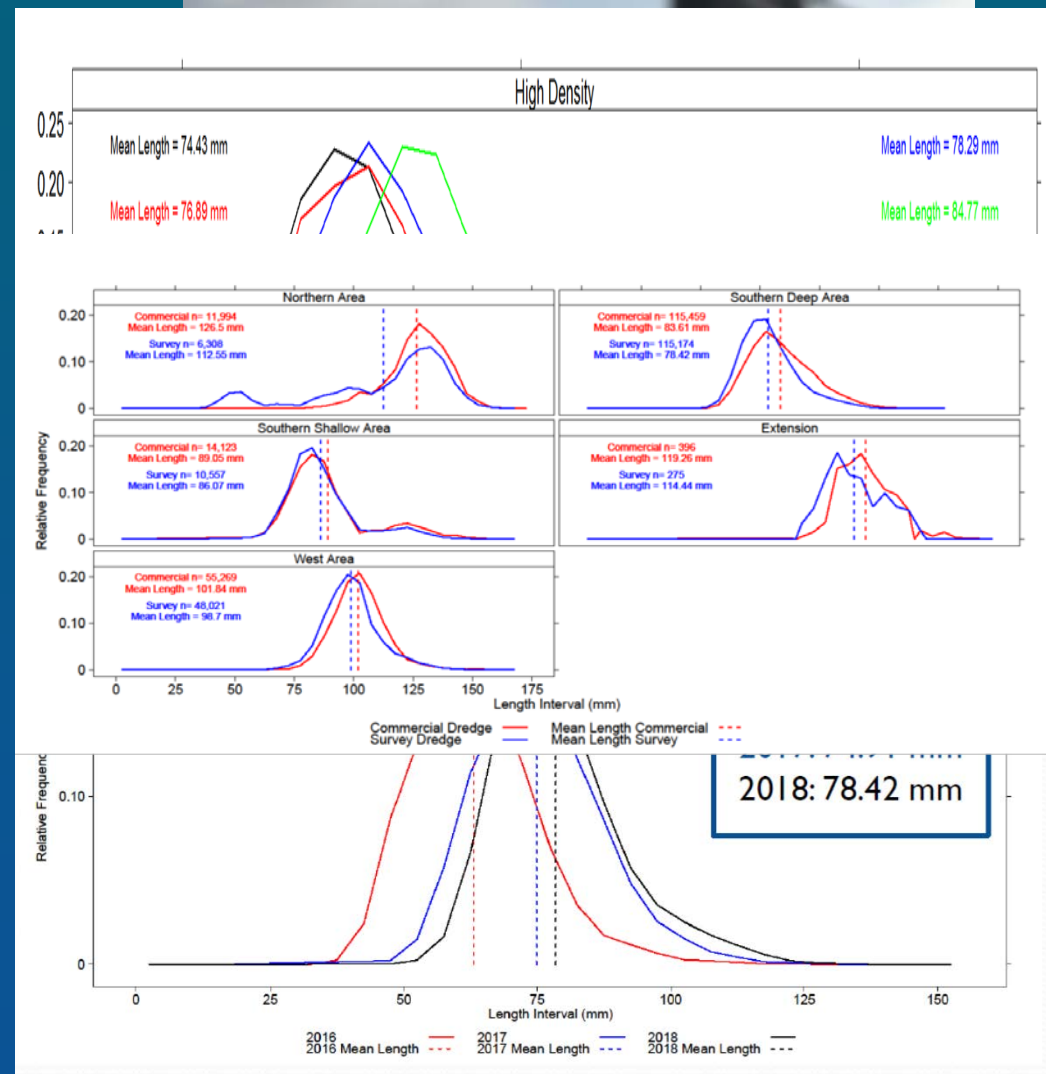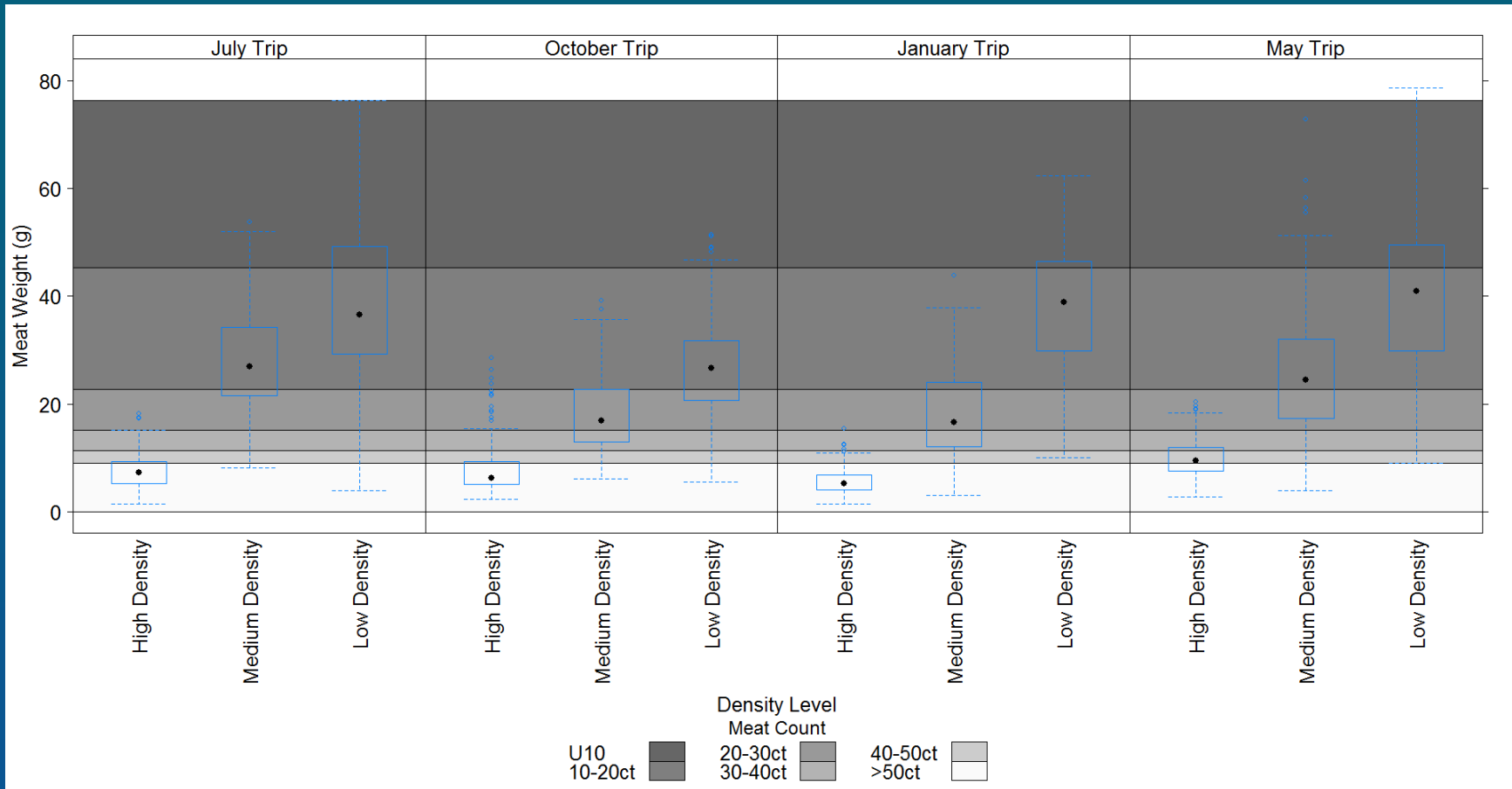
Characterizing growth in the NL-S
shell signatures
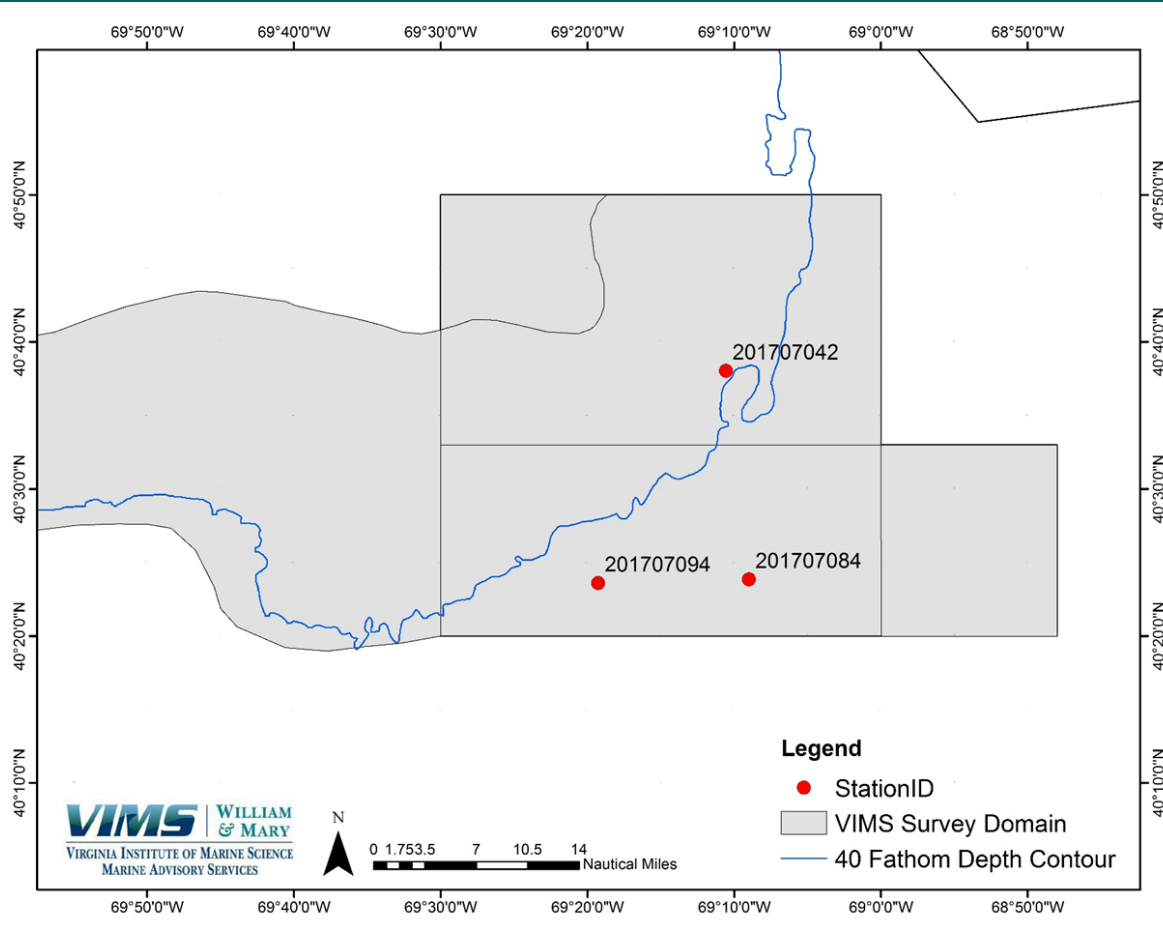
- Insight into growth from both LF and shell signatures.

- Additional shell samples (~25 stations) were collected during the 2017&18 NL dredge survey and quarterly sampling.

- Objective was to characterize growth across the range of abiotic and biological conditions present in the management area and understand what factors are important in explaining the observed variation.

- Results seem to suggest the potential influence of density, but other factors (i.e. depth, food availability) are also likely important.

42	0.46	151.25
84	0.37	101.1
94	0.42	81.37

Characterizing yield in the NL-S

- Yield is typically characterized by the relationship between shell height and meat weight.
- Actual yield is dependent upon the underlying size structure of the stock.

Characterizing reproduction in the NL-S

- Hypothesis: Dense aggregations of mature individual scallops may result in high levels of larval production.

- Conventional thinking suggests that gametogenesis occurs as a function of excess metabolic energy.

- Gamete production scales to this excess energy.

- Gonad weight measured, often though even in times of development inability to determine sex.

- Larval production is not a definite determinant of recruitment (e.g. transport, match/mismatch, predation…)

Additional considerations

- Observed densities in the NL-S region have been observed to be declining.
    - 2017: 9.70 per m^2
    - 2018: 5.50 per m^2
    - 2019: ?? Although quarterly sampling suggests further decline.

- Mean size in high density area is below L_{50} of commercial gear (~105 mm)

- Thin shell typical of deep water scallops, may be subject to higher levels of trauma associated with fishing.

- Meat quality appears good/excellent.

- No indication of widespread disease/parasites

Summary

- The data supports the hypothesis that the scallops in the NL-S are existing in a food limited environment with possible amplification of this effect as a function of density.

  - Growth – as of May 2019 the mean shell height was ~84 mm. That is roughly equivalent to a 3-4 year old animal. This cohort is 7 years old.

  - Yield – below expectation, with an average of 45-50 MPP as of May 2019.

  - Reproduction- limited gametogenesis has been observed, egg viability and actual contribution to the spawning stock is unknown.

  - Density - Survey results suggest that density in the area is dropping. Complete 2019 survey data on a comparable spatial scale will provide a more definitive observation.

- The mean shell height is currently below the L_{50} of the commercial dredge, indicating that scallops are likely to pass through the rings.

- Shells are thin, typical of deep water scallops suggesting a potentially higher risk of trauma as a function of interaction with fishing gear.

- Spatially, there exists a large biomass of animals (~35,000 MT) in a small area suggesting that operational issues may need to be addressed if access is considered.