New England Fishery Management Council
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MEETING SUMMARY

Habitat Plan Development Team

September 18, 2018
Waypoint Events Center, New Bedford, MA

The Habitat PDT met to discuss the Clam Dredge Framework, which considers hydraulic clam dredge access to the Great South Channel Habitat Management Area (HMA), and other business. To start the meeting, Ms. Bachman reviewed the agenda, inviting members of the clam dredge industry and other interested parties to participate in the discussion.

Meeting attendance

PDT members included Michelle Bachman (Chair), Geret DePiper, Julia Livermore (webinar), Doug Potts, David Stevenson, Peter Auster, Marianne Ferguson, and Kathryn Ford. Chris Quartararo (Council staff), Alison Verkade (GARFO Habitat Conservation Division), and Eric Powell (University of Southern Mississippi and Science Center for Marine Fisheries) also participated in the meeting.

Audience members included Eric Heupel, Chad Brayton, W.T. Sherman Butler, Louis Legace, Allen Rencurrel, Chris Shriver, Monte Rome, Domenic Santoro, Scott Lang, Catherine Kramer, John Verissimo, David Borden, David Wallace, Kevin Stokesbury, Geoff Cowles, David Frulla, Adam Silkes. Bill Silkes listened to the meeting via webinar.

Discuss proposals received from fishing industry for the clam dredge framework

Ms. Bachman reviewed the proposals provided for clam and mussel dredge exemption areas. These were discussed at the Habitat Committee meeting on August 28, 2018. At their meeting, the Committee requested analysis of specific areas and criteria. For the clam exemption areas, the Committee received a recommendation from a group of six clam companies, coordinated by Daniel Cohen. They recommended nine areas based on locations of fishing activity (2010-2018 vessel monitoring system polls filtered for speed and summarized on a fine scale grid). Combined, the nine areas encompass approximately 90% of the hours fished in the HMA. The Committee recommended analysis of five of these areas (Rose and Crown, McBlair, A, B, and D) with respect to past fishing effort, age distribution of clams, and adverse effects minimization, per the underlying goal of the Omnibus Habitat Amendment (OHA2). The Committee asked the PDT to develop a rotational management framework, with areas closed for a rotational period of at least 7 years. The Committee recommended eliminating four of the areas proposed by industry due to concerns about overlap with cod spawning areas. After the Committee meeting but before

the PDT meeting, the proponents responded with a recommendation that these four areas be open seasonally but closed for six months beginning October 1 and reopening April 1. This letter also expressed concerns about the area rotation concept, and the proponents suggested that rotational management NOT be used. Some of the rationale provided echoed comments made by the PDT in the spring (lack of fine-scale data on clam biomass, among other concerns).

A second clam exemption area recommendation was provided by another set of clam industry members. This proposal included a larger western area that would be open year-round, every year, three smaller areas that would be closed long term, and two other larger sections of the HMA that would rotate. The Committee liked the rotational concept but did not favor the area boundaries from this proposal.

Peter Auster asked how the Committee came up with a seven-year minimum. Ms. Bachman noted that the PDT had previously said that a timeframe of at least five years would likely be required for habitat recovery, but that the PDT had noted this recommendation was uncertain. Ms. Verkade commented that the Committee modified their recommendation to be a minimum of seven years. The specific rationale for seven years was not clear, but it was longer than the five years previously discussed by the PDT. Ms. Bachman commented that if the PDT had a specific rationale for some period less than seven years that she felt the PDT could recommend a shorter interval.

Eric Powell commented that a five-year rotational interval doesn't make biological sense from a surfclam optimization perspective – you pay more in mortality than you gain in yield. A PDT member responded that the Committee indicated the purpose of rotation in this context was to promote habitat recovery, not to optimize surfclam yield.

David Stevenson remembered a previous meeting when this was discussed; was not a substantial discussion at the time. Ms. Bachman suggested that we should develop a concept for how we would determine a time frame. Dr. Auster noted that in the Grabowski et al paper on the SASI vulnerability assessment, the longest recovery interval was 5-10 years, so 5 is the lower bound from that analysis. Dr. Stevenson noted that other thing to bear in mind is that NMFS is open to considering a rotational management framework. Ms. Bachman agreed, and said that this seems to be why the Committee was open to developing the concept.

In terms of mussel dredge exemptions, Ms. Bachman explained that the first ask from Domenic Santoro earlier in summer was for an EFP to determine where mussel beds occur within the habitat management area. A separate recommendation from Mr. Santoro was for a specific mussel dredge exemption area to be included in the framework. This area is located along the western edge of the habitat management area, looking at known beds, stations in clam surveys with large mussel catches, and areas with fewer stations with complex habitat showing up. Committee declined to ask the PDT to move forward with analysis of that area. She noted the Council could take this up on September 27. She suggested that while she didn't think it was time to stop thinking about the issue of mussel exemptions, given the Committee's direction, today's meeting should focus on clams.

Alison Verkade questioned whether we have data for that area to evaluate occurrence of complex habitat. Ms. Bachman agreed that drop camera stations exist within the proposed area but data

are somewhat limited. In addition, the idea of the proposal was to avoid complex habitat in some of the known beds further to the east by focusing on the western edge. Mr. Santoro noted that this proposal overlaps the area fished historically, and the alternative originally suggested by the Committee (Northwest Quadrant of HMA). He commented that he withdrew his EFP proposal because the purpose was to help the Council in the process, but if the desire is to have any mussel exemption only within areas were surfclam dredging occurs, then not sure what the purpose of an EFP would be. Doug Potts asked if Domenic was harvesting blue mussels exclusively, or horse mussels. He confirmed blue mussels. Dr. Powell noted that they caught a few horse mussels during their survey but not in any abundance.

John Verissimo commented that he worked for Blue Gold, and supported Domenic's request for an exemption. What he hears a lot is that they are looking at the mussel fishery as a new fishery, but it is not a new fishery, and it provided jobs, seafood, etc. from this area previously. Ms. Bachman agreed that her read on the situation was similar to John's, that the Committee was viewing the surfclam and mussel fisheries differently, the former as a current fishery and the latter as an historical fishery. Adam Silkes from American Mussel noted that they buy all of Domenic's mussels, and in early 2018 talked about building expansion and equipment purchases to be ready to accept mussels from Nantucket Shoals. However, this week they are actually laying off production staff.

Ms. Bachman also acknowledged the collaboration between the surfclam fishery and NOAA Office of Law Enforcement to implement 5-minute pinging for VMS.

Since there were no further questions, she turned the meeting over to Dr. Powell to give his presentation on age and growth of surfclams. She wanted to the PDT to understand how his data might play into a rotational program, including how surfclam distribution patterns might affect shifts in effort over time.

Presentation on age and growth of surfclams in the GSC HMA

Dr. Powell presented recent work on age and growth of surfclams caught during an August 2017 dredge survey of the northern part of the HMA and areas immediately to the west. The results of this survey have been presented to the PDT already (September 2017), apart from this recently completed age and growth work. The SSC reviewed the utility of this survey for informing the development of the framework and issued their findings in April 2018 (see discussion below).

Two reasons for surveying the area were support of this action, and to look at areas both inside and outside the HMA with lots of clam landings but that have never really been surveyed by the Northeast Fisheries Science Center (NEFSC; presently NEFSC has a working group to address clam survey design considerations). Shallower stations were identified by the survey design group as locations with lots of landings but no survey data.

In terms of protocol the survey used a 99-inch dredge with ¾ inch shaker closure, fished on 5-minute tows at 3 knots, for approximately 1300 m^2 per tow (2.51 meters wide times 520 meters long). All catch was sorted, using the Delaware II survey protocol to measure everything including rocks and cobbles and not just surfclams. Everything was counted individually, except for clams, mussels, cobbles, rocks, and boulders (all measured in bushels). At present the

NEFSC survey is done from the Pursuit, and only clams are counted and measured. For those interested, Dr. Powell noted that they have put the full Delaware II dataset into electronic format (the PDT already had the data from the GSC HMA).

Overall and as previously indicated to the PDT, the survey caught a lot of surfclams. Large catches were on the edge of or outside of area that has historically provided a lot of landings. A size of 120 mm is used in assessment to define market vs. sub-market. Clams above and below submarket (0-120 mm) and smaller market (120-150 mm) do not appear to overlap spatially. Dr. Powell noted that 120 mm is not a rigid size in management, but it is used into the stock assessment (i.e. don't read into it too much). All smaller clams are in the same region of the HMA, relatively offshore. The biggest clams caught approached 170 mm in size, which is unusual for the rest of the stock.

The survey found lots of surfclam shell in the historically fished area, which has had surfclams for decades and decades. Dr. Auster asked if the area is productive in terms of more biomass generated per unit time or because there is a high standing stock, and Dr. Powell responded it was both; growth rates here are higher. A lot of these clams are above the von Bertalanffy $L\infty$ size used for the assessment ($L\infty$ = asymptotic size according to growth curve). Deeper stations had much less shell, suggesting that this area has been recently colonized.

Next Dr. Powell described the results of the correspondence analysis completed to determine the relationships between different components of the catch. They did these analyses with all information including mussels, cobble, crabs, etc. In the plots, X is the abundance axis, where not common is left, common on right. L indicates low abundance and H is high abundance. Y axis is depth. The take home is that the mid depths are areas of high abundance for all sorts of things, including small clams, cobbles, and boulders. Deeper areas there is not much of anything in abundance, shallow areas there is not much except for big clam, combined with slipper shells (*Crepidula*) and clam shells. Will argue in a bit that while all of these things fall in the same depth range, they do not appear to be distributed in same place in space.

Next Dr. Powell presented the Spearman's and Pearson's correlation coefficients calculated for various pairs of components of the catch (variables included surfclams ≤ 120 mm, 121-150 mm, 151-170 mm, 171-200 mm, > 200 mm, mussels, and cobbles). All data were standardized as number per m^2 and no differences in catchability were assumed across catch components. He clarified that boulders are > 12 inches, rocks are 6-12 inches, and cobbles are 2-6 inches, and that rocks and boulders sometimes co-occur with cobbles, while at other stations cobbles were observed alone. Most of the Spearman's correlations were significant. Few of the Pearson's coefficients were significant, and only the relationships between ≤ 120 mm and 121-150 mm surfclams as well as 171-200 mm and > 200 mm were significant when zero/zero stations were dropped from the datasets. Dr. Powell argued that the Pearson tests with zero/zero stations dropped was a more rational approach to analysis.

In terms of the age and growth analysis, a question is why the clams in moderate depths are smaller. Do those clams grow more slowly, or are they just younger? They chose two shallow and two deep sites to take age samples from (A3 and C3 shallow stations and I1 and I4 deeper stations) and used the NMFS strategy of selecting animals across the size frequency for aging. They conducted a calibration exercise including age readers from University of Southern

Mississippi, Virginia Institute of Marine Science, and NEFSC. They compared three growth increments, 1-2y years, 3-4 years, and 7-8 years using a nested analysis of variance (ANOVA). A nested approach was used to compare shallow and deep sites without the need to pool data across the two shallow and deep stations in case there were differences. Based on papers by Pace and Munroe, the analysis used birthdate as a covariate; earlier work showed that for quahogs that there is a strong relationship between birthday and growth. Munroe expected that birthdate would have an influence based on changes in temperature over time, such that different cohorts experience different conditions.

We expect to see 20 to 25-year-old clams in a mature age distribution; above age 25 is rare. Stations A3 and C3 include clams that get pretty old. These sites have a typical age frequency for the mid-Atlantic, from age 4-5 and up to age 25 (clams under age 4-5 don't show up in the dredge as they are too small, although there may be some recruitment to fishery at age 3). The oldest clam at the deeper stations was 13 years old (implying colonization began in 2004). So, one reason why the moderate depth surfclams are smaller is simply because they are younger. Comparing the age 1-2 growth interval, there was not a significant difference between sites or stations, and birthdate was not a covariate. So, the earliest growth is consistent throughout different locations and year classes. For the age 3-4 growth interval, there was a barely significant difference between shallow and deeper stations, but not between stations at the same depth. In this interval, birthdate was strongly significant, with shallow site clams growing a bit faster when they were 3-4 as compared to the clams at deeper sites. Between 7-8 years we lose a lot of data as there are fewer older clams at the deeper sites. Growth rates for this age grouping were higher at one of the deeper sites than at all the other sites, although this result should be used cautiously as there was a lack of significance in the overall ANOVA,

Considering birthdate and depth, clams that colonized the deeper sites in early 2000s were growing more slowly than clams born more recently. Now these early 2000s colonists are growing at the same rate as shallow water clams. This differential is the reason for significance between shallow and deeper stations. In terms of the underlying mechanism for this, in the early 2000s the temperature regime was suitable for colonization, but not sufficient for optimum growth. Now waters are warmer, and growth rates have increased. These deeper water sites will be important to the fishery in about five years.

After 2000, there was regime shift that affected the entire north Atlantic. There are several other examples of populations affected by this, including Delaware Bay and Gulf of Mexico oysters. In terms of surfclams specifically, offshore surfclams died off in waters off Delmarva, and the NJ state waters fishery collapsed. Also, in that timeframe surfclams moved into deeper waters offshore NJ and colonized additional parts of Nantucket Shoals. Areas of co-occurrence between surfclams and ocean quahogs are increasing (paper on this will be published soon).

Dr. Powell's prediction was that surfclams will continue to expand into deeper water and the fishery will shift. He observed that the horse mussel *Modiolus modiolus* is gone from Nantucket Shoals; they cannot burrow to escape warm summer temperatures like ocean quahogs can. The blue mussel *Mytilus edulis* has been moving northward for a while now; probably on its way out in this region. There is an overlapping temp preference for mussels and surfclams but assume coincident occupation of surfclams and mussels is transient. Surfclams likely can't settle

successfully in mussel beds. And mussels may not settle successfully in surfclam beds, which are bioturbated.

Dr. Powell observed that while you can't take a tow without picking up a cobble, areas with lots of cobbles are not areas with lots of surfclams, or lots of mussels. Audience member John Verissimo commented that in order for clams to occur, there has to be a lot of sand. If you look closely, boats are working in sand sections of area. Rocks are continuously covered and uncovered. Mussel beds couldn't exist if they were attached to rocks as they would be covered, but because they are held down by pebbles, they can shift with the tides/currents of 4-6 knots.

Dr. Auster suggested that there are other processes that could explain the same patterns. Familiar with European literature on mussel ecology, but there are other processes that influence habitat management issues here that could be fully consistent with observations made with a dredge. Dr. Powell suggested that the sand is highly mobile in this location. Organisms observed on rocks are those that grow fast and then are scoured off at intervals. Animals and plants that are permanent are algaes that can be ripped off and then grow back. Barnacles are mostly scars but they grow back quickly. Dr. Ford confirmed that Dr. Powell's sense of these dynamics was based on the catch of cobbles and other constituents in the clam dredges and asked if the dredge damages epifaunal species. Dr. Powell's sense was that the dredge does not damage mussels, but that barnacles are likely damaged. He was uncertain about sponges but suggested that even if they are removed from their substrate they should still be retained in the dredge, which occurs in other regions where sponges are captured. Ms. Verkade asked about tunicates, and other soft bodied animals, and Dr. Powell said they were caught in specific areas, specifically those with less sand scour, somewhat finer sediment.

Dr. Ford recalled that the SSC didn't think clam dredges were appropriate for benthic habitat assessment and asked if Dr. Powell disagreed with this finding, which he did. He suggested that it would be useful to see to what extent the cobbles and rocks are routinely buried by placing a camera on a dredge. It seems that there would be much different growth of organisms on these substrates if they were exposed more often. Dr. Ford agreed it would be feasible to put cameras on a dredge.

Audience member Monte Rome asked if we can safely say from these data that if surfclam vessels encounter rocks they would not stay in the rocky area? Dr. Powell said no, not from these data, but from experience working with clam fishery, yes, there is incentive to avoid rocky areas. Mr. Rome asked how would you compare action of sand waves to action of a hydraulic dredge? Dr. Powell suggested that the dominant factor governing the habitat is the movement of sand. In comparison the dredge does nothing. Dr. Stevenson pushed back that these were opinions, but Dr. Powell disagreed.

Dr. Ford asked about the sample size in the mid-depth range. Dr. Powell commented that stations can be no closer together than 2.5 nm based on NMFS protocol. That would be the densest they would do. Stations with letters D, E, F, and G were considered 'mid' depth (I is 'deep'; J, K, L, 'very deep'). These deeper stations have no big fauna except big sea cucumbers. No sand movement there. Out of region of big sand waves.

Dr. DePiper asked if an ANOVA or regression analysis would be better than using Pearson coefficients. You argue surfclams are engineering the habitat to some extent. Since you found that depth is important with respect to growth, and mid-depths are likely where overlaps occur between mussels and surfclams, could you get additional information about where they overlap spatially? Suggestion to do a correlation conditioned on depth. Dr. Powell said he could do that, but that he guaranteed you won't see a depth difference between two species. They all fall out on the same line in the correspondence analysis. Dr. Auster commented that finding is useful for thinking about alternatives. He read from the conclusion of the April SSC sub-committee report: "Given the heterogeneity of this habitat, it is not possible to identify specific areas where clam dredges could operate without impacting complex habitat. A finer-scale survey would be required to determine whether clam dredges could operate without impacting complex habitat within this area. Because the hydraulic dredge that was used in the two surveys, by itself, is insufficient for characterizing habitat complexity and because treatment of the survey data as point data is appropriate given the high degree of spatial heterogeneity, interpolation between the point samples would not be justified. Therefore, the surveys are not informative for identifying areas where clam dredges could operate without impacting complex habitat."

Dr. Auster continued that we could argue about this infinitely, i.e. about what you could gain from these dredge samples, spatially. Ms. Verkade emphasized that the SSC sub-committee recommended using image analysis to classify habitat. Dr. Powell commented that image analysis has considerable negatives too – in particular, that total area covered is small. They published a paper in J. of Continental Shelf Research about using those sorts of surveys to characterize megafauna abundance. The SSC is correct that there is obviously a lot of fine scale differences in habitat at this depth range. A better would be comprehensive bottom mapping.

Dr. Auster noted that we have what we have, and both approaches to habitat characterization suffer from different types of problems. And we need to acknowledge and work on tasks set by the Committee. Dr. DePiper agreed that we will always have a disconnect between the two spatial data sets. Audience member Monte Rome asked how would you compare the data on which you are relying [drop camera survey] with Eric's? Dr. Auster emphasized we would use both, but that the dredge survey can't give us fine scale habitat attributes. We need to take the useful parts from all the data and come up with some useful solutions. With either survey type, in regard to occurrence of different habitat features/species, we can characterize the patchiness but not count patches. No different to any other survey, unless you are doing continuous transects. Dr. Ford suggested that acoustics would be useful, and Dr. Powell agreed, although he suggested that large sand waves could interfere. RoxAnn could be a useful tool.

Audience member John Verissimo asked if the PDT had been given guidance about the amount of habitat protection required, i.e. is there an acceptable loss? Ms. Bachman responded that we are trying to minimize impacts to extent practicable; whether impacts are adverse relates to both their duration and intensity. The Council talked about establishing a baseline or tolerance many times during the development of the Omnibus Habitat Amendment but was never able to. Perhaps worth revisiting as we continue with fishing effects modeling.

Audience member Louis Legace asked if it would be helpful to obtain additional data – for example taking more photos, or towing a video camera? He suggested that they should be given more time to obtain complete data, since this is a lifechanging decision. Ms. Bachman

emphasized that the PDT's role is to present what we have and say if it is complete or incomplete, what the gaps are, and also how they could be filled. However, there is an end to this exemption in April of next year, so we need the council to take some action here. We can't just take longer with this process, or the exemption will sunset. Well and good to point out data gaps, and of course we should use the 2017 clam survey to help evaluate alternatives as needed.

Dr. DePiper asked about fishing happening outside the HMA – it doesn't seem from the data that there is much recent effort outside, but it was part of the survey. Dr. Powell responded that the area has historically been important, from the 1980s onward, which is why it was part of the survey footprint. Dr. Ford asked about the relationship between the survey data and the potential exemption areas suggested, for example Rose and Crown, which appears to heavily fished, but seems to overlap survey stations with smaller clams. Dr. Powell agreed, and commented that the smaller clams are still marketable.

In terms of understanding whether past fishing grounds will continue to be as productive, the PDT discussed the physiology of surfclams in relation to temperature. Will the areas to the west that have been historically important become less important? Depends on temperature changes; when temperatures are above 21° C, their filtration rate drops off. If the increase is prolonged, they starve. In the 1970s and 1980s, lost animals off inshore MD/VA. In 2000, lost offshore animals off Delmarva, and inshore animals off NJ. This decade losing all inshore NJ and also inshore NY. Not sure when these changes could reach Southern New England. It seems that a prudent piece of advice from PDT to council is that environmental is changing, surfclams are moving, and they need to be aware of where the future of the fishery is. In areas where clams remain, warmer waters lead to smaller maximum sizes because of longer low feeding/low growth intervals each year

Dr. Stevenson asked about the other species/subspecies of surfclam, *Spisula solidissima similis*. Are Nantucket clams this species? Probably not – recent genetics (Matt Hare and Jim Weinberg) concluded it is a separate species. Recent evidence (but not documented in the literature) that two species can reproduce. Not sure if they are producing interspecies crosses or that they're the same species northern vs. southern. *S. s. similis* is inshore off VA, *S. s. solidissima* is ITQ species. *S. s. similis* appears to be in Long Island sound; warm temperature species. Doesn't get as big as *S. s. solidissima* and probably not commercially viable.

Eastern areas, E and C suggested by clam industry, are clams going to increase in those areas over time? Dr. Powell suggested that small clams will be recruiting over middle depth region, but that it would be nice to have a little more info on really small clams. On a standard dredge (typical bar spacing) small clams will run right through. Would be useful to know where those smallest animals are at present. Is there an idea that the fed survey will cover these areas eventually? Dr. Powell said, no, it won't, the Pursuit cannot be used in this area. One discussion amongst the working group was that it would be useful to have a periodic survey with a smaller vessel, but nothing will be done routinely. Will never know as much as we would like about these clams. We should survey Nantucket Shoals intermittently to keep tabs on stock. Is there a specific kind of habitat where surfclams settle and grow? Dr. Powell said he was working on a paper that looks at range of settlement of surfclams relative to where adults are. Their strategy is for larvae to recruit almost everywhere but in some places they don't grow up. They don't preferentially recruit to themselves. Mussels do that, however. Positive thing about this dynamic

in surfclams is that it allows a fast range shift because the larvae settle beyond the adult footprint. Before breaking for lunch the PDT recommended that Dr. Powell do an analysis of just the stations overlapping the region where clam exemptions are under consideration. Dr. Powell will provide the analysis to the PDT in the coming weeks.

Response to Committee tasking

Eric Heupel, Kevin Stokesbury, and Geoff Cowles from SMAST joined the group after lunch. The Habitat Committee asked the PDT to develop rotational management alternatives based on five of nine areas suggested by the clam industry for exemptions. The Committee asked the PDT to consider the age distributions of clams in the areas, historical fishing effort, and minimization of the adverse effects of fishing on EFH. The question for the PDT is how to use the information at hand to complete this evaluation.

Historical effort: We have used logbook (similar to vessel trip report) data to evaluate previous spatial management areas (see May memo – revenue by area, number of permits and owners by area and relative dependence). Now we also have an estimate of hours fished per year that can be compared to the logbook estimates of revenue. Should ensure that the 20 vessels in the VMS database match the vessels in the logbook data. We are also exploring measures of effort or revenue standardized by area size, to give a sense of the relative importance of areas that vary greatly in their spatial footprint.

An industry member noted that the area in northeast (mobile bottom tending gear closure section of the HMA) hasn't been fished during the 2010-2018 period, suggesting there are no clams there, or that the habitat is for some other reason not fished. The PDT noted that we cannot interpret fine scale habitat types that are fished or unfished based on available data, for example by looking at the gridded VMS polls to infer avoidance of certain features. Ms. Bachman emphasized that the Committee is interested in opening discrete areas for access vs. closing discrete areas for habitat protection, and that she did not think the framing of that issue is a debate we should be having – that is a policy question for the council.

Getting back to the PDT's task, there is a question of how effectively adverse effects are being minimized if these 5 (or 9) areas are designated. For the next Committee meeting we need a range of alternatives as well as a sense of impacts (fishery and habitat). There is obviously a lot of heterogeneity in the habitats in the HMA. We can make general observations about the occurrence of different types of features (surfclams, mussels, cobbles, epifauna) at the scale of the proposed exemption areas. In some of these polygons we are data poor; only know depth and seabed form.

The PDT discussed what information to present from the drop camera survey for these specific areas, given their spatial scale. It was mentioned that most of the images are from 2006, which is prior to the effort data evaluated for this action so far but is not a 'pre-fishing' period. One suggestion was to look at specific features (cobble pavement, longer-lived epifauna) to get at different gradations of complexity. Other members were concerned about this. On the one hand at the outset of the EFH amendment process we established that we are not in the business of conserving every rock with something growing on it. However, we already parsed the region to identify areas of importance on multiple fronts, and the boundaries the GSC HMA and other

HMAs emerged at the end of the that process. Parsing this area up further adds a whole other layer, and we lack the data to establish a threshold for exactly which or how much habitat to protect. Yes, 10% pebble/cobble cover is a threshold, but one based on detectability of complex habitat, and it is precautionary because we don't know how specific amounts of habitat protection influence the production rates of managed species.

The counter argument that suggests we should parse out the occurrence of specific seabed features more finely here is that we are simply drilling down, which is a good thing; at the regional scale we didn't have data that were this detailed, only occurrence of specific substrate grain sizes and inferences about occurrence of biological associates or the percent cover of those substrates. Dr. Auster commented that the more detailed data do reinforce our underlying assumptions about how we designated HMAs. But not sure data are dense enough to relate them in a robust way to fishing events. Dr. DePiper suggested that practically speaking, there is no reason to parse the data more finely into varying levels of complexity unless the results suggest that different sections of the HMA are the most important to protect from impact. Let's say we refine our sense of what complex habitat is – our threshold for concern – how does that help? We have pushed these data as far as we can, and we are not further along. This is not to say that fishermen don't fish on less complex habitats between complex bottom, but there are concerns with parsing up this area into sections that need or don't need gear restrictions when we have already selected this area as the HMA for this region. Perhaps the solution is that, given everything we know, if we want fishing, with this sort of gear, in this location, let's move the boundaries of the HMA.

Ms. Bachman suggested that we bring the discussion back to the task at hand. The Committee asked us to consider exemptions for a subset of these areas, help us understand how they can be fished in a rotational fashion and if that minimizes adverse effects. Options are that fishing in these areas causes no adverse effects, some level of adverse effects, or we don't have enough information to say. How do we construct that argument? If there are likely to be adverse effects based on our best understanding of the habitats and gear, then does rotational management help, or not? Does it matter what fraction of the overall HMA is being protected? Answer could be that given what we know, we don't think this management strategy avoids adverse effects. Practicability is a decision for managers. So how do we help them to understand tradeoffs? The PDT discussed that while we could ask the Committee for additional guidance about their willingness to consider some adverse effects in the name of practicability, it seems that at this stage they are just looking for concrete suggestions for alternatives, and a sense of impacts.

Audience members Monte Rome and John Verissimo expressed concerns about whether these areas would work if accessed rotationally. What is the logic to say there are plenty of clams there for a 7-year period? What if it turns out to be lots of towing for few clams?

Ms. Bachman reiterated an earlier point that even if there is targeting or avoidance at scale of individual tow of certain habitat features, we don't have the data to match habitat type with fishing events (tows). The fishing industry can certainly state how you assess the bottom and what your strategy is for avoiding complex features. The PDT can agree that there may be avoidance occurring, but we simply don't have the data to show that empirically.

Audience member Allen Rencurrel said that vessels avoid certain areas by marking them on their plotters. If they are towing in an area that is all sand (good for fishing) and we start to deplete it, we will move north or south. If we encounter cobbles or rocks we will mark them and then avoid them so we don't rimrack the dredge. And this is how the boats are all working out there. We move slowly around in one area until we feel it is time to move on. Chad Brayton commented that in a new area, the only way to determine if an area is good is to put the dredge down and do a test tow. This lets you find areas without clams, or with rocks. Ms. Bachman asked if the areas to target or avoid ever change. Mr. Rom suggested that when you are working an area you are driving the clams down. You may come back to an area a few weeks later and find clams.

Audience member Geoff Cowles said it seems like we have some opportunity here. This is arguably the highest energy area in the region; anything that is sand is mobile. There are rapidly growing species in these sandy areas, and fishermen are constrained and avoid complex habitat. So you will be minimizing impacts naturally via allowing fishery to operate with the least constraints. To me that is an opportunity because it will be very difficult to do this (define finer scale areas) from any mathematical perspective.

Ms. Bachman suggested that for her, this comment brings up questions about tradeoffs. Now vessels can work wherever they want, avoiding areas they want to avoid, and fishing in areas that are most productive. If we minimize access to certain sections of the HMA then we reduce their available options. That being said, the Council has shown a willingness amidst this sort of uncertainty to designate durable closures where all mobile bottom tending gears are prohibited.

One question we could answer is what are the benefits of setting aside the fraction of HMA we are setting aside? What is in the area outside the nine exemption blocks? Ms. Verkade cautioned that we need to be clear about data we have. What percentage of open area was actually sampled? And what are those samples telling us? We need to represent both the amount of information we have and the results and think about how to make inferences about areas that are not sampled.

What do we do about area rotation? All nine areas represent around 90% of hours fished. Around 60% in the five areas identified by the Committee. How many bins can we put these polygons into, reasonably? Is three too many? We could also suggest no rotation and can discuss the potential for effort displacement in both contexts. If all the areas are open, then based on disturbance theory you might have greater recovery within disturbed patches. By developing a rotational strategy that doesn't at least give everybody somewhere to go when they want to go fishing, you'll end up with worse conditions in some locations. At least give choices throughout the HMA.

Are there merits to seasonal closure? Yes, you could argue that clam dredging would have an impact on cod that are aggregating to spawn. Work in Massachusetts Bay suggests it is possible to disrupt spawning; this is the argument for seasonal closures. This is separate from issues of habitat impact and protection of larval settlement areas. It was noted that cod larvae settling here likely come from Massachusetts Bay. While towing through and area with a dredge might not reduce the suitability of the area as larval settlement habitat from a sediment perspective, it could affect epifauna, such as bryozoans, which are used for flow refuge. This mediates survivorship of larvae.

Considering all areas being open at once, the PDT discussed whether there is a limit on fishing effort. Dave Wallace suggested that while there are no limits on boats, days, there are practical limits. Processors have a finite amount of what they need. Only so much demand from restaurants, etc. Not everyone willing to fish here – there are only so many captains who have both the skills and interest in working in the area.

Can we optimally define a rotational management area? Can we design one? Feel like this is an experiment, a research project. If we are being asked to develop a research program to evaluate habitat impacts, rotation would do it. So, we can certainly design a rotational scheme that allows us to ask some interesting research questions but might miss the mark for industry in terms of access to sufficient numbers of clams.

Approaches for filling information gaps

Issue keeps coming up of how we could get more information. Part of this process should flesh out a research plan. (And then find the money to do it). Then industry could say they are willing to take on the cost. This becomes part of the discussion and then this information might allow us to modify the designation. Especially in context of environmental change, different sizes of clams in different parts of the area, etc.

Thinking about where fishing is occurring with respect to habitat. We don't have sufficient data to make those links now. Can we figure out a way to get high resolution habitat data and determine fine scale effort distribution as well? Would a towed camera work here? Not sure; tough landscape to tow but could add camera to dredge. Say we did a rotational, blocks open, closed, take pictures of both, over time. Dr. Powell responded that is one of the obvious things to do. We do not know what daily or monthly change in the bottom looks like. Don't know how frequently things are uncovered. Don't know how much fishery is redistributing rocks on the surface of the sediment. Anything smaller than around 2 inches goes through the gear.

The PDT agreed that having folks from industry involved in these conversations is really valuable, and an opportunity to find common ground between bottom images and data obtained from sounders and from dredging. Talking about plotting areas where you can operate; I don't think you're saying you're avoiding every rock. There are going to be smaller pebbles and granules that are important habitat that you're never going to see. But we see those in the bottom photos. Dredging can't afford the same perspective. Photo area is smaller, dredge tow is hundreds of meters. Avoidance will be at the scale of a tow. Chad Brayton commented that clams are moving up and down in the sediment – the bottom is a living thing.

Audience member Dave Borden suggested that a way to package this is totally in the research mode. Industry has already been talking about how they will raise money to fund this. Put together compelling argument that there is uncertainty, here's what we need to do. And industry is willing to help. That type of package/alternative is not 'doing nothing', it is very important.

Other business

The PDT discussed updates to the fishing effects model, and suggested looking at various recovery curves (exponential, linear, logistic). Ms. Bachman will follow up with the contractor and with PDT members individually about specific issues. The meeting adjourned at 4:15 p.m.