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To: Tom Nies, Executive Director
From: Scientific and Statistical Committee
Date: May 28, 2013

Subject: **Review of approach used by the Groundfish Closed Area Technical Team (CATT) to identify important juvenile groundfish habitat and spawning locations**

The SSC met on May 16, 2013 to address the following terms of reference (TORs):

1) Review the basic approach used by the CATT to identify important juvenile groundfish habitat and spawning locations.
    a. Is the basic approach sound? Are there any red flags?
    b. Are choices and assumptions made by the CATT to analyzing groundfish hotspots reasonable and appropriate?
2) Are the analyses, results, and hotspot summaries used by the CATT appropriate for developing management options?
3) Are there important caveats about the data and results that the Council should recognize?
4) Given the shortcomings of currently available data for this purpose, can the SSC recommend data that should be collected on a routine basis to evaluate the performance of habitat and spawning management areas?

The SSC considered the following documents in its deliberations:

2.1 Synopsis of CATT analysis
2.2 Getis-Ord G-star and Spatial Autocorrelation implementation in ArcView
2.3 Getis-Ord statistic
2.4 Limiting distribution of the G statistics Zhang 2008
2.5 Correspondence with Dr. Brian Kinla
2.6 Juvenile groundfish substrate association scoring
2.7 CATT report April 2013 Council meeting
2.8 CATT Progress Report January 2013
2.9 Fortin et al spatial autocorrelation and sampling design in plant ecology
2.10 Baruch Mordo et al spatiotemporal distribution of black bear human conflicts in Colorado
2.11 Cod structure workshop June 2012 Zemeckis
2.12 Mapping and Analysis to Support New York State's Offshore Spatial Plan
2.13 Final report on cod and yellowtail flounder habitat association, Truesdell, UMO

TOR1

The SSC concluded that the approach used by the CATT is technically sound. No red flags were identified, and the choices and assumptions adopted are all reasonable.

TOR2

The SSC concluded that the analyses, results, and hotspot summaries used by the CATT are appropriate for developing management alternatives. Development of alternatives should take into account the considerations identified in TOR3 and the following:

1) Objectives should be clear, ideally including quantitative metrics for both development of alternatives and evaluation of success. However, the SSC recognizes that much of the information needed to determine metrics for development of alternatives is not available at present. This means that alternatives will by necessity be developed using a combination of quantitative measures like those provided by the hotspots analysis, and qualitative decisions about the cut-off for protection. This should not hinder development of alternatives, but underscores the importance of a thorough research and monitoring program in order to evaluate and adapt management strategies in a timely manner (see response to TOR4).
2) Development of alternatives should proceed not only using the analyses conducted by the CATT, but also other data, analyses, observations and other information, such as observations of spawning aggregations from fishermen, other properties of the ecosystem and socio-economic considerations. The strength of alternatives and extent of measures implemented will depend upon the breadth of information brought to bear in their development.

TOR3

When evaluating and applying the CATT analyses the SSC believes that consideration should be given to the following points:

1) The possibility of mismatches between the timing of the survey and the timing of spawning within each season means that the alternatives aimed at protecting spawning might miss some or all of the spawning activity in space or time. The significance of this mismatch will depend on the spatial and temporal extent of the closure.
2) Areas with bottom structure that cannot be sampled by survey vessels might represent important juvenile and/or spawning areas that will not be detected by the analysis. This concern is primarily restricted to areas with especially complex bottom, including Fippenies Ledge, Cashes Ledge, Platts Bank, Jeffreys Bank and the northern extent of Jeffreys Ledge in the Gulf of Maine, plus the area of Nantucket Shoals west of the Great South Channel. These sampling limitations highlight the importance of considering other information alongside the analysis (see point #2 under TOR2).
3) The hotspot analysis included selected non-groundfish species such as alewife, Atlantic herring, goosefish and other species, but the weighted grid analysis was intentionally limited to species managed in the groundfish FMP to address the goals and objectives approved by the Council. Further analysis of effects should include other species so that the potential benefit to other species managed by the Council, species managed by other Councils or the states, protected species, or unmanaged species can be assessed.
4) The analysis assumes that a high concentration of juveniles indicates that the underlying habitat is both important and vulnerable.
5) The potential for displacement of fishing effort into vulnerable areas not identified by the analyses can lead to unintended consequences. Combining the CATT analyses with other

information on species distributions and use of space (per the SSC response to TOR2) can lessen this concern by providing additional insights.

6) The analysis assumes some stationarity in the factors that determine the importance of a given area for either juveniles or spawning. However, other more dynamic factors, such as temperature and other oceanographic conditions, might be as or more important as drivers in the system. If these factors change, then the identified areas might no longer be the most important ones for juvenile groundfish habitat. Further work on the CATT's juvenile cod and yellowtail flounder habitat GAMs analysis could provide further insight, because temperature and currents (shear stress) were included in the models. Since the GAMs analysis was indirectly used to support management measure options, it was not reviewed by the SSC at this time.
7) The analysis assumes that the data period chosen reflects the conditions most likely to be observed in the near-term future. Historic data are less useful in this context, but might be indicative of future conditions if ecosystem balance is restored and groundfish and forage stocks are rebuilt. However, this might not be the case if species' distributions and use of different areas change with either increases or decreases in abundance, or if ecosystem change (e.g., temperature, predator or prey fields, etc.) alters use of different habitats independent of changes in abundance. Time periods further in the past when stock sizes were larger could lend insight into condition in the future if abundance increases, unless ecosystem change alters those patterns.

The SSC reiterates that it finds the analysis to be sound and useful for developing management alternatives. These additional considerations should inform development of alternatives, gauge expectations of closed area performance, and help design research and monitoring strategies. Thorough research and monitoring will allow more timely evaluation of these issues, and adaptive management strategies in response.

TOR4

Time constraints precluded a thorough discussion of recommendations for additional information that should be collected, as well as prioritization of different types of information. Given that the SSC strongly recommends monitoring and adaptive management as being critical to effective implementation of spatial management strategies, a more thorough discussion and prioritization is needed. The SSC did, however, compile a preliminary list of information to consider, building on recommendations developed by the CATT, including:

- Ecological and socio-economic data, including value of a particular trophic component to the ecosystem, market value of harvested fish, and fleet composition and capacity to allow for a structured decision-making framework for evaluating decision options relative to harvesting one component of the fish community while protecting another.
- Observer data that we currently have on hand should be further analyzed and additional data should be collected. Consideration should be given to collection of more biological information on finfish and invertebrate catches on a subset of observed trips using trained biologists. At the present time, only total weight and lengths are typically measured and no biological information about gonad condition and stomach contents are collected.
- Information provided by fishermen and other ocean users that is organized and analyzed by scientists with expertise in collection and application of local ecological knowledge.

Summary of recommendations

1. **The SSC concluded that the approach used by the CATT is technically sound. No red flags were identified, and the choices and assumptions adopted are all reasonable.**
2. **The SSC concluded that the analyses, results, and hotspot summaries used by the CATT are appropriate for developing management alternatives. The CATT analyses should be used in combination with as much additional information as possible. Future development and evaluation of management measures will be improved by a well-designed research and monitoring program, and mechanisms for timely adaptation based on measured performance against clear metrics is recommended.**
3. **A series of considerations related to assumptions about past, current and future conditions, as well as important factors not addressed by the analysis, should be borne in mind when developing alternatives. Consideration of additional information, monitoring, and adaptive management can help address these issues.**
4. **Improved research and monitoring linked to clear objectives and adaptive management strategies will improve effectiveness of spatial management, especially in an evolving ecosystem.**