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# Habitat Plan Development Team Meeting Summary

February 22-23, 2010
Boston MA

The PDT met on Monday and Tuesday, February 22 and 23, 2010, to review results of the Swept Area Seabed Impact (SASI) model, which is part of Phase 2 of the Omnibus Habitat Amendment, and to discuss the best way to deliver model outputs to the habitat oversight committee. In particular, on the second day of the meeting, the team revisited the committee's tasking from before the SSC review and developed a work plan to address the committee's questions using the SASI model. Team members in attendance included Michelle Bachman (NEFMC staff, chair), Chad Demarest, Brad Harris, Kathryn Ford, Jon Grabowski, Mark Lazzari, David Stevenson, David Packer, Tom Hoff, and Steve Eayrs. Committee members in attendance included David Preble (chair) and Gene Kray. Between two and three audience members attended each day of the meeting.

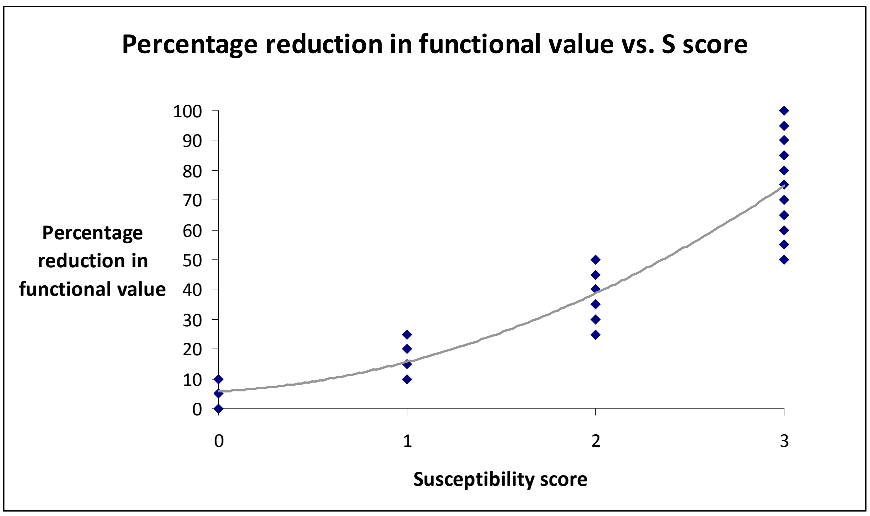
## *SSC review (see document 9, SSC memo to council)*

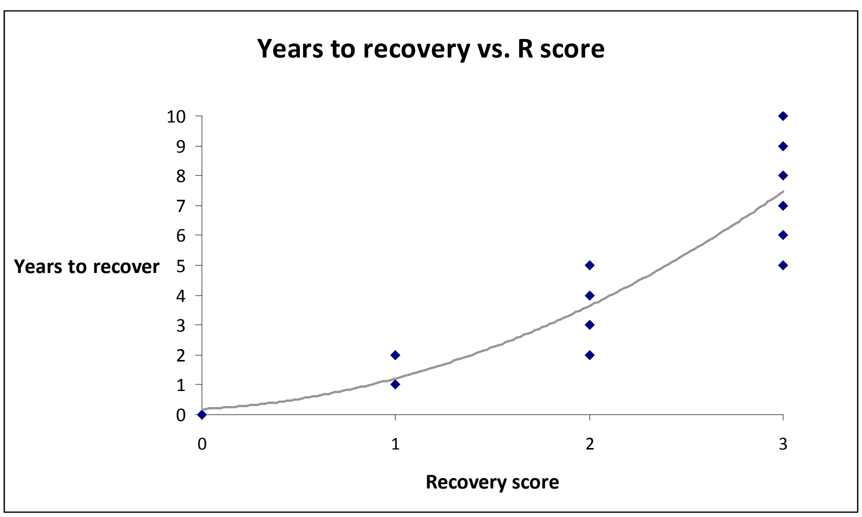
The team briefly discussed the results of the December 9 SSC review, which were presented to the Council at their January meeting in Portsmouth. The SSC had concerns about the ability to compare between mobile and fixed gear impacts based on model outputs, but a team member noted that the way this point was phrased in the SSC's report minimized concerns somewhat. (The model does have a number of assumptions, of course, which the team will continually work to present clearly and effectively, alongside any model results that are presented to the committee or council.) Another concern of the team was the SSC's request for quantitative measures of uncertainty, which will probably not be possible to produce in the same way that uncertainty measures might be generated for stock assessment-type models. However, the team will continue to test sensitivity to model assumptions as questions arise related to various model inputs and parameters. The team briefly discussed the SSC's desire to review model applications before management decisions are made based on outputs, and was made aware of the Council chair's objection to taking time for formal review. It was noted that staff and the team will make their best attempts to communicate with the SSC, in particular the habitat liason, Dr. Kritzer, throughout alternatives development.

## *Vulnerability assessment (see document 1, SASI doc Part 1, and document 4, VA summary figures, document 5, distribution of features by substrate and energy)*

Next, the team reviewed the vulnerability assessment (VA) results. The need to convey the 'story' of the VA and the major conclusions of the analysis was discussed. The needs related to the Part 1 document were listed as follows and divided amongst team members for completion: summarize major results (JG), finalize details related to S/R justifications (MSB, DS), identify biases in vulnerability assessment (MSB), list gaps in research identified during the VA process (DP?).

The chair presented a series of bar charts showing average S and R scores by habitat component (geo/bio), substrate (mud-boulder), and energy (high/low). It is important to remember when viewing these plots that when these scores are brought forward into the model, that (1) each score is used individually, and that the S or R score is selected randomly from the possible distribution each time a score is applied (2) there is not a linear relationship between the ordinal score number and the % susceptibility or the years required for recovery. The possible percentages and years to recovery that correspond with the S and R scores are shown below:




Conclusions related to VA:
Model outputs are driven both by where fishing occurs, and how much fishing occurs. Because there are some high and some low S and R scores in all substrate/energy combinations, there is

less distinction between habitat types in the model outputs than might have been expected. In particular, biological S/R differences between substrate/energy environments are subtle, given the array of features inferred. Given that biological and geological components are weighted evenly between one another, geological scores appear to have a greater influence on model outputs. However, it appears that outputs are primarily driven by the amount of area swept.

Sources of bias:
Having a smaller number of features in a habitat type means that each feature's score is effectively given greater weight. The idea of using dummy features to compensate for this was discussed (this may be investigated further at a later time). Also, feature inferences by substrate/energy are generalized for the entire domain and do not necessarily reflect features actually occurring in a particular area. It was discussed that perhaps feature distributions can be refined on a regional basis (this will be investigated for possible implementation at a later time).

This transitioned into a discussion of the percentage distribution of features in the model domain. This distribution results from combining the inferred feature distributions by substrate and energy with the unstructured base grid. The resulting percent distributions are shown in document 5, and vary by gear type because of the depth-based truncations of the model domain. The tables are separated according to bio and geo components, and the percentages shown reflect the equal weighting between to the two.

### *Model implementation (see document 2, SASI Part 2, document 3, glossary, and document 7, gear impact functions, document 8)*

Next, Chad Demarest led a discussion on model implementation (the equations are shown in document 2, and the terms are summarized in document 3). At its most basic level, adverse effect, Z, equals area swept, A, multiplied by Ω. Because Ω includes both S and R, a difference equation is employed. In words, the difference equation means that the stock level of Z in time t+1 equals the stock of Z in time t, plus incoming impact Y, minus outgoing recovery, X. Y, the impact vector, combines A, contact-adjusted area swept, with the appropriate % reductions in functional value according to the S scores.

Mr. Demarest then showed the various data input tables.

Next, the team examined the map outputs.[1] They were reminded that when viewing the simulated maps, it is inappropriate to compare values between gear types because the area

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[1] Simulated outputs use a simulated fishing effort layer. Currently, this means that an even and arbitrary distribution of area swept is applied to every 100 $km^2$ cell in every year the model is run. These outputs and the resulting maps are intended to show the result of combining the susceptibility and recovery parameters for a particular gear type with the underlying substrate and energy distributions. Between gear types, the locations that are more or less vulnerable can be compared, but the magnitude of the Z

swept inputs are somewhat arbitrary. Instead, these maps are intended to highlight areas of the model domain which accumulate relatively more or less adverse effect for a particular gear type. The realized maps, in contrast, are intended to be used to compare the magnitude of adverse effects between gear types. It is important to remember that although the colors used on the various map outputs are the same, that the values associated with the color ramps differ, so map legends should be reviewed carefully. Standardization of ramps was discussed during map generation, but given the order of magnitude differences between gear types, is not a practical way to display the data. However, for realized A and realized Z maps, ramps are standardized over time within a gear type to indicate temporal change.

For the simulated maps, in terms of sensitivity testing, it was noted that if the terminal R assumption is changed, the same areas will appear more vulnerable to fishing, but these areas show a greater/lesser contrast with the surrounding areas if terminal R is longer/shorter.

An audience member wondered about the possible inability of the maps to convey the fact that some gears cannot fish on some substrates. (The example given was related to scallop dredges on boulder habitat.) Broadly speaking, the response from the team was that the simulated maps are intended to indicate areas to focus on in terms of vulnerability, and that the simulated maps are one tool for the committee to use, rather than a depiction of exact areas that require habitat management measures. The simulation maps will indicate general areas because area swept is applied to $10km^2$ cells, which typically contain multiple substrate types and sometimes multiple energy types. Thus, use of the $10km^2$ grid visually smoothes variation between substrates/energies.

The team then reviewed the Z accumulation curves, shown in document 7. These curves

An audience member wondered whether the Z accumulation curves corroborate the assertion that the first pass of a gear over the bottom is most damaging. The response from the team was that SASI is an aggregate analysis, such that it can't really be used it in this way. However, it is possible to test the rates indicated by Z curves using closed/open studies, and it will be important as the process moves forward to consider the possible research purposes for maintaining closures.

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estimates should not be compared because the input area swept values are arbitrary. The model is run continuously, with area swept added in annual time steps, and the simulated outputs are mapped for the terminal year, once the model has come to equilibrium. As written currently, the terminal year is year 11 because the maximum recovery time is 10 years.

Realized use realistic estimates of area swept. They are intended to represent actual impact of fishing on the seabed. The magnitude of the resulting Z estimates can be compared between years and between gear types. The model is run continuously, with area swept added in annual time steps, but these outputs are mapped on an annual basis.

### *Committee tasking related to EFH impacts minimization alternatives*

On the second day of the meeting, the team discussed how to package model outputs in a way that addresses committee tasking. <u>Overall, there appeared to be consensus amongst team members that the job of the PDT is to tell the committee, advisors, and council how the model can be used to support the analysis of habitat impact minimization alternatives, but that it is not the job of the PDT to develop alternatives per se.</u> In particular, in order to develop alternatives, it will be important for the committee and council to clearly state their objectives. For example, an objective that could be analyzed using the model might be to develop a set of habitat closed areas that include a diverse array of substrates in both high and low energy in roughly equal proportions.

Determining whether adverse impacts have been minimized to the extent practicable will not be straightforward. During the discussion, a team member asked what more than minimal and not temporary in nature actually means. Dr. Hoff noted that the guidance received by the Mid-Atlantic council was that temporary means recovery time plus a year, but this is really a policy determination.

The following tasking comes from the Committee meeting summary dated 14 October 2009:

1. *Analyze existing EFH closed areas:*
    a. *For vulnerability to particular fishing gears, independent of actualized fishing effort*
    b. *To determine how effective existing closures are in terms of minimizing vulnerability- and contact-adjusted area swept (Z) under both current and proposed levels of fishing effort*
2. *Provide recommendations on new habitat management areas, considering the following:*
    a. *Areas that might improve recruitment for stocks that have not improved under other measures. This could be accomplished by integrating information from EFH text descriptions with the results of vulnerability assessment. During this analysis stocks would be prioritized on the basis of recruitment histories.*
    b. *How could we redistribute management areas to maximize efficiency?*
    c. *Can we distribute areas in ways that maximize overlap with vulnerable components of EFH for key managed species?*
3. *Provide recommendations on modifying boundaries of existing closures, such as the WGOM closure or the Northern Edge of GB (part of Closed Area II).*
4. *Provide recommendations on the designation of gear restricted areas.*
5. *Analyze fishing impacts with respect to proposed HAPCs and determine if those impacts need to be minimized.*

Below, the tasking (italicized) is reworked in the form of questions that the model can be used to answer (bold). Following the restatement of the tasking as a question, various options for the analysis are reviewed. Where regionally-based outputs are discussed, the regions will include Gulf of Maine, Georges Bank, and Southern New England/Mid-Atlantic Bight. Regions will be delineated according to the four regulated mesh areas, combining the SNE and MAB areas into a single region.

*1.* Evaluate existing EFH closed areas using the SASI model

   a. *Tasking: Analyze existing EFH closed areas for vulnerability to particular fishing gears, independent of actualized fishing effort.* **Question: Within a region, does mean Z among the 100 $km^2$ grid cells in open areas differ from the mean Z among the 100 $km^2$ grid cells in the habitat closures?**

The null hypothesis is that cells in EFH closed areas will accumulate more Z than cells not in closures. Because the tasking was phrased as 'independent of actualized fishing effort', this analysis will use the results from the terminal year of the simulated uniform model runs. A cell would be classed as occurring in a closure if the centroid of the cell falls within the closure. Difference will be expressed as a percentage. Differences will be tested for significance using a non-parametric (i.e. rank-based) statistical test and all assumptions of the test used will be evaluated.

This analysis could be conducted for any set of closures (e.g. multispecies year round closures or scallop EFH closed areas), but to start, the multispecies EFH closures will be examined. These six EFH closures include: Closed Area I (both sections combined), Closed Area II, Nantucket Lightship Closed Area, Western Gulf of Maine Closed Area, Jeffrey's Bank, and Cashes Ledge. The results of the trawl gear simulation would be used as a starting point. Each habitat closed area would be compared individually to the open areas within its region. However, if you were evaluating alternatives that combined multiple closures in a region, you might compare the entire area that was inside closures to the entire area outside closures.

It was noted that, if desired, the analysis could be run using smaller (or larger) structured grid cells, according to the different resolutions of substrate data between regions. An alternate approach altogether would be to randomly select areas within a region that are the same size as a particular EFH closed area and compare mean Z between cells in closed areas and cells in open areas – rather than comparing all the open cells to the cells in each of the closures. The purpose of this alternate approach would be to compare current closures to potential closures of the same size.

As a reminder, the simulated model runs are intended to show how the underlying vulnerability of the structural seabed habitat to various gear types varies across the model domain. Thus, the purpose of this analysis would be to estimate whether the underlying vulnerability of the various areas is greater or less than the average vulnerability of the region.

   b. *Tasking: Analyze existing EFH closed areas to determine how effective existing closures are in terms of minimizing vulnerability- and contact-adjusted area swept (Z) under both current and proposed levels of fishing effort.* **Question: Does a proposed amount**

**and distribution of area swept by a particular gear or gears result in lower Z as compared to the current amount and distribution of area swept?**

The team discussed that if the question is how effective existing closures are at minimizing the accumulation of adverse effect (Z), whether you are evaluating simulated, uniform effort or realized effort, you would want to compare Z accumulation between areas, using the methods listed above (there are other ways to do this as well). So, the simple answer is that the analyses generated for 1a answer 1b: what really matters is the differential accumulation of adverse effect (Z) by area. As a reminder, realized effort data includes the following elements, which can be summarized at the grid cell level: nominal contact (A), hours fished, revenue generated, catch weight by species

If the committee makes some assumptions about how fishing effort might change, various alternative fishing effort scenarios could be analyzed to see how shifts in the amount or location of area swept (A) affects resulting Z values. Then you could ask the question: what is total Z for a given gear type, given realized effort distributions? How does Z compare among gear types? If you opened the existing closures and made assumptions about how effort would shift, how does Z change?

To develop a proposed effort scenario, you would need to make assumptions about how effort might be redistributed given changes in management. For example, if you wanted to evaluate impacts on total Z of removing all the existing habitat closures, you might assume that, after opening the areas: (1) without changing total effort, area swept in the previously closed cells would be the same as for adjacent cells before the closure; or (2) without changing total effort, area swept in the cells previously closed would be removed equally from all other cells in the domain; or (3) without changing total effort, area swept would be removed unequally from cells elsewhere in the domain, etc.

For proposed effort scenarios to be meaningful, you would want to carefully consider the portion of the model domain to which you would apply area swept for a certain gear type. Currently, these domain restrictions are based on depth alone, but you could determine these domains using historic effort, perhaps combining that information with depth.[2]

2. Recommend habitat management areas

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[2] The following options were discussed but will not be analyzed at this stage: (1) Run simulation model with non-uniform fishing effort, either in space or in time. Spatial – keep footprint the same as realized run from a given year (say, 2008) but distribute effort evenly across that footprint. (2) Is total Z equivalent if you compare a realized model run with all areas included vs a model run with the EFH closures removed? For both runs total effort would be held constant. (Ho – Z increases if fishing is allowed to occur in the EFH closures).

a. *Provide recommendations on new habitat management areas, considering the following: areas that might improve recruitment for stocks that have not improved under other measures. This could be accomplished by integrating information from EFH ~~designations~~* ***text descriptions*** *with the results of vulnerability assessment. During this analysis stocks would be prioritized on the basis of recruitment histories.* **Questions: What features are valuable to the species of interest? Is the inferred relative abundance of those features higher in closed or gear restricted area A in comparison with the domain as a whole? Are the features vulnerable to gears X, Y, or Z such that restricting the use of gears X, Y, or Z in area A helps to preserve the functional value of the features?**

This type of analysis would rely on numerous assumptions. First, it was assumed that EFH designations referred to the features identified in the EFH text descriptions. If only substrates were identified in the text descriptions, you would need to consider whether to evaluate all or only some of the features in that substrate, because substrate vulnerability was not considered per se in the vulnerability assessment. You would need to be able to relate recruitment for the species of interest to features or substrates evaluated in the SASI model. By enacting measures developed using this type of analysis, you would be making the assumption that protecting the features or substrates of interest would improve recruitment. This might occur if, for example, fishing impacts to that feature or substrate were causing a bottleneck.

As an illustration of the type of analyses that could be completed, you could assume that cobble substrate is important for cod recruitment because it improves juvenile cod survival. You could determine what portion of the adverse effect (Z) comes from the features inferred to the cobble portion of the domain. You could then select contiguous areas of the model domain that have proportionally large amounts of cobble substrate.

Similarly, you could summarize all of the relative contributions of the features inferred to a particular substrate/energy to Z. For example, you might calculate ratio of $Z_{cobble}$ over $Z_{total}$, or the ratio of $Z_{boulder}$ over $Z_{total}$. You could do this at the feature level, as well (e.g. $Z_{sponge}$ over $Z_{total}$). Then, the end user would look at the Z ratios for the substrate or features they were interested in, given the assumed requirements of a particular species. This would be useful if a specific substrate or features was of particular value to one or more species.

In looking at these types of results, it would be important to be aware of the relative abundance of particular substrates, or the inferred relative abundance of particular features. In other words, while the relative contribution to Z of a particular substrate or feature helps to identify which substrates and features are most vulnerable to a particular gear, this value needs to be considered within the context of the overall amount of the available habitat. For example, boulder might contribute very little to $Z_{total}$, but it could be because it isn't very vulnerable, or it could be because there isn't much boulder habitat.

b. *Provide recommendations on new habitat management areas, considering how we could redistribute management areas* ***(habitat closed areas)*** *to maximize efficiency*. Question: **Does the distribution of fishing effort under area closure scenario 1 result in more or less efficient fishing than the distribution of fishing effort under area closure scenario 2?**

For this question, you might assume that efficiency means catch efficiency – i.e., highest catch per effort. This analysis would require data on the spatial distribution of CPUE, which could be inferred from fishery data and/or from underlying species distributions/densities. The analysis would also require making assumptions about how effort would shift given different area closure alternatives. Similarly, you might examine value per unit of effort. In order to isolate the effects of changing the spatial distribution of areas, you would probably want to assume constant total catch or constant total closure area.

The question of more or less efficient under scenario 1 vs 2 could be answered independent of SASI. However, as a follow on question, you might wish to compare the resulting total Z values for different scenarios designed to maximize catch efficiency. This analysis could be demonstrated clearly for sea scallops, which have a distribution that is rather static and very spatially heterogeneous.

Efficiency might also mean the smallest closure possible that would encompass the greatest accumulated impact (Z).

c. *Provide recommendations on new habitat management areas, considering whether we can distribute areas in ways that maximize overlap with vulnerable components of EFH for key managed species?* **Questions: What are the key managed species? What features are valuable to those species? Are those features vulnerable to fishing by a particular gear? If they are vulnerable, does area closure scenario 1 encompass relatively more of those features than area 2?**

This question is similar to 2a, but further discussion along these lines led to a number of other questions, which are listed at the end of the tasking section. It is important to point out that it is a non-trivial undertaking to identify the features valued by particular species, and that this is likely not possible for most managed species.

3. *Provide recommendations on modifying boundaries of existing closures, such as the WGOM closure or the Northern Edge of GB (part of Closed Area II).* **Question: Do modified boundaries meet some management objective better than status quo boundaries? Objectives might include minimizing Z given uniform simulated effort, incorporating a relatively high proportion of some feature or substrate of interest, etc.**

This question would be analyzed using methods described in 1a. The team discussed that it would be important to understand the reasons underlying each closure's existence in order to determine the relevant objectives. It was also discussed that this type of analysis will require a higher grid resolution.

4. *Provide recommendations on the designation of gear restricted areas.*

There are multiple ways to achieve reductions in Z. We're choosing to reinterpret this question more generally as provide recommendations on gear modifications and/or areas that are closed to some but not all gear types. There are two ways you can look at this. First, you might change the size of gear components and see how that would affect total A. Example – increasing ground cable length improves herding ability of the gear, but there may be ways to increase catch by shifting where fishing can occur while decreasing ground cable length, and thus reduce total Z. Second, you might make assumptions that given a certain gear restriction, fishing can no longer occur on particular substrates. Example – 12 inch roller gear restriction in Gulf of Maine. Given uncertainty about underlying substrate distributions, gear modifications that reduce A might have a greater impact on total Z.

5. *Analyze fishing impacts with respect to proposed HAPCs and determine if those impacts need to be minimized.* **Question (analogous to 1A): Within a region, does mean Z among the 100 km$^2$ grid cells in open areas differ from the mean Z among the 100 km$^2$ grid cells in HAPCs?**

Assuming you were concerned with the vulnerability of HAPCs independent of fishing, this analysis would be similar to that completed to address question 1a. The team discussed that it would be important to identify why HAPCs were designated, and also whether they are subject to fishing impacts, or mainly to non-fishing impacts. Because most of the current HAPCs allow fishing, you could use model outputs based on realized fishing effort in the analysis, in addition to simulated outputs. Simulated outputs would tell you if HAPC's are particularly vulnerable, and realized outputs would help you to assess if they are currently accumulating lots of Z relative to unfished surrounding areas, or all unfished areas.

Other, more general, questions raised during the discussion included the following:

- What is the value of closing an area if it is not currently subject to fishing, or not subject to much fishing? If there is no fishing in an area, why not - lack of fish, or management measures? Even if there is no fishing, does establishing a habitat closure serve to protect the area from other possible uses?
- Is there a need to reduce overall Z?
- Do you close areas to protect a representative array of habitat types?

Following the discussion of tasking, a team member had a question about how the model was implemented when R=0. He wondered whether, in the year following a particular fishing event, if the impact resulting from that event was removed completely as per the R=0 definition of less than one year. Mr. Demarest responded that currently, if R=0, adverse effect will either be completely removed in the year following the impact year, or, will require one additional year to be removed.

To determine how this coding choice is affecting model outputs, you could map Z three ways: (1) if R=0, area swept from year t is removed before year t+1; (2) if R=0, area swept from year t has an equal (or some other probability) chance of being removed before year t+1 or before year t+2, or (3) if R=0, recovery occurs before year t+2. The team noted that given the higher number of R=0 scores for mud, that the latter two approaches to coding R=0 could mean that mud vulnerability is being over estimated.

Ms. Bachman noted that for the realized Z outputs, the fraction of adverse effect corresponding to a feature with R=0 will still be shown on the maps for the current year, such that adopting the true R=0 definition will not completely wash out the contribution of R=0 features to annual Z estimates.

The meeting concluded at approximately 3 p.m.