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To: Chad Demarest, Chair, Habitat Plan Development Team
From: Dr. Steve Cadrin, Chair, Scientific and Statistical Committee
Date: March 26, 2009

Subject: Technical Feedback on EFH Omnibus 2, Phase II, Analytical Tool

The SSC developed consensus recommendations for the Council on the status and applicability of the Fishing Gear Seabed Impact model as a basis for crafting and analyzing alternatives to minimize to the extent practicable the adverse effects from fishing on essential fish habitat. This technical feedback is provided with the intention of working with the habitat PDT to improve the analyses.

SSC Recommendations to the Council are:

1. *Vulnerability Analysis:*
    a. *While the literature review may not be comprehensive, it is an adequate basis for the development of analytical tools for evaluating adverse effects of fishing and associated uncertainty.*
    b. *The general matrix-based structure is appropriate for evaluating vulnerability, includes information on uncertainty and is consistent with the literature review. However, the approach presented to the SSC only included one major aspect of habitat, namely the geophysical component. The biological components of habitat, which have yet to be addressed, are essential elements for the evaluation of vulnerability, and they are necessary for implementation in the Omnibus Amendment.*
2. *The analytical approach of swept area of fishing effort is appropriate for evaluating seabed impact, but some modifications to the characterization of fishing effort should be considered to refine the method.*
3. *The general approach to the spatial analysis is appropriate to overlay habitat and fishing effort, but several methodological refinements are needed to more accurately characterize habitat, including analysis of heterogeneous data and the inference of energy levels from shear stress.*
4. *The proposed method for evaluation of impact of fishing on habitat has the potential to provide sensitivity-adjusted fishing areas for specific management alternatives. However, a more formal and transparent method is needed for the derivation of the sensitivity criterion used by the model and its uncertainty as a function of susceptibility and recovery. Higher spatial resolution of fishing effort is also needed.*
5. *In general, the SSC concludes that the PDT's general approach provides the best available approach to assessing the impacts of fishing on habitat. However, critical elements of the analysis need to be revised and the method needs to incorporate biological components before the methodology can be used to evaluate fishery management decisions. A revised methodology should be reviewed by the SSC or an external peer review before being applied as the analytical tool for the EFH Omnibus 2, Phase II.*

The SSC commends the PDT for compiling a large volume of information and developing innovative approaches to evaluating the impact of fishing on habitat. We recognize that the proposed methods are developmental, and we offer the following technical comments to help refine the methods toward developing the ôbest science availableô for this task. Comments are organized according to the Terms of Reference for our review:

1. Vulnerability Assessment

1a. Literature review

- The literature review may not be comprehensive, but it is adequate to proceed in the development of analytical tools for evaluating adverse effects of fishing. There are some conspicuous omissions from the literature review (e.g., Deiter et al. 2003, Løkkeborg 2005, NRC 2002) and areas of limited scope, but the published reviews included in the PDTôs review include the major scientific advances and case studies for evaluating fishing effects, vulnerability, susceptibility and recovery. The PDTôs literature review is well organized to apply results and conclusions to the evaluation of fishing impacts.
- The PDT may have been too selective in its use of a small subset of publications that are directly related to the impacts of fishing. Other publications on impacts and recovery may be indirectly related to fishing impacts and should be considered in the vulnerability assessment.
- The focus on benthic habitat is an appropriate initial step, because the benthic habitat is a critical component and should be a priority. However, the entire water column should eventually be considered, particularly for the prey component of habitat.

1b. Matrix-based evaluation of vulnerability

- The matrix-based approach is appropriate for the descriptive nature of much of the information on vulnerability, susceptibility, recovery and sensitivity. As scientific information and methods develop, it would be appropriate to transition to a quantitative model that is based on functional relationships.
- Despite a considerable amount of effort by the PDT to include a ôbiologicalô component of habitat, the current evaluation is primarily based on the ógeologicalô component of habitat. The SSC concludes that ôbiologicalô and ópreyô components of habitat are essential elements for the evaluation of vulnerability, because many substrate properties are more determined by the benthic community they support than their physical attributes. Therefore, application of the proposed methodology without those components may produce misleading results. Although the PDT proposes to eventually include all habitat components, the SSC advises that they are necessary for implementation in the Omnibus Amendment.
    - An alternative categorization of habitat components that would more closely reflect mandated requirements of EFH would be shelter and prey.
    - Ecological succession models may be an approach to determining biological components of habitat where observational data are lacking.
    - Although fine-scale spatial models are appropriate for characterizing the geological component of habitat, it may not be the optimal approach for some biological components (e.g., some forage species). Non-spatial alternatives, or broader-scale spatial models should be considered as a basis for the incorporation of biological components of habitat.
- Some of the categories in the matrix-based approach are arbitrary or subjective, and results may not be repeatable by a similar group of experts. Sensitivity analyses would be an informative approach to evaluating uncertainty in results.
    - ôRecoveryô is appropriately evaluated as a function of high or low energy environments used to derive sensitivity score for spatial cells. However, sensitivity of result to the depth

threshold and energy threshold for determining high or low energy categories should be assessed.
    - The proposed matrix approach considers susceptibility and recovery of different habitats, but not their relative values for fishery resource production or ecosystem services. Future developments should consider habitat value. For example, ómatureô benthic communities (i.e., the climax stage of ecological succession for each physical habitat type) should be considered a high-value habitat.
- Methods for deriving quantitative indices from subjective determinations should be explored to more formally retain information from individual PDT membersô scores, and analyze them in a statistically sound and repeatable way that includes variability among scores and uncertainty in derived decision variables (e.g., Saaty 2008).
- The PDT interpreted the EFH requirements of the Magnuson-Steven Act and associated guidelines to consider only adverse effects of fishing on habitat. An alternative interpretation of the guidelines would allow for consideration of positive habitat effects in the evaluation of net adverse effects.

2. Swept Area Seabed Impact (SASI) Model

- The analysis of swept area of fishing is appropriate, but some modifications should be considered to refine the method.
    - The assumption that epifaunal species are more sensitive than infaunal species may not be accurate, and three-dimensional impact (i.e., penetration of substrate) should eventually be incorporated into the evaluation of seabed impact.
    - Several specifications of fishing gear are not included because data are not available. Information should be collected and incorporated into the analysis, including weight of gear on the bottom (including buoyancy at depth and hydrodynamic lift), trawl foot rope type (e.g., cookies, rollers, tickler) should be considered.
    - The calculation of swept area assumes additivity of fishing effort. For the same gear type, there is no consideration of the relative impact of multiple passes. Similarly, interactive effects of different gear types on the same bottom are not considered.

3. Spatial Model

- The SSC agrees that the level of resolution should be optimized for each source of information independently. However, alternative levels of resolution and methods of aggregating multiple-observation cells should be examined for substrate data.
    - Averaging data within cells does not recognize the different nature of observations or the nonlinear relationship of grain sizes. For example, averaging a survey hang and a USGS sand observation to derive an average of gravel is not accurate. The simple arithmetic average implicitly assumes a linear scale of grain size. Extrapolation of grain size between two observations should be nonlinear (e.g., cubic extrapolation is conventional for volumetric processes).
    - An alternative approach to multiple-observation strata would be to express heterogeneity as percent-coverage (e.g., 10% boulder, 90% sand), similar to the characterization of heterogeneous ecological coverages in terrestrial applications of geographic information. Some aspects of ecological recovery may be associated with heterogeneity.
- Groundtruthing and cross-validation are needed to assess the accuracy of spatial extrapolations.
    - For example, it would be informative to compare USGS observations with the SMAST video survey observations in the same spatial cell.

- Point observations of benthic communities and sidescan acoustic imagery should be used to groundtruth inferred energy environments.
- Spatial results of ecosystem components from the ATLANTIS model could be used as source data or groundtruthing.

- Determination of ôboldersô habitat using trawl survey ôhangsô may inappropriately extrapolate the inference of hard bottom to nearby areas.
  - As illustrated in Figure 9 of Document 1, the area south of Cape Hatteras is determined to be boulder as a result of survey hangs with no associated substrate data in the area. The same inaccurate extrapolations are also likely in smaller areas throughout the region.
  - Information from fishermen may be a valuable source of information on hard-bottom areas.
  - Perhaps some information on area swept to boulder encountered would provide an estimate of boulder density that would be more informative that the presence or absence of a hang.
- The determination of high or low energy environments is critical for the evaluation of recovery. However, energy categories are inferred from shear stress calculations rather than direct observation. Deriving shear stress from an oceanographic model requires empirical information on bottom rugosity wherever it is available to avoid rugosity values that are adjusted to fit observed tidal dynamics.
- When the entire methodology is accepted as the basis for fishery management decisions, all spatial data will need to be documented, transparent and available upon request.

4. Fishing Gear Seabed Impact (FiGSI) Model

- The derivation of ósensitivityô as a function of susceptibility and recovery scores (Document 1 Table 34) is not clearly documented and may not have appropriate properties for sensitivity-adjusted fishing effort.
  - The derived values are essentially non-ordinal ranks that have been assigned equal intervals between 0 and 1. However, the equal spacing between intermediate sensitivites and equal sensitivities of different combinations of susceptibility and recovery are difficult to justify. For example, Table 34 lists equal sensitivity values (*Se*=0.2) for two combinations of susceptibility and recovery (medium susceptibility-fast recovery or low susceptibility-moderate recovery), and both situations are score as 20% of the sensitivity of a high susceptibility-very slow recovery (*Se*=1.0) and about 50% more sensitive than low susceptibility-fast recovery (*Se*=0.13). Although the extreme values are logical, neither the rankings nor the intervals appear to be scientifically justified.
  - As noted above for the vulnerability assessment, aggregate indices of sensitivity should be based on a more formal and quantitative process that is repeatable and transparent.
  - Methods routinely used for multimetric indices of benthic habitat should be considered indices used to assess environmental quality (e.g., Karr and Chu 1997)
- The spatial resolution of fishing effort data from vessel trip reports is too crude to provide an informative analysis for fishery management decisions. Information from vessel monitoring systems, observers and study fleets should be explored for higher spatial resolution of fishing effort.

The SSC appreciates the progress made by the Habitat PDT in developing a methodology for evaluating fishing effects on habitat. The SSC looks forward to working with the PDT and learning

how best to manage the scallop fishery in conformance to the new guidelines. Please contact me or Dr. Jake Kritzer (the SSC lead for habitat) as these methods and analyses develop.

References

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