New England Fishery Management Council
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MEETING SUMMARY

Research Steering Committee

Holiday Inn, Taunton, MA
October 22, 2015

The Research Steering Committee met on October 22, 2015 in Taunton, MA to: review two 2012 Scallop RSA reports and one 2012 Monkfish RSA report.

MEETING ATTENDANCE: Mark Alexander (Chairman), Vincent Balzano (Vice Chair), Ellen Goethel, Dr. Bill DuPaul, and Dr. Earl Meredith (absent: Terry Alexander, Gib Brogan, Dr. John Hoey, Mike Pol, and Elizabeth Etrie); Maria Jacob and Lou Goodreau (NEFMC Staff); and Ryan Silva (NMFS GARFO staff). In addition, approximately 6 members of the public attended.

KEY OUTCOMES:

- The Research Steering Committee recommends that a high priority be placed on additional integrated research that examines the factors associated with gray meats in sea scallops and may lead to the ability to predict the incidence and distribution of gray meat scallops. Such predictive ability could become an important aspect of rotational management in the scallop fishery. This research may also form the basis for the development of best practices in fishing that may limit the spread of the parasite that [may] cause gray meats in sea scallops.
- The RSC agrees that there is a need to enhance sampling of the sea scallop population to monitor scallop meat quality and marketability. That data needs to be used in the stock assessments and stock projections (factoring in localized depletion and higher natural and discard mortality), and addressing the implications of meat condition to [optimum] yield.
- The RSC supports additional research to further refine and substantiate the genetic stock structure of monkfish, particularly in the Mid-Atlantic.

AGENDA ITEM #1: REVIEW 2012 SCALLOP RSA PROJECT BY SMAST
***PRESENTATION: WHAT CAUSES GRAY MEAT IN THE ATLANTIC SEA SCALLOP IN GEORGES BANK CLOSED AREAS?* (SUSAN INGLIS AND DR. KEVIN STOKESBURY, SMAST)**

Ms. Inglis presented research results regarding gray meat in sea scallops on Georges Bank within Closed Area I (areas outside Essential Fish Habitat regions) and Closed Area II (southern region). Gray meats in scallops have a negative impact on the percentage of realized harvestable biomass due to poor meat quality and reduction in meat yield. Analysis of the shell height to meat weight ratio for normal-colored and gray meat scallops shows a lower meat yield in gray meat scallops. The research effort focused on identifying agents that may cause gray meats in sea

scallops based on observed correlation patterns, which include age, presence of disease, habitat association, and nutrition.

Samples collected from the yellowtail bycatch survey by Coonamessett Farm Foundation on Georges Bank (Closed Area I, Closed Area II, and Open Area) were analyzed for correlation between meat quality, shell height, and location. Results from Generalized Additive Models (GAMs) indicate the correlation between shell height and gray meat quality is 8.49% goodness of fit between the two variables). Although the GAM model showed a correlation, it is a weak one and it only improved slightly when location was included as a variable. The results also indicate that there is a correlation between shell height, location, and gray meat quality in the samples tested (13.7% goodness of fit between the three variables). Preliminary information indicates that there is no observed difference between gray and white meats on the reproductive staging (i.e. ripe, spawned). However there was a difference in gonad weight (GSI), where gray meat scallops have a lower GSI. Additional research is needed to show the effect on reproductive cycle for gray scallop meats compared to white scallop meats, because the sample size is relatively small. Analysis of Variance (ANOVA) indicate that there is a significant difference between meat yield for gray and white scallop meat in Closed Area I and Closed Area II.

Samples collected from survey work and commercial fishermen in Closed Area I and II were tested for muscle composition for protein, carbohydrate, lipid content, and moisture content. Analysis of muscle composition revealed that gray meat scallops had reduced percentages of carbohydrates, lipids, and protein in the meat, and an increase in moisture content compared to white meat scallops. In addition, gray meat scallops fall outside the range of normal scallop moisture content by FDA and USDA. In addition, observations show that Atlantic sea scallops have a newly identified genus and species of parasite (apicomplexan) in the muscle tissue of scallops in Canadian and U.S. waters on Georges Bank and the inshore Gulf of Maine region. The parasite is similar (based on DNA sequence analysis) to the parasite observed in three different sea scallop species located on Iceland, Scotland (west coast), and the Faroe Islands. The parasitic infection targets muscle tissue, and is observed in both white and gray meat scallops, with a larger percentage of infected gray meat scallops. The parasite intensity is slight and rare in scallops with white meat, with moderate intensity in scallops with brown meat, and high intensity of parasite infection in scallops with gray meat. Based on observations of infected muscle tissue, the muscle fibers become thinner over time, and eventually the muscle deteriorates and no longer has its structure. The parasite causes severe muscle necrosis which increases with increased parasite intensity. However, muscle necrosis is not observed in scallops with white meat, even if they have a slight infection of the parasite (i.e. there are no pathological changes observed).

Controlled laboratory studies are necessary to accurately characterize the effects from the parasitic infestation on meat quality. It is worth noting that the transmission of infection from the parasite to the host (sea scallop) is not yet understood, and would also need further research, because scallop fishermen process the shellfish at sea and handling techniques may affect the spread of the disease (i.e. discarding scallops with gray meats and the discarding of the scallop muscle tissue where the infection is found). Furthermore, stressors such as age and poor nutrition may increase susceptibility of scallops to parasitic infections. Current School for Marine Science

and Technology (SMAST) project is focused on nutrition as a stressor for gray and white meat scallops.

Committee Discussion

Ms. Inglis clarified that the brown meat scallops and gray meat scallops are infected by the same parasite (confirmed through DNA verification), and the brown meat scallops seem to be an intermediate phase for infected sea scallops. In addition, some of the gray meat and brown meat scallops were also infected with *Mycobacterium spp.* at the same time that the parasitic infection was present in the organism.
One Committee member asked whether ocean acidification and other environmental factors would have an effect on the prevalence of the infection. Ms. Inglis responded that the ocean warming and changes in pH would likely have an effect on the prevalence of the parasite, but the effect is unknown.

One Committee member asked whether the parasitic infection requires a stressor to become susceptible after exposure to the parasite or does the scallop automatically become infected. Ms. Inglis responded that the research hypothesis is that the animals are more susceptible if there is lack of nutrition that causes additional stress. Testing is needed to determine whether the parasite infecting the scallop requires some stressor, or if the infection just continues to increase in intensity over time. One committee member asked whether there was information to support the claim that areas with an overabundance of scallops have more gray meats. Ms. Inglis stated that anecdotal information from the fishing industry claim that recently opened areas have more gray meats due to overabundance of scallops in one area. If the gray meats are caused by the parasitic infection [report does not establish causation], and the parasitic infection is transferred from one host to another [not yet confirmed], then there could certainly be an increased quantity of gray meat scallops in recently closed areas that is caused by parasitic infection. A second RSA project by SMAST would investigate whether density of scallops in an area plays a role on infection rates. Dr. Stokesbury stated that exploitable biomass could be overestimated if discard rates increase due to poor meat quality from gray meat scallops.

One committee member stated that total biomass and exploitable biomass are used in the management approach to scallop allocations. The Scallop PDT has discussed effective biomass as another factor for consideration in management, which would account for the gray meats issue in the allocation process. Effective biomass may be an issue that scallop fishery managers have to address, and the optical surveys would not be able to capture these issues.

One committee member asked for clarification on the type of shell debris observed in the nearest neighbor analysis for habitat correlation to meat quality. Dr. Stokesbury responded that the shell debris was made up of many clam shells and some scallop shells, and is not necessarily related to shucking activity.

Dr. Stokesbury also indicated that documented large recruitments on Georges Bank show that biomass is likely four times larger than the current scallop biomass estimates. Therefore, there are important management implications if disease prevalence is higher in areas with higher

biomass. Ms. Inglis indicated that part of the Saltonstall-Kennedy grant work underway by SMAST involves a modeler to help predict the locations where these gray meats are found.

One commenter asked whether there were signs of the parasitic infestation in the Gulf of Maine, and Ms. Inglis confirmed that the parasite was also observed in scallop samples as far north as the Bay of Fundy, but the Gulf of Maine scallops with the parasite infestation had white meat (at low to slight intensity levels). One Committee member asked whether the shell damage from polycheate worms could have an effect on the likelihood that the scallop would be infected by the parasite. Dr. Stokesbury indicated that damage to the shell from the boring sponges (*Cliona vastifica*) could be secondary to an animal that has already been infected with the parasite, and in its weakened stage is unable to properly close its shell and is then taken over by sponge attaching to the shell. Ms. Inglis stated that the shell effect may reduce the overall fitness of the individual if increased stressors impact the animal's ability to fight infection, or contain the parasitic infection and then the parasite causes pathological changes in the muscle tissue that is symptomatic of gray meat.

One Committee member raised concern that the management issue is self-perpetuating if fishermen avoid areas with a high prevalence of gray meats, and areas with gray meats are caused by an overabundance of scallop. Ms. Inglis indicated that the prevalence of gray scallops in previously closed areas are episodic in nature, based on preliminary results. Dr. Stokesbury indicated that another consideration is how long should management areas be closed [for scallop harvesting]. For example, the Closed Area II Essential Fish Habitat (Northern Edge) has been closed for 20 years, and research focused on the gray meats issue in that particular areas would be very informative to consider the proper rotational management system if the area is reopened under Omnibus Habitat Amendment 2.

One commenter raised concern that the Gulf of Maine scallops with the parasitic infection were white, not gray, and asked whether these scallops would progress to another stage (i.e. gray meats). Ms. Inglis indicated that follow up research must address that concern, to determine if the scallops require a stressor to become affected by the parasitic infestation.

One Commenter asked whether a study could address best practices for scallop shucking and throwing discarded scallops and scallop parts overboard, to avoid the spread of the disease.

One Commenter asked whether research on the correlation between plankton density and the location of gray meat scallops existed. Ms. Inglis indicated that this is one of the variables being investigated under their current SMAST research work.

1. **Consensus Statement: The Research Steering Committee recommends that a high priority be placed on additional integrated research that examines the factors associated with gray meats in sea scallops and may lead to the ability to predict the incidence and distribution of gray meat scallops. Such predictive ability could become an important aspect of rotational management in the scallop fishery. This research may also form the basis for the development of best practices in fishing that may limit the spread of the parasite that [may] cause gray meats in sea scallops.**

Public Comment:

Ron Smolowitz (Coonamessett Farm Foundation): Agrees that the research needs further development, particularly research on diseases that are subject to positive density dependence of the host species. The Habitat Area of Particular Concern (HAPC) is an important area for this type of research to study the spread of the disease, similar to the Closed Area I which remained closed for three to four years longer than typical rotational management areas. The RSC should recommend that research projects in the habitat closed areas is critical for maximizing the productivity of the fishery. Currently, researchers are not allowed to sample within the Northern Edge HAPC (Closed Area II Essential Fish Habitat). Increased emphasis on the optical surveys mean there are less samples collected from surveys. Researchers need increased dredge tows to collect these samples. There should be enough samples collected to address the gray meats issue.

***AGENDA ITEM #2: REVIEW 2012 MONKFISH RSA PROJECT BY CORNELL UNIVERSITY PRESENTATION: COASTWIDE STOCK STRUCTURE OF MONKFISH MICROSATELLITE DNA ANALYSIS* (DR. WIRGIN (NEW YORK UNIVERSITY) AND EMERSON HASBROUCK (CORNELL UNIVERSITY)**
Dr. Wirgin (New York University) has been doing genetic research for 25 years, and is currently doing research on Atlantic Sturgeon to identify ancestry of these fish. Has also done molecular work with toxicity of environmental stressors, and works almost exclusively with fish.

Since its inception, the Monkfish fishery has been managed as two distinct stocks. The stock delineation currently in place is based on the temporal recruitment patterns from survey information. Researchers are testing the hypotheses that the monkfish stock is only one stock throughout its range, or that monkfish is made up of two or more stocks throughout its range. To test the hypotheses, the researchers collected biological samples from the tail fin of monkfish from fishing vessels, research institutes, and dockside samples, for a total of 1,572 samples collected between April 2012 and May 2013. Within the management area boundaries, the sampling strata is divided by inshore/offshore components and by latitude.

Microsatellite DNA analysis was used to distinguish populations for monkfish, using genotype differences to differentiate between stocks. Microsatellite DNA analysis produces hyper-variability in the DNA sequence, which provides the raw material for analysis. This study was not able to test whether the differences in genotype would remain stable over time; that would require additional research. The researchers first developed the DNA markers for monkfish in order to conduct microsatellite DNA analysis. The DNA markers were tested to confirm that the results from the study would be reproducible, and that the variations in DNA markers would be noticeable. Polymerase chain reaction of DNA was used to identify the 13 microsatellite loci that would be used for 1,329 specimens collected. To identify population structure, F statistics and the Exact Test were used to compare frequencies of microsatellite genotypes among the 19 different locales. Among all of the samples, 228 different types of genotypes were identified. For cases where a particular locus has a large number of alleles, comparisons among specimens can determine if there are reproduction variations at these particular loci. Sample sizes were sufficient for the majority of the 19 collection locales, but were much lower (i.e. less than 50 samples per locale) for four of the offshore sites in the southern-most extent of the range (i.e. offshore areas east of the Carolina states).

The results of the Pairwise Exact Test and the Structure analysis show that there are two or three genetically defined clusters among all the samples that were analyzed. Strata 3D southern NJ to northern MD) has a significant break in the allelic frequency significant break compared to the areas to the north of 3D (Delaware Bay area). In addition, there is also an allelic frequency break in strata 6A/6B (Virginia to North Carolina). The observed differences in population structure indicate that the actual stock delineation based on genetic variations does not match the current stock structure used in management and assessment. Future research should look at the temporal stability of the genetic variations identified in this study.

Committee Discussion:

One Committee member asked whether there are physical barriers that could be creating the delineation of the stock, and whether the conclusions from the study make sense from an ecological viewpoint. Dr. Wirgin stated that there is reproductive isolation between groups that exhibit genetic variability in the study. It could be geographic barriers or a timing barrier that causes these genetic variations. Although these genetic differences among marine species are not dramatic, they are important. There are greater genetic differences within marine species than previously thought. Examples include cod spawning in the spring at Ipswich Bay versus the cod that spawn in the winter at Ipswich Bay. One Committee member asked whether the data from tagging studies would help inform the study's hypotheses. Dr. Wirgin responded that if a monkfish is tagged and it migrates a lot, a researcher cannot be sure that they are spawning where they have been tagged. For example, tagging sub-adult Atlantic sturgeon, a researcher cannot identify population structure if the animal was not spawning at that location where the animal was tagged. It is important to test that the diagnostic genotype differences remain stable over time.

One Committee member asked how often genotype differences would translate to phenotype differences that would have management implications. Dr. Wirgin stated that the microsatellite DNA results are based on neutral DNA markers, and does not have any function for identifying phenotype differences; it looks at the history for the population. There are significant phenotypic differences that correspond with the microsatellite differences, but research efforts would have to focus on those particular loci to analyze phenotype differences.

One Committee member stated that the Northeast Fisheries Science Center found increased abundance of black fin monkfish in several survey strata (i.e. strata 11 and southern strata) in recent years, and during the period that this study was conducted. Therefore, some of the genotypic differences may have been due to the occurrence of black fin monkfish species in the samples from that area. Therefore, DNA analysis should be done to determine if some of the fish sampled were black fin monkfish. Dr. Wirgin stated that he would need to use a reference of 10 to 20 DNA samples of black fin monkfish to compare to the samples used in the study. In his experience, species within a same genus would have substantial differences in genotypes. It would be good to address these concerns, but it likely would not have an effect on the overall results, unless there are hybrids of the two species. Mr. Hasbrouck indicated that the researchers can certainly look at that concern going forward if there is additional funding to address these concerns. Regarding the sampling of the monkfish in future RSA program funding opportunities, researchers plan to address the issue by taking mitochondrial DNA analysis and comparing the

two samples (monkfish and black fin monkfish). It would be more important to focus research in the southern extent of the range, and collect samples to delineate the locations where the species exist.

2. **Consensus Statement: The RSC supports additional research to further refine and substantiate the genetic stock structure of monkfish, particularly in the Mid-Atlantic.**

AGENDA ITEM #3: REVIEW 2012 SCALLOP RSA PROJECT BY VIMS
***PRESENTATION: AN INVENTORY OF THE SEA SCALLOP RESOURCE IN THE GEORGES BANK CLOSED AREA II AND SURROUNDS,* DAVID RUDDERS (*VIRGINIA INSTITUTE OF MARINE SCIENCE*)**
Mr. Rudders focused his presentation on the research results for biological sampling conducted during the scallop survey work in Closed Area II and its adjacent area, with more fine scale observations for the northeast Georges Bank area. The Omnibus Habitat Amendment 2 action helped guide the research areas studied, which included the Northern Edge HAPC. The biomass information in the report is outdated, because scallop abundance can vary substantially between years (the data was collected in 2012). In addition to collecting information on shell height and meat weight, researchers also characterized product quality of sea scallops, and observations of nematode infestation and Conchlion blisters.

Results show spatially explicit estimates of the marketability of the scallops in the HAPC. Observation of meats from the Northern Edge HAPC were in the tan in color, "stringy" meat, and many samples were biologically fouled mainly from barnacles. The shell height to meat weight ratio for these scallops indicate poor quality due to reduced meat weight. Within the HAPC, approximately 50 percent of the scallops were marketable, on average. The cause for such a low number of marketable scallops is not known, but there is research underway to investigate causative agent(s) for poor-quality scallop meat (i.e. nematode issue), and examine the adverse impact on scallops from these agents. Additional sampling protocols would characterize the prevalence of the nematode in the Nantucket Lightship Closed Area, Delmarva Area, Elephant trunk Area.

Regarding effective biomass, it is important to know what percentage of the biomass is not marketable, and adjust fishing effort measures accordingly. The information could be used to inform management advice on the appropriate allocations for scallop based on marketability information. The 2010 scallop survey in Closed Area I showed larger, older animals with poor meat quality in the area. The PDT is aware of the issue of high discard rates in Closed Area I from unmarketable meats. However, additional sampling is needed, because sampling effort varies by area the processes (i.e. what is causing the low marketability in these areas) are dynamic and not well understood.

Committee Discussion:

One committee member asked whether managers would have to assume a much higher estimate of discard mortality based on this information. Mr. Rudders responded that in order to maintain a certain level of harvest with the nematode and other parasites affecting meat product quality and yield, the discard mortality would be greater to achieve the appropriate harvestable biomass

estimates. Fishermen avoid the areas where meat quality is lower. Therefore, Delmarva area may not be favorable for harvest due to the high number of discarding in that area. Mr. Rudders confirmed that this issue could lead to redistribution of effort and localized depletion due to high discard rates. Mr. Rudders confirmed that the SAMS model was used to set limits, and there is effort underway to identify ways to include the information into the harvest projection models.

Public Comment:

Ron Smolowitz (Coonamassett Farm Foundation): At higher biomass levels, the marketing condition for disease and parasites is becoming a larger issue. This is why the dredge surveys are important. In Closed Area I, the issue was not due to rotational access; rather a delay in rotational access for that area. If there was similar finer scale information on the nematode issue for Delmarva, managers and researchers would know that the resource was in worse condition than anticipated. Managers need finer scale study information to address the issue, so it is important to maintain biological sampling within these areas. In addition, gray meat scallops do not contribute (most likely) to the spawning stock biomass. Researchers must look at a natural mortality on a finer scale to inform management on appropriate harvest levels for the following year.

Committee Discussion:

One committee member stated that we need to enhance our sampling of the scallop population to monitor the scallop meats issue; that data needs to be used in the survey information (i.e. localized depletion and higher discard mortality, and the information should address [optimum] yield due to meat condition).

3. **Consensus Statement: The RSC agrees that there is a need to enhance sampling of the sea scallop population to monitor scallop meat quality and marketability. That data needs to be used in the stock assessments and stock projections (factoring in localized depletion and higher natural and discard mortality), and addressing the implications of meat condition to [optimum] yield.**

AGENDA ITEM #4: REVIEW NOAA COOPERATIVE RESEARCH AND COOPERATIVE MANAGEMENT WHITE PAPER
PRESENTATION: OVERVIEW OF COOPERATIVE RESEARCH DISCUSSION OF WHITE PAPER (STAFF)

Ms. Jacob presented information on the white paper discussion regarding cooperative research, and highlighted aspects of the white paper that pertain to the RSC role and responsibilities.

The Committee discussed ways to address major concerns with data analysis before researchers present at meetings. One committee member suggested that when the report and the reviews come to the RSC, we determine whether or not the review is sufficient via a conference call prior to the meeting, and propose to have the presentation take place after we determine that the technical review is robust. Several committee members supported this procedure. Other Committee members and the public were in support of joint meetings with the appropriate Advisory Panel and Committee members with the RSC.

Public Comment:

Ron Smolowitz (Coonamassett Farm Foundation) stated that fishery-dependent catch data must be made reliable and fed into management.

Committee Discussion:

Committee members agreed that they will explore the question – "how does this information feed into the management process?" Council staff will provide the Committee with a cover letter that specifies the management priority identified in the project proposal (to be obtained from GARFO cooperative research program staff).

Committee members generally agreed that the principal investigator of a research proposal needs to be more informed on RSC expectations for presentation at meetings at the time that the request for proposals is published.

One committee member stated the committee should consider the types of cooperative research that could be valuable for recreational projects. There are a lot of research topics (habitat, marine mammal, barotrauma) that use recreational fishermen to conduct research.

The Research Steering Committee meeting adjourned at approximately 5:00 p.m.