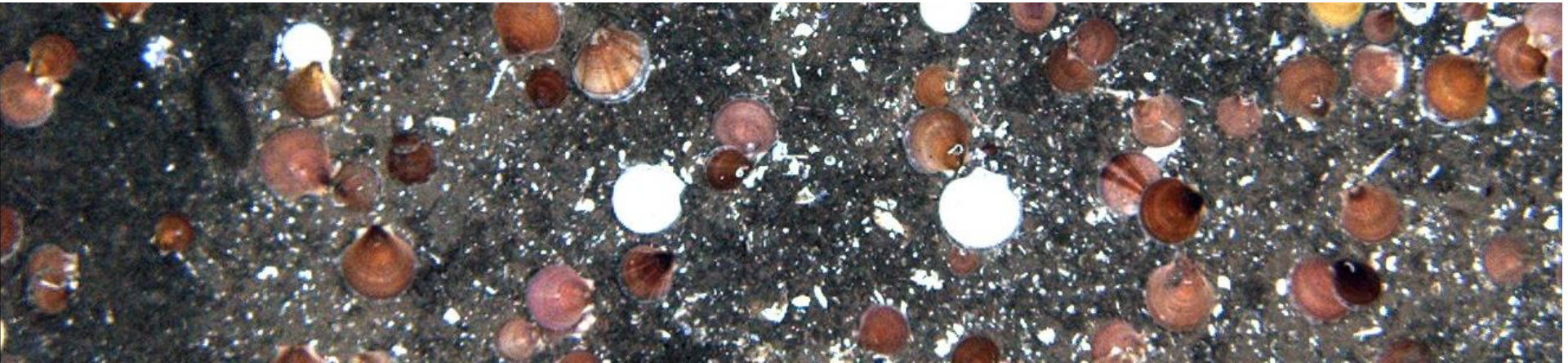
Overview of March 2015 Review of Sea Scallop Survey Methodologies Used in the Northeast

Paul Rago, NEFSC, NMFS

New England Fisheries Management Council

Newport, RI

June 18, 2015

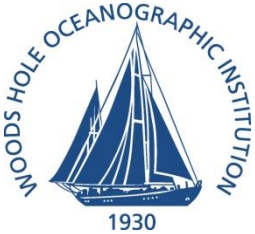


Background

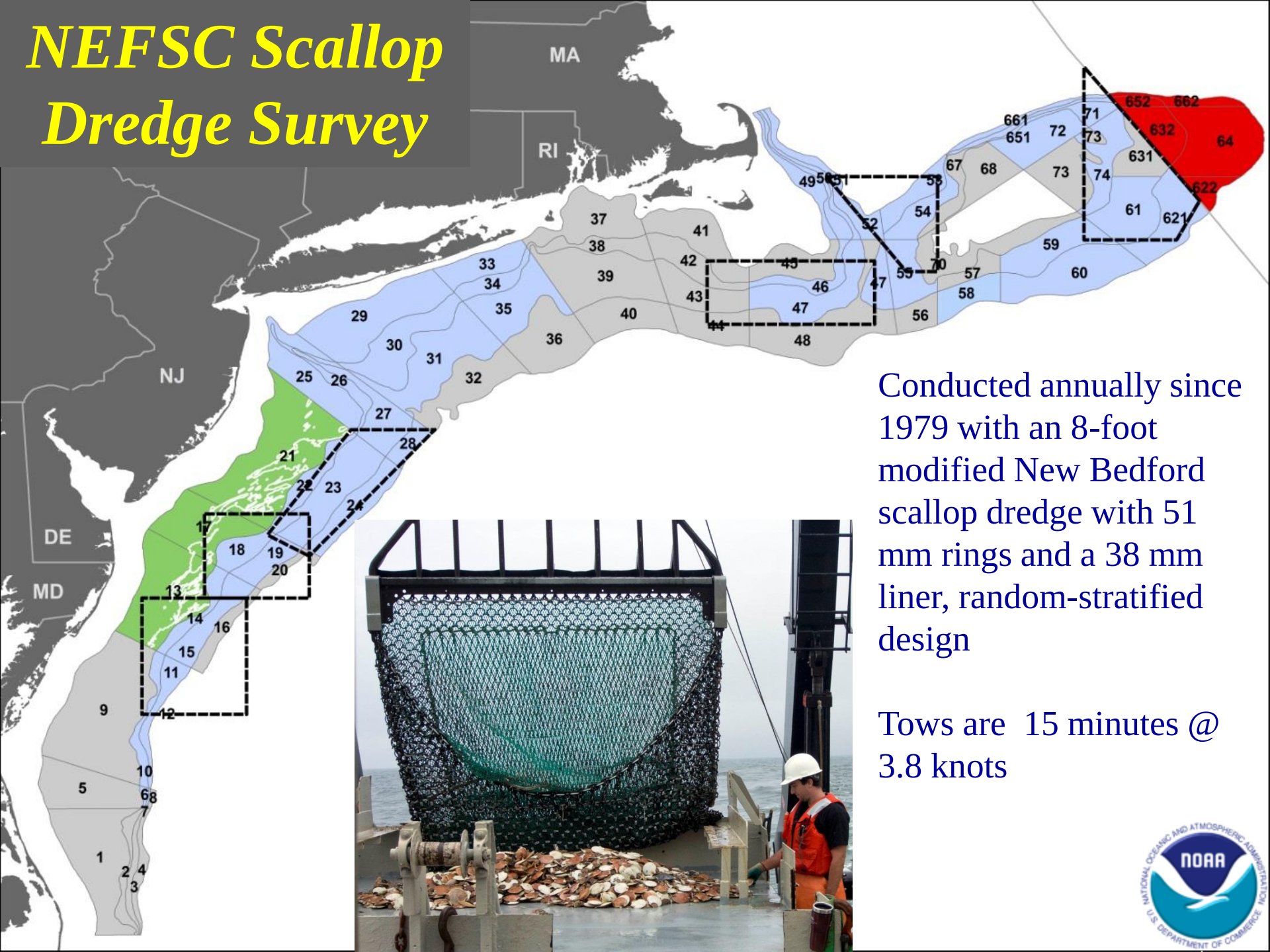
- One of most valuable fisheries in US
- Complex management system relying on combination of quotas, effort controls and spatial management
- Supported by multiple dedicated surveys and directed research efforts by academia, industry and government.
- Strong support for scientific management and investment in research and monitoring by industry.
- Review in response to Council request regarding use of new and existing technologies

Sampling Programs Reviewed

- Northeast Fisheries Science Center
- U. Mass Dartmouth, School of Marine Science and Technology
- Virginia Institute of Marine Science
- Woods Hole Oceanographic Institution
- Arnie's Fisheries



NEFSC Scallop Dredge Survey



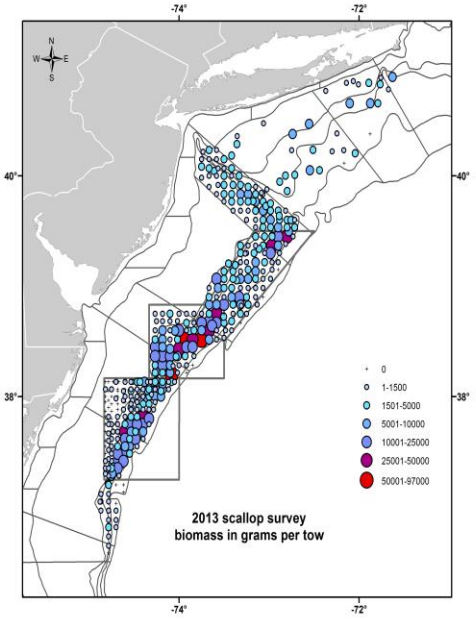
Conducted annually since 1979 with an 8-foot modified New Bedford scallop dredge with 51 mm rings and a 38 mm liner, random-stratified design

Tows are 15 minutes @ 3.8 knots

VIMS Dredge Surveys

VIMS | William & Mary
Virginia Institute of Marine Science
1940-2015 75 Years

- Conducted on Commercial Fishing vessels
- Use lined dredge identical to NEFSC survey dredge, and
- Commercial dredge side by side
- Dredges calibrated to R/V Albatross
- Grid surveys, intensive sampling effort
- Collaborative with Fishing Industry



SMAST Drop Camera Video Survey

--Pyramid with cameras is dropped 4 times per station

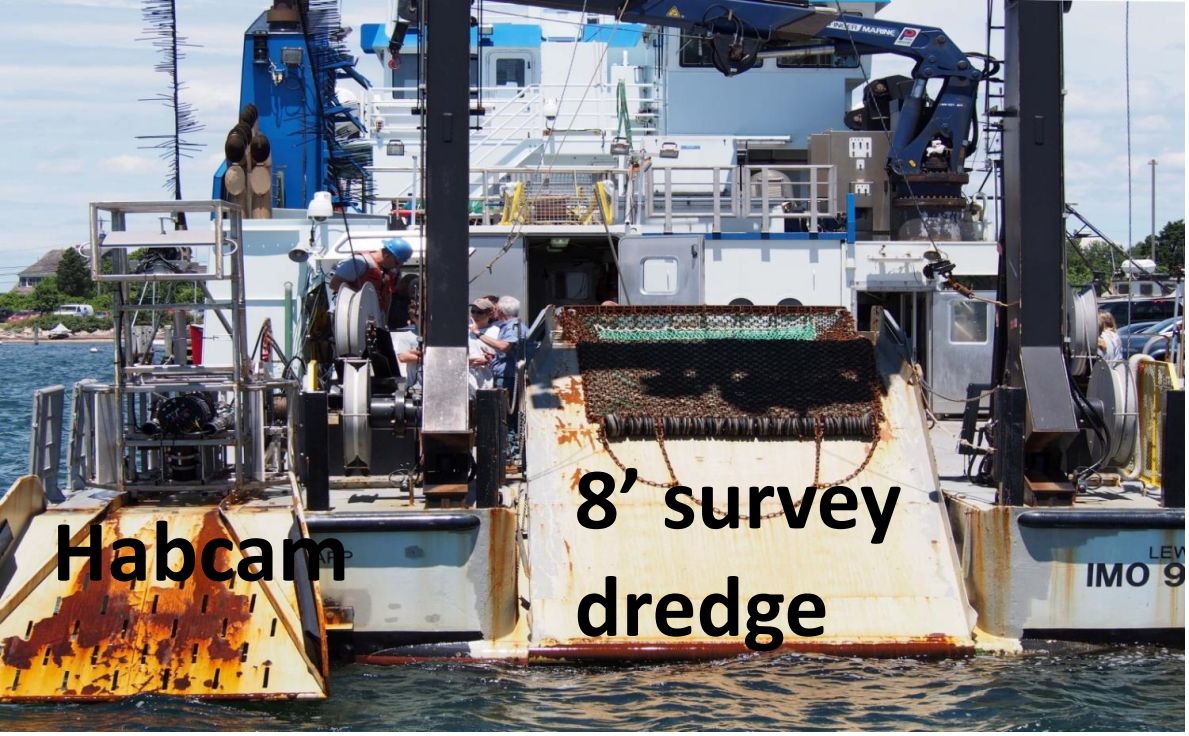
--Stations located on 3 nm^2 grid pattern, 2003-2014 time series

--Collaboration with industry

HabCam—Towed Camera System on Commercial Fishing Vessel

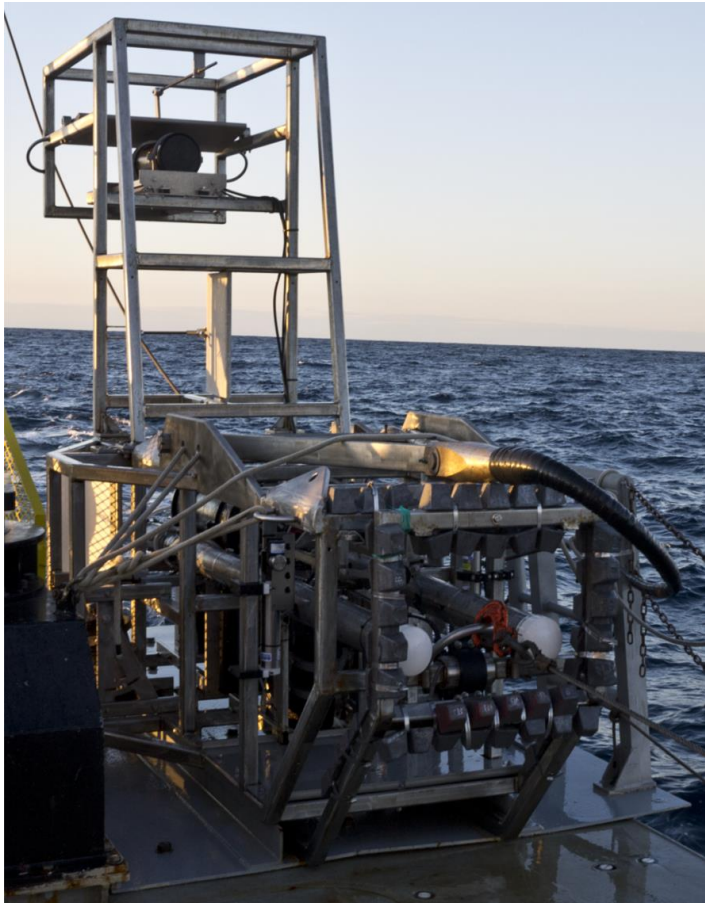
Developed by collaboration between scientists at the Woods Hole Oceanographic Institution and fishermen, especially Arnie's Fisheries

"V2" Habcam in operation since 2005, primarily deployed on the scalloper *F/V Kathy Marie,* but used on the *R/V Hugh Sharp in* 2011.



NOAA/NEFSC v4 Habcam system

In operation since 2012 on R/V Sharp



--Dual digital cameras for 3D images

--Sidescan sonar for examining sea bottom type

--Oceanographic instruments include CTD, chlorophyll, pH, DO sensors, water spectrometer, optical plankton recorder

HabCam
HABitat mapping CAMera system

WOODS HOLE OCEANOGRAPHIC INSTITUTION 1930

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

Meeting Details

- Presentations and materials provided by all survey groups (Arnie's Fisheries, NEFSC, SMAST, VIMS, and WHOI)
- Over 20 presentations – March 17-19
- 8 Terms of Reference
- In New Bedford
- About 50 people attended the meeting with 1-2 dozen participants online
- All documentation and reports available at

Review Panel

- **J.-J. Maguire (Chair, SSC Member)**
  - Stock assessment
- **Noel Cadigan, CIE Reviewer, Canada**
  - Survey design and analysis
  - Statistics
  - Stock assessment
- **Martin Cryer, CIE Reviewer, New Zealand**
  - Monitoring and assessments of invertebrates, esp. scallops
  - Image analysis
- **Jon Helge Volstad, CIE Reviewer, Norway**
  - Survey design
  - Fisheries monitoring
- **Brent Wise, CIE Reviewer, Australia**
  - Geostatistics
  - Fisheries assessments





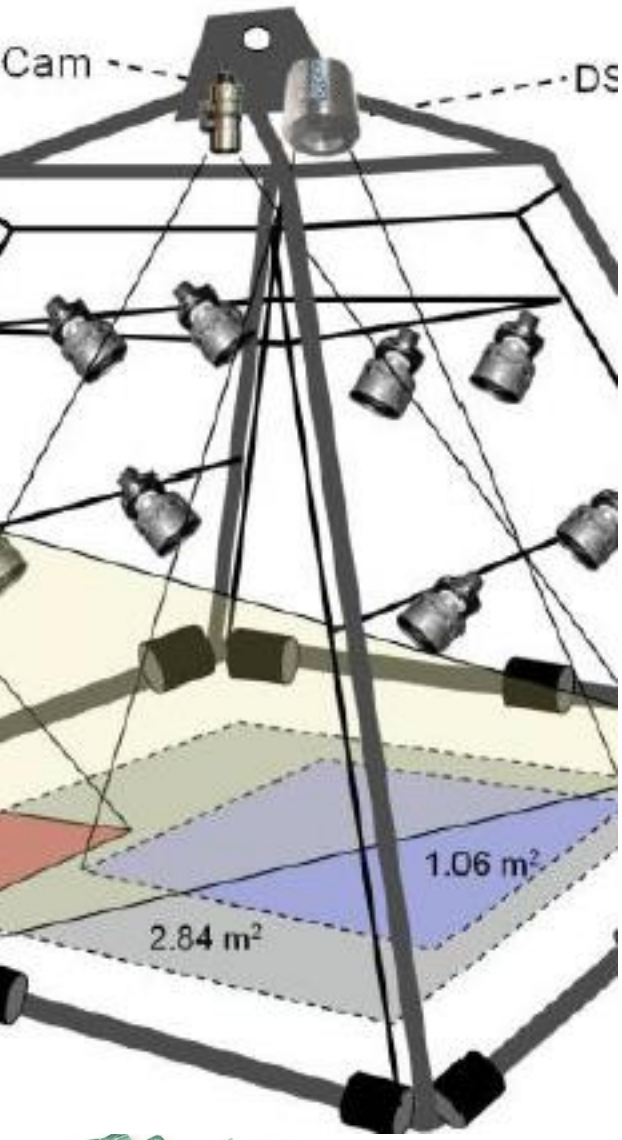
So what did the reviewers say?

- http://www.nefsc.noaa.gov/nefsc/saw/scallop-2015
- Summary Report with input on each Term of Reference
- Individual Reports from each Center for Independent Experts (CIE) reviewer

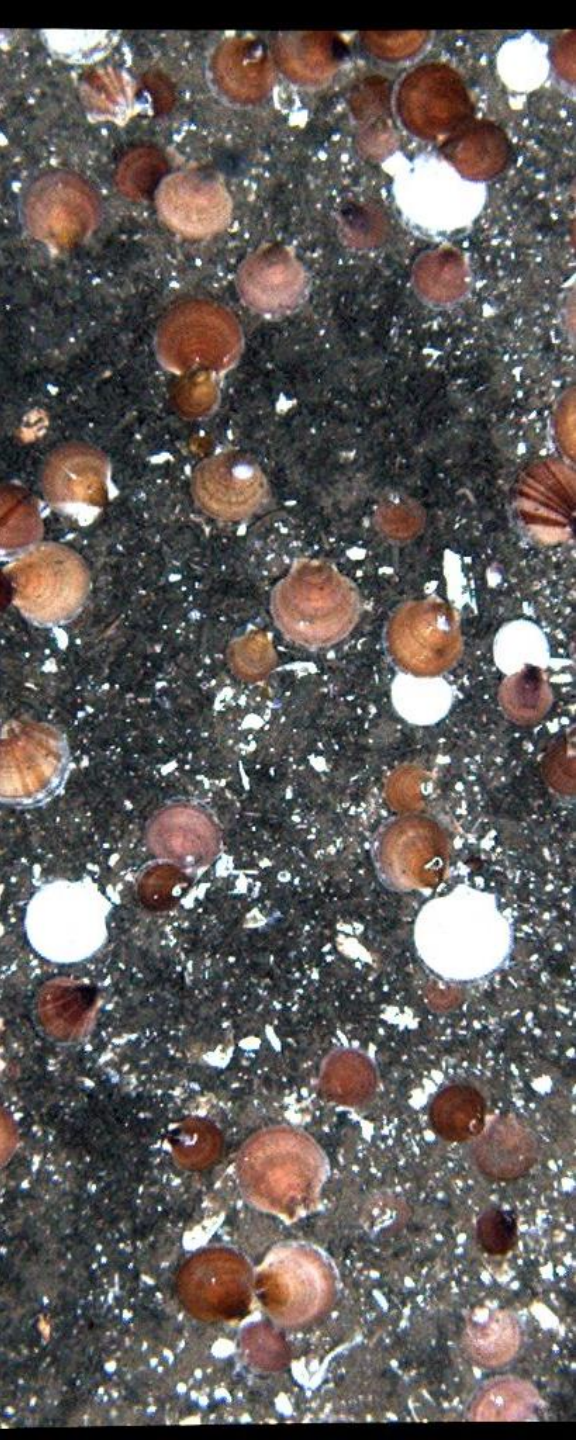
#1 Statistical Design and Data Collection

1. All provide unbiased estimates of mean abundance, but difficult to produce a design-unbiased estimator of the variance for grid design surveys.
2. Precision of grid sampling could be improved with higher sampling rates in areas of abundance and vice versa.
4. Federal Habcam has detailed info along transect, but distance between transects seems wide.
5. NEFSC dredge survey has been reduced over time; this introduces risk of estimates with lower precision and possible bias.
6. Federal survey is flexible and can take into account other surveys to achieve a comprehensive survey.
7. Gear types have been calibrated so results can be combined.

#2 Measurement Error



1. Dredge surveys provide more accurate measurements of shell height compared to optical surveys (both drop and towed cameras).
2. Optical surveys provide almost complete detection of exploitable scallops and better detection of recruitment compared to dredge surveys;
3. Paired Habcam/dredge tows used to estimate dredge efficiency – 40% on sand and 24% on gravel.
4. Edge effects of estimation are important to consider in optical surveys.
5. Differential detectability of scallops from drop camera, especially in corners, which probably leads to some negative bias.



#2 (cont.) Measurement error

6. Optical surveys would produce less reliable estimates of the proportion of dead scallops (false alive or dead) but magnitude was not quantified
7. Many confounding factors (optical distortion, attenuation, etc) for optical surveys and many of these have been addressed for both the drop and towed camera systems. The panel considered that the Habcam v4 imaging processing procedures are more advanced and encourages further research.

#3 Biological Sampling

- Samples from dredges are necessary for info on disease, grey meat, etc. Sources of natural mortality can greatly affect the efficacy of management plans, growth rates and potential yield.
- Suggested more investigation of subsampling procedures for dredge and HabCam surveys
- Optical surveys have higher detectability of scallops <20mm than dredge, but less accurate info on exploitable scallops.

#4 Estimation of Abundance

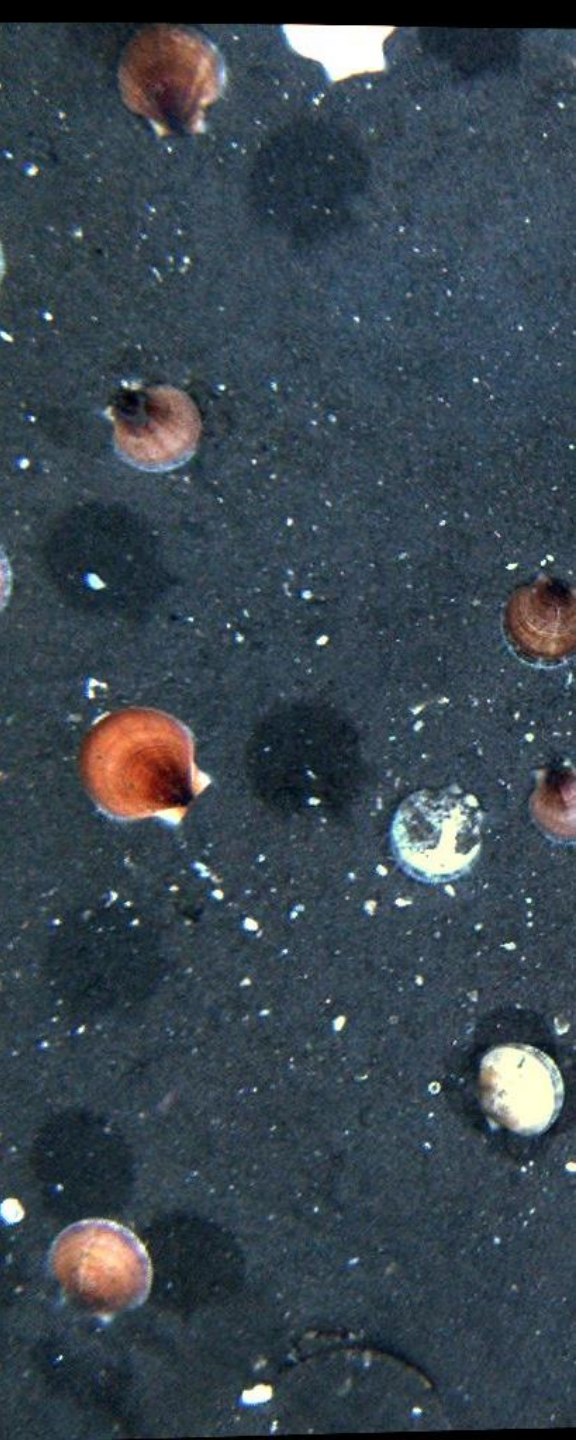
1. Commercial dredge –standard design-based methods used. Potential biases in efficiency estimates over time or space will affect accuracy. Variance estimate has issues and survey is exploring survey design changes.
2. Drop camera – method seemed appropriate subject to probable positive bias associated with edge effects correction and probable negative bias associated with detectability of 100% of scallops in image.
3. Both HabCam surveys use model-based methods (kriging and GAM with kriging) and a design based method (stratified mean) – all 3 tested through simulations but no single method consistently achieved low bias. Variance estimates are likely underestimated.
4. Model-based methods should be used with care.

#5 Using Surveys for Management

1. VIMS and NEFSC dredge survey results have been combined and this is appropriate because the same gear is being used; but caution urged since surveys are not at the same time.
2. Survey results are currently combined into one overall biomass estimate using two methods: straight average and inverse variance weighting.
    1. Combining surveys is appropriate only if the estimates are for the same area.
    2. Inverse variance weighting is reliable only if there are reliable estimates of variance.
    3. An analysis that combines all surveys in a single model using co-kriging was presented, but it is still a work in progress.
3. **Complementary surveys provide enhanced capabilities to achieve other objectives because no survey covers the complete stock area on a regular basis.**

#6 Use of Data for Non-Scallop Species and Other Purposes

1. All surveys have potential to contribute to other purposes; info is complementary or additive. Optical surveys have provided additional information on habitat, scallop ecology, and ecosystem studies.
2. All have provided information on changes in abundance of other species.
3. HabCam V4 has the greatest potential in providing info on habitat, gear impacts, species interactions and spatial structure on a continuously variable variety of scales.



TOR #7 Optimal Frequency and Combination of Survey Methods

1. Annual surveys are required to support the management process. Continuity of time series is important.
2. Important to detect and protect recruitment events and avoid under/ over harvest of stock components.
3. To some extent, surveys are integrated because they cooperate to address survey gaps and standardize dredge catch rates.
4. Optical and dredge surveys are complementary and both should be maintained and integrated.
5. Panel recommends that all info be used to devise an optimal and integrated statistical survey design involving use of complementary methods for estimating stock size, spatial distribution, and other primary objectives. May require simulation studies.

#8 Future Research and Areas of Collaboration

1. Investigate efficiency of using shorter dredge tow durations, examine correlation between dredge tow catches and HabCam observations, and use of model-assisted regression estimators
2. Panel found no compelling advantage in using both dredge and HabCam gears on the same vessel.
    1. A portion of dredge samples that overlap HabCam tracks are still required.
    2. Continuous sampling of HabCam is the best use of the technology (compared to taking the vehicle in and out of the water).
    3. A joint integrated survey using two vessels could result in a better survey with improved coverage.

Where do we go from here?

- Spatial management requires detailed surveys
- Each research group has many factors to consider
- Some changes have been implemented on surveys now underway in 2015
- Ability to implement changes depends on time, funds, and expertise.
- Leverage resources across programs.
- Can these findings be integrated into future research priorities for Research Set Aside programs?

Questions

And a special note of thanks to New England Fishery Management Council for their leadership and technical assistance for this Review!

New England Fishery Management Council

VIMS | William & Mary
Virginia Institute of Marine Science

Woods Hole Oceanographic Institution
1930

HabCam
Habitat mapping CAMera system

NOAA