

Industry Based Surveys NEFSC Comments on Pilot IBS Reviews and Status For RSC Discussion

#4

The Northeast Cooperative Research Partners Program (NCRPP) funded three Industry Based Pilot Surveys (IBS);

- Gulf of Maine Cod - with MA-DMF,
- Southern New England Yellowtail flounder – with RI-DFW, and
- ME-NH Inshore survey – with ME-DMR and NH-DFW (alt years funded by Northeast Consortium).

These pilot surveys addressed the following specific objectives (identified during facilitated regional workshops in 2000 and 2001);

- broad scale distribution of cod aggregations in the Gulf of Maine, in space and time, by age and size composition;
- assess the abundance, distribution, movement patterns and size/age composition of SNE yellowtail (and associated species) temporally and spatially within the Nantucket Lightship closed area, and proposed closed and adjacent areas,
- a multi-species fishery independent inshore standardized trawl survey for inshore and nearshore coastal species in areas off NH and ME.

The GOM-Cod and SNE-YTF projects addressed management questions relating to the effectiveness of closed areas and collected ancillary biological samples for age-length keys and maturity information as a secondary priority. The ME-NH inshore survey was designed to complement the federal research vessel (Albatross & Delaware) surveys and provide standardized inshore coverage similar to that provided by the MA-DMF inshore survey, conducted aboard a federally owned industry style trawler.

All of the pilot surveys reflect significant industry, science and management interest in using industry vessels to address specific and limited resource assessment and management questions. The IBS concept was to engage industry in conducting short “one-off” surveys with specific objectives, as opposed to longer-term monitoring surveys. *The design of each survey is therefore, critically linked to the survey objective. Choices relating to the number of vessels, net design, station sampling protocols, temporal and spatial coverage, and arrangements for vessel inter-calibration and/or depletion studies; constrain the utility of the data in terms of what analyses and uses are statistically appropriate.* The final design and implementation of these surveys was limited by appropriated budgets and differed from the discussions at the workshops.

These pilot surveys have collected data for a few years. The NCRPP and the NEFMC-RSC require peer reviews before cooperative research results can be considered by managers. The Resource Steering Committee (NEFMC-RSC) has been provided copies of peer review reports for the following surveys:

- ME-NH Inshore Groundfish Trawl Survey – Sept 2005,
- Review of mid-Atlantic supplemental finfish survey and the cooperative monkfish survey – March 2006,

- Industry Based Survey for Gulf of Maine Cod – August 2006.

The NEFSC has committed to schedule a peer review for the SNE-YTF in early 2007. All YTF and cod catch data are available through the NEFSC survey database and accessible to the public through the web based GIS system (see NCRPP website). A representative sub-sample of the biological samples collected during the IBS (age and growth structures) are being processed for the benchmark assessments in 2008.

Initial cod review comments indicate that, in terms of evaluating the effectiveness of time and area closures and to supplement biological sampling, significant data has been provided and the cod IBS has been largely successful at providing data to evaluate the closed areas. Clearly, there are opportunities for additional analyses of the cod data relative to upcoming assessments. The analytical resources needed for these analyses are limited in the NEFSC.

Rather than provide detailed comments on each peer review, the NEFSC would rather focus on the issues that have direct bearing on the utility of the cod IBS (and other IBS) for improving the reliability and precision of analytical stock assessments. While the NEFSC emphasis is on the stock assessments and gaps in survey coverage, this does not rule out discussions on IBS utility for addressing new management questions.

Reviewers identified significant technical issues with respect to utility of these surveys and their current designs in providing **indices of abundance**. The reviewers focused on stratification design issues (random vs industry selected), geographical and depth coverage, standardized gear and station protocols, vessel consistency, and fishing power calibration. These comments are consistent with NEFSC concerns. The NEFSC is addressing similar issues in preparation for the transition to the FSV Henry B. Bigelow, along with a new net and survey design which will include sampling in deeper strata. It would be valuable to begin a discussion centered on the concept of an “integrated survey system” that incorporates the FSV Henry B. Bigelow, industry based surveys, and coastal ecosystem surveys conducted by State Marine Resource Agencies.

The NEFSC recommends that an initial priority be placed on discussing the potential utility of Industry Based Surveys at addressing concerns about the adequacy of inshore survey stations. This would require addressing peer review comments relating to survey design, and consistency in vessel and sampling protocols. This is consistent with the response of the ME-NH IBS team to their surveys peer review comments, and partially explains the RSC recommendation to place a priority on funding that inshore survey. While the NEFMC-RSC is primarily concerned about the New England area, the NEFSC is interested in comprehensive inshore surveys that cover from NC to ME. There is an inshore survey gap in southern New England, between Martha’s Vineyard, MA and Montauk, NY. The NEFSC also points out that dedicated funding for the NEAMAP survey from NC to Montauk is uncertain.

The NCRPP is seeking Council (through the RSC), and constituency discussions on future fishery independent surveys and other cooperative research priorities.

**Northeast Cooperative Research Partners Program
Industry Based Survey Technical Review (Days 1 & 2)
And
Discussion session on Integrating State, Federal
and IBS surveys in the Northeast Region(Day 3)**

**August 29 – 31, 2006
University of New Hampshire
Urban Forestry Center
Portsmouth, New Hampshire**

Agenda

**Day 1
Technical Review Cod and YTF IBS
August 29, 2006**

10:00	Welcome and Introductions - Review Terms of Reference
10:15 – 11:30	Industry Based Survey Presentation - Gulf of Maine Cod
11:30 – 12:45	Break
12:45 – 2:00	Continue IBS GOM Cod Presentation – Question and Answer Period
2:00 – 3:00	Lunch
3:00 – 4:15	Industry Based Survey Presentation – Southern New England Yellowtail
4:15 – 4:30	Break
4:30 – 5:45	Continue IBS SNE Yellowtail Presentation – Question and Answer Period
5:45 – 6:00	Closing remarks – Adjourn

Day 2
Technical Review Cod and YTF IBS
August 30, 2006

8:00 – 10:00	Panel member meeting – closed (optional)
10:00 – 12:00	Presentation review Panel Question and Answer period
12:00 – 1:00	Lunch
1:00 – 3:00	Presentation review Panel Question and Answer period Open Forum
3:00 – 5:00	Review Panel report drafting session (optional)
5:00 – 5:15	Closing remarks - Adjourn

Day 3, August 31, 2006

9:00 – 12:00	Strategic Planning – State, Federal, and IBS Survey Integration Trigger Questions provided by NEFSC Future of IBS versus other Cooperative Research activities New IBS initiatives (fixed gear) Integration with other nearshore survey programs
12:00 – 1:00	Lunch
1:00 – 2:00	Preliminary Review Committee Comments Wrap up Overview.

DRAFT Terms of Reference for Technical Peer Review of the NCRPP Industry Based Survey (IBS) Program

1. **Design and Execution.** The review panel should evaluate the statistical and scientific validity of the two survey designs relative to the program goals and objectives, highlighting strengths, weaknesses, and potential biases. In particular:
 - a. evaluate the temporal and spatial design elements relative to survey objectives,
 - b. evaluate random versus industry selected sample stations,
 - c. evaluate the estimation of survey area as it relates to absolute biomass estimates and the validity of such estimates,
 - d. evaluate sampling protocols, sub-sampling procedures and onboard processing of biological materials and total catch, and
 - e. evaluate data post-processing procedures and archival policy.
2. **Data Utility.** The review panel should evaluate the surveys' utility in assessing:
 - a. the efficacy of fishery closure areas,
 - b. stock abundance,
 - c. migratory or movement patterns,
 - d. reproductive demographics,
 - e. and other biological characteristics such as age and growth parameters.
3. **Consistency.** The review panel should evaluate the consistency and comparability among temporal and spatial sampling frames in relation to field procedures, gear selection and maintenance, vessel comparability, data acquisition, and analysis.
4. **Quantitative Analysis.** The review panel should evaluate quantitative analysis techniques, measures of statistical precision, and recommend design or analytical processes that will improve the utility of existing survey data.
5. **Cost Effectiveness.** The review panel should compare the cost effectiveness of the IBS program relative to the costs of the NEFSC Bottom Trawl Survey.
6. **Integration.** The review panel should evaluate the potential for integrating the IBS surveys with NMFS or other inshore trawl surveys or fishery independent monitoring programs. This includes interoperability and comparability of NEFSC current (R/V Albatross IV) and future (R/V Bigelow) bottom trawl surveys and states' near shore trawl survey programs. The panel should also evaluate the potential of integrating fixed fishing gear in the IBS program.
7. **Future of IBS and Other Initiatives.** The review panel should be prepared to make recommendations concerning the continuation of IBS program and development of future fishery independent programs under NCRPP.

Peer Review of Industry-Based Survey for Gulf of Maine Cod

August 29-30, 2006, Portsmouth, NH
Ghislain Chouinard, Ken Weinberg, and Jack McGovern

Introduction

The following report is a review of a cod industry-based survey (Cod IBS) designed to examine the distribution and demographics of the cod stock in the Gulf of Maine. The survey design utilized a standardized grid as well as randomly selected locations provided by fishermen. An additional objective of the study was to provide information on the age and length structure of cod within rolling closure areas. An external panel was invited to review the technical aspects of this survey following the terms of reference provided in Appendix 1. The organization of this report follows the terms of reference. Participants at the review are listed in Appendix II.

It should be noted that the review was originally intended to also examine the southern New England yellowtail flounder industry-based survey; however, no presentation of the information could be made at the meeting and that review was dropped from the agenda.

Main Findings and Conclusions of the Panel

- The Cod IBS represented an enormous amount of work for the investigators, cooperating fishermen, and NCRPP. Much care was taken in the development of the survey design and gear. An outreach program designed to keep the fishing community and general public aware of survey activity was initiated consuming considerable time and energy. The panel commends the survey team for their thoroughness and dedication.
- The Cod IBS provides valuable information on cod in the Gulf of Maine when no other sources of data are available. The Cod IBS is a good example of a cooperative project.
- The survey provides high resolution information on the spatial and temporal distribution, size composition, maturity and potentially age of cod and augments existing surveys.
- There is some concern that the lack of sampling of cod in water deeper than 75 fathoms may not provide a complete picture of cod distribution particularly during the winter.
- Survey data are useful in determining the location and timing of cod in spawning condition as well as the coincidence of spawning cod with rolling closures.
- It is assumed the efficiency of the four commercial vessels providing data is the same; however, inter-vessel comparisons would be desirable.
- The data presented provide a qualitative spatio-temporal view for a number of parameters; however, further statistical analyses are required to determine if there are significant differences.
- While it may be possible to use the data collected during the survey to derive indices of stock abundance for specific species, a significant number of issues would first need to be examined and resolved.
- Survey design is very good for the objective of examining cod distribution but the mixed design is not easily adaptable for other types of common survey analyses.

1. ***Design and Execution.*** *The review panel should evaluate the statistical and scientific validity of the two survey designs relative to the program goals and objectives, highlighting strengths, weaknesses, and potential biases. In particular:*
 - a. *evaluate the temporal and spatial design elements relative to survey objectives,*

The Cod IBS utilized two independent designs to address their primary and secondary objectives of providing a high-resolution temporal view of cod distribution in the Gulf of Maine in conjunction with rolling closures and provide information on other commercially important groundfish resources. The survey area extended from the Canada-U.S. border south to 41°30' N. latitude and appears to adequately cover the geographic boundaries (excluding Georges Bank) of the Gulf of Maine. The survey area encompasses a depth range of 10 to 75 fathoms and may fall short of describing the entire cod distribution believed to occur out to depths of 90 fathoms, particularly in winter when cod are found in deeper waters. Detailed size composition and maturity data provided an excellent view of the size and maturity distributions of the cod stock from this region. Although collected age structures have not been processed to date, once read, they will provide valuable information on the age composition of the Gulf of Maine resource. Data provided fills gaps in NMFS surveys by sampling different periods as well as inshore areas. Maturity information also fills temporal gaps in data provided by the inshore surveys conducted by the state of Massachusetts and the Maine-New Hampshire inshore cod survey. There is potential for this survey to provide valuable information on cod recruitment but would require further analyses. A secondary objective of the Cod IBS was met by providing quality size composition data throughout the study area for a number of other commercially important groundfish species; although, further improvements in sampling are suggested below.

During each year of the Cod IBS, five cruises spanning the survey area were conducted, providing investigators with adequate opportunity to compare cod distributions temporally. However, due to conflicts with fixed gear and/or encountering untrawlable bottom several stations were dropped during some or all cruises. Users of the data will want to consider this when making direct comparisons between cruises.

The survey area was overlaid with a systematic or "fixed" grid background consisting of 9-minute blocks having a sampling station centered in each block. Sampling density achieved under this grid design would be considered high by most bottom trawl surveys used for stock assessment purposes. While a more random approach to sampling populations is often used, systematic grid designs are effectively employed elsewhere to assess and describe fish distributions. The Cod IBS included a second layer of sampling effort based on advice from industry to ensure the centers of cod abundance were sampled. These "industry tows" were placed in 3-minute cells over 16 strata that overlapped selected portions of the background systematic grid, forming a pool of stations that were randomly drawn from on each cruise. It is important to note that industry stations available between cruises within a survey year varied based on fishers' perception of cod availability. Sampling effort was apportioned between these two designs with 64% of the effort expended on fixed tows and the remaining 36% on industry tows. The combination of both designs was useful for evaluating rolling closure

areas. However, the usefulness of industry tows for other purposes such as analyses involving size and age composition or for computing indices of relative abundances is questionable and combining the data from the two designs does not appear outwardly appropriate for routine statistical analyses.

The Cod IBS originally covered depths ranging from 10 to 60 fathoms during the first year of sampling but was later extended to 75 fathoms based on advice from an external review committee to improve sampling of large mature and spawning cod, particularly during winter. Consideration was given to cover depths out to 90 fathoms, but given financial constraints and the negative impact the additional fixed grid tows would have on reduction of industry tows, a decision was reached to keep sampling within 75 fathoms. The Panel felt, for the purpose of a pilot survey, sampling of the Gulf of Maine Cod stock between the depths of 10-75 fathoms was adequate and in part supported by NEFSC survey findings. However, sampling in water deeper than 75 fathoms may prove worthwhile and should be considered if the survey is continued, even at the expense of losing industry tows.

b. evaluate random versus industry selected sample stations,

An ad hoc presentation of the catch comparison between fixed grid and industry tows showed similar distributions. The data from fixed grid tows are appropriate for most standard statistical analyses. The Panel recognizes that a genuine attempt to randomize tows within industry strata was made; however, the inferred area these tows may represent is unclear and likely limited. The Panel recommends further analyses and comparisons between grid and industry tows be made but also notes the outcome may be contrary to industry expectations. The use of industry tows in future surveys may not be warranted. The Panel felt the characterization of cod size and age distribution for the entire area is better accomplished by using only the fixed grid tows.

c. evaluate the estimation of survey area as it relates to absolute biomass estimates and the validity of such estimates,

Estimating absolute abundance was not a stated objective of the Cod IBS. Accordingly, the review panel was asked not to address this term of reference as stated, but instead, to offer an opinion as to whether these data could be useful for determining relative indices of abundance. Inter-vessel comparisons would be desirable before using data for this purpose. Should funding be limited, side-by-side comparisons between vessels could be performed in an area of high abundance and varied depths in lieu of obtaining samples from a low productive stratum such as in the east where both station completion and cod distribution was low. In some cases, but not all, fishing power corrections are appropriate on a species-by-species basis. A decision rule on when to apply fishing power correction factors is described by Munro (1998) and may be applicable to these data.

Standardization in the gear and methodology used to conduct bottom trawl surveys is essential for a correct interpretation of catch per unit of effort as a measure of relative abundance. The Panel recommends protocols on station search patterns and fishing operations be clarified, tightened, and targeting of fish sign as is commonly practiced in

“commercial style” towing be monitored constantly and prevented to ensure catch efficiency remains constant between samples. Stations should be assigned randomly between participating vessels rather than having vessels working in different areas and depths. The Panel also expresses concerns over the potential for fish loss during tows sustaining variable magnitudes of net damage and the inclusion of these tows in analyses. Further refinement in the standardization process for tow acceptance is needed and more detailed accounting of questionable tows should be contained in metadata files.

The net mensuration data indicated some vessel differences in the spread of the trawl gear, particularly for the smaller vessel used in the survey. For this reason, area-swept methodology for estimating CPUE, taking into account curvature of the tows, may be preferable to estimates based on time X speed methodology, or at the very least, CPUE could be based on distance fished from GPS (also taking into account curvature of the tows) if net mensuration data were missing for a large number of tows. Perhaps fitting a regression to net spread and wire length data can be used to estimate the area swept for tows without net mensuration data. The use of net mensuration equipment on all tows is highly recommended for future surveys.

A stratified random survey design could be considered to replace the Cod IBS mixed survey design, given the difficulty of obtaining some fixed station samples each year and the analytical problems associated with using industry-selected tows. Fisher acceptance of such a survey design might be explored by presenting the distribution of tows from the surveys completed to date and those resulting from a stratified random selection, which may adequately cover hot spots and address concerns about the lack of sampling of potentially high abundance areas.

d. *evaluate sampling protocols, sub-sampling procedures and onboard processing of biological materials and total catch, and*

The Cod IBS utilized 4 commercial vessels of similar class, skippered by 4 captains having adequate trawling experience. The survey gear seemed appropriate given the objectives of the survey. Each vessel utilized the same survey gear from the doors aft (no information on trawl wire specifications was provided). Assurances of proper gear maintenance was given to the Panel; however, it is understood that trawls sustaining repetitive damage in the range of 10-30% would be difficult to maintain to survey standards while at sea. It was unclear as to the standards used for proper wire measurement or if monitoring of differential wire lengths by side was regularly performed. Detailed descriptions of the process used to set and retrieve the gear, critical to the use of multi-vessel surveys, were also absent from the report, although they were briefly touched upon in the presentation.

Catch sampling protocols were appropriate paralleling those employed by the NEFSC. Maturity and age information collections were adapted to new levels as recommended by outside sources during the second year but may have been excessive. Collection rates for maturity and age should be further evaluated should the Cod IBS be continued. If a smaller sample size is needed more time can be spent on collecting information from other species. The use of high precision Marel basket scales to calculate total catch

weight and catch weight by species is commendable. Small amounts of fish and individual fish weights were taken with a spring scale but could be improved by using a smaller capacity Marel scale. Subsampling methodology was good. Subsampling tows having large numbers of cod could potentially make more time available for the collection of data on other species.

To make the survey more useful, the collection of comprehensive data for other species should be done more consistently. This would imply establishing minimal sampling levels and/or cyclical sampling levels based upon life history. Otoliths must still be processed and interpreted so that the temporal and spatial distribution of ages can be examined.

e. evaluate data post-processing procedures and archival policy.

Attention to detail was adequately applied during all phases of the data editing process as described to the Panel during the presentation of survey results. Both manual and automated processes were used. The data were provided to the NEFSC for archival with appropriate measures taken for control of its use. A metadata file describing protocols, towing and catch sampling procedures and anomalies to the data contained in the database (particularly for tows sustaining varied degrees of net damage) should be developed and stored along with the database. This would be useful in data interpretation over the long term.

2. Data Utility. *The review panel should evaluate the surveys' utility in assessing:*

a. the efficacy of fishery closure areas,

The Cod IBS has provided additional data on cod in locations and during times when data are not available from any other fishery-dependent or fishery-independent sources. The Cod IBS has also provided good data on the temporal coincidence of spawning cod and rolling closures; therefore, potentially providing information on the adequacy of these closure in reducing fishing mortality and protecting spawning individuals.

The utility of the Cod IBS data relative to the fishery closure areas (rolling closures) lies mostly in the identification of the areas containing spawning fish during specific times of the year. Generally, the monthly closed areas matched well with the areas where the highest catches of spawning fish could be found. In that respect, the survey data are useful to determine the location and timing of cod in spawning condition.

During the winter, the utility of the survey to identify areas containing spawning fish would likely be enhanced by extending the Cod IBS to deeper waters. It was also noted that the presence of spawning fish in May suggests cod in spawning condition may also be present in the area during summer months.

No data were presented on the assessment of the efficacy of the fishery closure areas. However, it was noted the objectives of the fishery closure areas remain somewhat unclear. The original objective of the fishery closure areas was to reduce fishing mortality by displacing fishing effort to areas and periods of lower aggregation. A perceived objective is that the fishery closure can lead to improved recruitment by

avoiding potential negative effects of fishing activity on spawning behavior and/or spawning success. If the objectives and rationale for the fishery closures were confirmed, an assessment of the efficacy of the fishery closures relative to the objectives could be attempted. The Panel considered this assessment would require data on a broader scale as well as data of a different type (e.g. fishing mortality or estimates of spawning success depending on the objectives) than those provided by the Cod IBS in the Gulf of Maine. The utility of the Cod IBS would be limited for the evaluation of the efficacy of fishery closure areas.

b. stock abundance,

The Cod IBS was not designed to estimate stock abundance. It has the potential to provide an index of abundance for cod in the future. However, some modification of the survey would probably be needed to meet the needs of assessment biologists. At the outset, the main objective of the Cod IBS was 'to define a broad scale distribution of cod aggregations in the Gulf of Maine, in space and time, by age and size composition'. The survey was; therefore, not designed to produce indices of stock abundance.

While it may be possible to use the data collected during the survey to derive indices of stock abundance for specific species, a significant number of issues would first need to be examined and resolved. One of the first issues to be considered is the survey area encompasses the entire distribution (or at least a high and constant proportion) of the species stock under consideration. Secondly, the current mixed design of the survey (grid stations and industry stations selected on a stratified random basis) is not amenable to the calculation of an index of abundance using traditional statistical techniques. An index derived from the grid stations only could be valid but, given that a number of grid stations could not be fished during each survey, the construction of an abundance index would require the same common set of stations be used from year to year. Using the same common set of grid stations may mean a significant portion of the species distribution is not sampled which may invalidate the use of the series as an index of abundance.

It was noted that it may be possible to derive valid indices of abundance for particular species with the existing data using geospatial techniques (e.g. kriging). The panel recommends that this be investigated if it is desired to derive abundance indices while maintaining the current survey design. Alternatively, the design of the survey could be changed to a stratified random design such as that used in the NEFSC, Maine-NH and Massachusetts surveys.

c. *migratory or movement patterns,*

The Cod IBS was not designed specifically to examine migratory or movement patterns. The data collected during the survey appear to provide some insights into the migratory patterns of a number of species. For example, the data provided suggested that cod and witch flounder appear to move to deeper waters while winter flounder does not appear to exhibit a significant migration. However, the absence of coverage in waters deeper than 75 fathoms limits the interpretation of survey results in that regards. It should be noted that seasonal surveys are an indirect way of inferring migratory patterns. Validation of the patterns uncovered through direct methods such as tagging programs is desirable. In that regard, a separate tagging study for cod in the Gulf of Maine has been conducted.

d. *reproductive demographics,*

The Cod IBS is successful in describing the spatial and temporal distribution of mature as well as spawning male and female cod with respect to time period and stratum. Currently, the Cod IBS is the only source of maturity information for Gulf of Maine cod. The seasonal nature of the Cod IBS also provides opportunities to collect samples for studies of reproductive dynamics (fecundity, egg viability, etc.).

e. *and other biological characteristics such as age and growth parameters.*

The temporal and spatial distribution of age and growth of cod cannot be described because otoliths have not been processed and interpreted by the NEFSC. In general, the utility of the survey for this purpose is potentially high for cod. It is noted that individual lengths and weight of cod have been collected and these data could be used to examine the spatio-temporal variation in fish condition in the area. Ageing material collected during the spring and fall Cod IBS could particularly be useful to augment the sample size for larger fish in aged-length keys.

3. ***Consistency.*** *The review panel should evaluate the consistency and comparability among temporal and spatial sampling frames in relation to field procedures, gear selection and maintenance, vessel comparability, data acquisition, and analysis.*

The Cod IBS experienced some problems affecting the consistency of annual sampling. Completion rates of the expected number of tows was lowest during the first year of sampling due to inexperience of the samplers, problems with the identification of towable bottom, and the presence of fixed gear. The presence of fixed gear in sampling grids, particularly off Maine has continued to pose an impediment to the completion of the specified number of stations during Years 2 and 3. As a result, some of the nine-minute grids have not been completed each year. However, despite these problems, the survey has obtained a very good picture of the spatio-temporal distribution of cod in the Gulf of Maine. Shorter tows off Maine might reduce interaction with fixed gear as well as hard bottom.

The same gear type has been used throughout the study period. Furthermore, the same protocol has been used in deployment of the gear by different vessels. However, protocol

could be enhanced to ensure that if different skippers or vessels were used in the future data would not be compromised.

Although the investigators have made efforts to ensure data are collected in a consistent manner among vessels, a vessel comparability study has not been conducted. The cost of conducting such an effort would affect the number of samples collected. One possible method to obtain the needed information would be to forego sampling in a less productive stratum (i.e. stratum 1 or 6) and thereby enable side-by-side comparisons in a more productive stratum (i.e. stratum 2 and 3). While data would be lost for one season in a stratum, the small study would help ensure data between vessels were being consistently collected and are comparable.

The data have been collected in a fairly consistent manner by the investigators. All cod are weighed and measured. Occasionally large samples of age 1 cod are subsampled for length. One change made in data collection procedures was to increase the number of cod retained for biological sampling from 1 per centimeter to 3 per centimeter. This change was based on a recommendation from a subcommittee who qualitatively determined sample size should be increased. However, it might be better to quantitatively estimate the appropriate sample size for age and maturity data. The current number of age and maturity samples might be adequate, more than needed, or less than needed. If fewer biological samples are needed from cod, then more emphasis could be placed on obtaining length information and biological samples from other species taken on tows.

Originally the Cod IBS sampled out to depths of 60 fathoms for cod. The Cod IBS provides good information on cod distribution, reproductive state, length and age structure within depth range of sampling, particularly during winter when there are no fishery independent data collected. However, the distribution of cod during the winter extends deeper than the original 60 fathom boundary of the Cod IBS design. Therefore, a change was made to the program to expand sampling from 60 fathoms out to 75 fathoms. There is some concern that there may be some cod as deep as 90 fathoms during winter. Expansion of sampling into deeper water would reduce the number of inshore stations that could be sampled and the vessel expense of sampling in deeper water would be greater. However, by not sampling in water deeper than 75 fathoms, the Cod IBS may not completely meet its primary objective of evaluating the spatial and temporal distribution of cod in the Gulf of Maine. Data from the NEFSC trawl survey could be compared to Cod IBS data to determine potential for cod in water deeper than 75 fathoms.

Sampling is somewhat inconsistent for species besides cod. Although samples are usually obtained for all species on a tow, a standard protocol should be identified for sampling species besides cod especially when catches are very large. Data are examined in a consistent manner; however, some statistical analyses are needed to determine if apparent differences in various parameters are significant. Comparisons of length frequency data are presented by stratum and time period. However, these comparisons include data pooled from grid and industry based stations. Before these data are pooled, the data from the different surveys should be analyzed to determine if they are

statistically significant. Furthermore, length frequency comparisons between strata and time period should be analyzed to determine if there are significant differences.

4. **Quantitative Analysis.** *The review panel should evaluate quantitative analysis techniques, measures of statistical precision, and recommend design or analytical processes that will improve the utility of existing survey data.*

Quantitative analysis of the data is lacking for the Cod IBS. Results presented appear to be qualitatively different with respect to time period and stratum; however, it is unknown if these apparent differences are significant. Comparisons could be made to determine if CPUE of cod from grid and industry sampling designs are significantly different. Comparisons between designs could be made within a stratum. Furthermore, similar comparisons could be made for lengths and age (once available) between grid and industry based tows. Once this is established, statistical comparisons of these parameters can be made between strata and time period.

Based on discussions at the workshop, it was unclear to the Panel whether expanded rather than raw tow data were contained within the database. The best practice would be to have raw data within the database to enable expansion through programming. Furthermore, it was not clear if all data contained in the field logs were contained within the database. Efforts should be made to ensure all data from field logs are entered into the database. Building maximum flexibility in the database would be obtained by recording and coding as much information as possible.

5. **Cost Effectiveness.** *The review panel should compare the cost effectiveness of the IBS program relative to the costs of the NEFSC Bottom Trawl Survey.*

Few data were provided to examine the cost effectiveness of the Cod IBS program as compared to the NEFSC bottom trawl survey. The investigators indicated the commercial vessel cost is \$4,844/day. These costs are somewhat higher than the 70-90' long industry vessels used by the NWFSC bottom trawl surveys on the west coast and lower than the 120-160' long chartered commercial trawlers used by the AFSC. The investigators also indicated the owners provided the vessel at a lower cost than they would to charter because this sampling task was put out for competitive bid and the vessel owners wanted to ensure they obtained the long term support of the IBS program. Federal vessels are higher in cost per day when annual maintenance, fuel and salaries are factored in, but NMFS Centers do not incur a charge for their use.

6. **Integration.** *The review panel should evaluate the potential for integrating the IBS surveys with NMFS or other inshore trawl surveys or fishery independent monitoring programs. This includes interoperability and comparability of NEFSC current (R/V Albatross IV) and future (R/V Bigelow) bottom trawl surveys and states' near shore trawl survey programs. The panel should also evaluate the potential of integrating fixed fishing gear in the IBS program.*

The terms of reference were revised at the meeting and this item was dropped.

7. ***Future of IBS and Other Initiatives.*** *The review panel should be prepared to make recommendations concerning the continuation of IBS program and development of future fishery independent programs under NCRPP.*

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References

- Munro, P. T. 1998. A decision rule based on the mean square error for correcting relative fishing power differences in trawl survey data. Fish. Bull., U. S. 96:538-546.

Appendix 1

**DRAFT Terms of Reference for Technical Peer Review of the NCRPP Industry
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 - d. reproductive demographics,
 - e. and other biological characteristics such as age and growth parameters.
3. **Consistency.** The review panel should evaluate the consistency and comparability among temporal and spatial sampling frames in relation to field procedures, gear selection and maintenance, vessel comparability, data acquisition, and analysis.
4. **Quantitative Analysis.** The review panel should evaluate quantitative analysis techniques, measures of statistical precision, and recommend design or analytical processes that will improve the utility of existing survey data.
5. **Cost Effectiveness.** The review panel should compare the cost effectiveness of the IBS program relative to the costs of the NEFSC Bottom Trawl Survey.
6. **Integration.** The review panel should evaluate the potential for integrating the IBS surveys with NMFS or other inshore trawl surveys or fishery independent monitoring programs. This includes interoperability and comparability of NEFSC current (R/V Albatross IV) and future (R/V Bigelow) bottom trawl surveys and states' near shore trawl survey programs. The panel should also evaluate the potential of integrating fixed fishing gear in the IBS program.
7. **Future of IBS and Other Initiatives.** The review panel should be prepared to make recommendations concerning the continuation of IBS program and development of future fishery independent programs under NCRPP.

Appendix II:

List of participants at the Industry Based Survey Peer Review Meeting
Portsmouth, New Hampshire, August 29-30, 2006, Convened by: Earl Meredith,
NMFS/NERO

Review Panel

Ghislain Chouinard DFO, Gulf Fisheries Centre, Moncton, N.B. Canada
John (Jack) McGovern NOAA Fisheries, SERO, St. Petersburg, FL
Ken Weinberg NOAA Fisheries, AFSC, Seattle, WA

Tuesday, August 29, 2006

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Wednesday, August 30, 2006

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Consensus Report
of the
Technical Review of the
Maine Department of Marine Resources

Maine–New Hampshire
Inshore Groundfish Trawl Survey

Convened by the
Northeast Consortium on August 22 and 23, 2005
at Maine Department of Marine Resources, Boothbay Harbor, Maine.

Submitted by:
Mr. Ghislain Chouinard, Chair
Mr. David Beutel
Dr. Christopher Legault

September 2005

Executive Summary

Impetus and goals for the review

Since the fall of 2000, an inshore trawl survey has been conducted in the spring and fall of each year in coastal waters of Maine and New Hampshire. The “Maine-New Hampshire Inshore Groundfish Trawl Survey” project has been funded by the Northeast Consortium and NOAA Fisheries, Northeast Regional Office and is led by scientists at the Maine Department of Marine Resources. The main objective of the survey is to provide abundance indices of marine species in coastal waters that could be useful in stock assessments conducted by NOAA Northeast Fisheries Science Center. The data are also of use to the New England Fishery Management Council and the Atlantic States Marine Fisheries Commission. As one of the major sources of information available concerning the coastal waters of the Gulf of Maine, it was imperative that all aspects of the surveys be formally assessed. The goals of the review required an extensive examination of survey design, data processing, and survey results to inform and improve future work and to assess the viability of using the data in the management of the resource. This report represents the consensus view of the review panel on this project.

Main findings and conclusions of the panel

- Overall, the “Maine-New Hampshire Inshore Groundfish Trawl Survey” was considered to be a valuable project with high scientific standards.
- The panel considers that there is a need to clarify the objectives of the survey.
- There is also a need to adjust the design of the survey (random and fixed stations issue).
- The panel recommends some minor modifications and suggestions for improvement in survey operations, biological sampling and data collection.
- The work is considered to be an excellent example of a cooperative project with extensive outreach work and good data accessibility.
- Data collected has high potential for use in stock assessments, ecosystem analysis and increased understanding of coastal waters of Maine and New Hampshire.

Recommendations for next steps for the project and the use of the data.

- There is need to seek secure and long-term funding for this project.
- Adjustments to sampling design, survey operations, biological sampling and data collection should be implemented as soon as possible.
- A few small scale experiments should be conducted to help resolve some issues with the survey operations (towing in tide, depth-warp ratio).
- If the secondary vessel is expected to be used again, it would be useful to consider conducting a comparative fishing experiment.
- More detailed analysis of the data collected to date is encouraged as it may help identify issues relating to the survey. It would also be helpful to illustrate the value of the work.
- Closer contact should be established with stock assessment analysts at NMFS who are likely to be important users of the data.

I. Introduction

Background

This document is the consensus report of the independent technical review of the cooperative research project titled "Maine-New Hampshire Inshore Groundfish Trawl Survey". The review was conducted in August 2005 and was co-sponsored by the Northeast Consortium and the NOAA Fisheries, Northeast Regional Office, since both entities have provided funding for the project which started in the fall of 2000. The review was conducted by three independent scientists, one from Canada and two from New England. The review was chaired by one of the panelists. The views expressed in this report are those of the review panelists and do not necessarily reflect those of the Northeast Consortium or NOAA Fisheries.

This survey of inshore waters of the Gulf of Maine is led by scientists at the Maine Department of Marine Resources (MEDMR) in partnership with the New Hampshire Department of Fish and Game and commercial fishermen. A primary objective of the survey is to derive indices of abundance of marine resources in inshore waters of coastal Maine and New Hampshire which are largely not covered by surveys conducted by the National Marine Fisheries Service (NMFS). It is hoped that these indices can be incorporated in stock assessments conducted by the NMFS. The survey has a number of other objectives, including the collection of biological data on marine species, the collection of data for the basis of fisheries management regulations, to assist fishermen displaced by groundfish closures, and to improve the credibility of science within the fishing community.

Two surveys of the area are conducted each year: one in the spring (early May to early June) and one in the fall (October-November). Since its inception, the survey team has faced a number of challenges including finding a bottom trawl gear design that is suitable for conducting the survey in difficult terrain, stiff opposition from lobster fishermen and other stakeholders concerned with potential damage to lobsters and marine habitat by the survey trawl, managing multiple and sometimes conflicting demands and objectives by those interested in the survey, insecure sources of funding, and lack of resources to conduct analyses of the data. Because the survey is conducted in lobster areas, the successful completion of the survey depends highly on the cooperation of lobster fishermen to temporarily remove their traps from survey stations. This has required the survey team to spend considerable amount of time in communication and outreach activities with the fishing community and the public at large. Despite the adversity, the survey team has managed to conduct both surveys every year.

Terms of Reference and Evaluation Criteria

The review panel was given the general task of reviewing the Maine-New Hampshire inshore groundfish trawl survey project with the overall objective of providing recommendations to inform and improve future work.

The panel was mandated to assess the project using general criteria that are specific to all projects funded by the Northeast Consortium (Appendix A). In order to guide the review, the panel was also given terms of reference specific to the Maine-New Hampshire Inshore Groundfish Trawl Survey (Appendix B). These related principally to survey design, survey operations, biological sampling, data recording, archiving and editing and the utility of the data in current and future biomass assessments.

Panel membership

The review panel was composed of three fisheries professionals who, as a group, had expertise in the areas of stock assessment, trawl gear design and trawl surveys, fish population dynamics, and fisheries statistics. A short description of their respective area of expertise and experience is provided below. All panelists have signed the Northeast Consortium's "Conflict of Interest and Confidentiality Policies for the Technical Evaluation of Projects" agreement. These individuals served as contractors independent of their employer. Views expressed do not necessarily represent those of their employer or government.

Mr. Ghislain Chouinard, Chair, Moncton, New Brunswick, Canada

G. Chouinard is a research scientist and Head of the Marine Fish Section, at the Gulf Fisheries Centre, Canadian Department of Fisheries and Oceans. He has been involved with stock assessments of cod, herring and flatfish of the southern Gulf of St. Lawrence. He has acted as Chief scientist on multi-species trawl surveys since the mid-1980 and has experience in the use of trawl survey data in stock assessment. Mr. Chouinard is a member of the Resource Management Committee of ICES since 2001.

Mr. David Beutel, Kingston, Rhode Island

D. Beutel is a research associate and fisheries operations supervisor at the University of Rhode Island since 1992. Mr. Beutel is a former commercial fisherman with experience in the design and construction of commercial fishing and experimental bottom trawls. He has been involved in mesh selectivity experiments and other outreach projects. Mr. Beutel is an instructor in the area of fishing gear and fishing operations for the National Marine Fisheries Service.

Dr. Christopher Legault, Woods Hole, Massachusetts

C. Legault is a research fishery biologist in the Population Dynamics Branch at the Woods Hole Laboratory of the National Marine Fisheries Service. Dr. Legault has extensive experience in fisheries research and the use of statistical techniques in the study and assessment of fish populations. Dr. Legault is a member of the ICES Working Group on North Atlantic Salmon and has served on several review panels in the area of fish stock assessment.

Review Process and Logistics

The review was conducted at the Maine Department of Marine Resources facility in Boothbay Harbor, Maine on August 22-23 2005. In advance of the review, the panel was provided with a number of background documents including:

- *Final Report to the Northeast Consortium on the Maine-New Hampshire Inshore Groundfish Trawl Survey: July 2000 – June 2001*; Maine Department of Marine Resources Research Reference Document 02/02.
- *Final Report to the NOAA Fisheries/NERO Cooperative Research Partners Initiative on the Maine-New Hampshire Inshore Groundfish Trawl Survey: July 2001 – June 2002*; Maine Department of Marine Resources Research Reference Document 03/01.
- *Final Report to the NOAA Fisheries/NERO Cooperative Research Partners Initiative on the Maine-New Hampshire Inshore Groundfish Trawl Survey: July 2002 – June 2003*; Maine Department of Marine Resources Research Reference Document 04/02.
- *Final Report to the Northeast Consortium on the Maine-New Hampshire Inshore Groundfish Trawl Survey: July 2003 – June 2004*; Maine Department of Marine Resources Research Reference Document 05/02.
- Sherman, Sally A., Keri Stepanek, and John Sowles, February, 2005; *Maine-New Hampshire Inshore Groundfish Trawl Survey Procedures and Protocols*; Maine Department of Marine Resources, Research Reference Document 05/01.
- Selected newspaper articles of the survey since its beginning.
- Project chronology, list of outside uses and correspondence on feedback received from the National Marine Fisheries Service on previous project reports.

In addition, project data was available to the panelists through the Northeast Consortium's Fisheries and Ocean Data Management System, accessible at the internet site www.northeastconsortium.org/data.shtml. This information provided the panelists with an excellent initial understanding of the survey.

The agenda (Appendix C) of the meeting was structured to systematically review all aspects of the survey. One of the objectives of the review meeting was to complete the information base through presentations (Appendix D) by staff from MEDMR. This was followed by questions of clarification by the panel and general discussion. The review meeting also served to explore potential solutions that would be most appropriate given the context of the survey. In addition to the review panel and survey team (staff from MEDMR, commercial fishermen, net maker, vessel owner), the meeting was attended by representatives of the funding agencies (Northeast Consortium, and NOAA) and users of the data (see participants list in Appendix E).

Acknowledgements

The members of the panel wish to thank Rachel Gallant of the Northeast Consortium for organizing the review. We are grateful for the warm welcome received at the Marine Resources Laboratory where the meeting was held. Our task was made easier by the excellent preparation, cooperation and openness of the survey team and the participants at the meeting.

II. Review of the project with respect to the Northeast Consortium General Evaluation Criteria and the Terms of Reference for the review.

The panel has organized its findings according to the Northeast Consortium General Evaluation Criteria (Appendix A) and the terms of reference for the review (Appendix B). Since there was some overlap between the two lists, some comments may be repeated.

General Evaluation Criteria

1. Project success.

- Clarification of the primary objective of the survey is necessary. The project has currently too many stated goals and objectives, one objective should be made primary with all others secondary. Given the discussion and intended uses of the survey, we recommend that establishing consistent time series of abundance indices be declared the primary objective. Secondary objectives would need to be enumerated and are valuable as well. However, achievement of secondary objectives should not compromise the attainment of the primary objective. A significant secondary objective of the survey is the collection of biological information on the various species. It would be important to document the specific secondary objectives for each survey so that users of the data can be made aware of the data available.
- The project has been successful in demonstrating that an inshore survey in Maine and New Hampshire coastal waters is possible. To some degree, the survey has been successful in meeting the primary objective described above, but some modifications are necessary to fully meet this objective (see criteria 2).
- Long term funding will be required to ensure that this survey can be continued and achieve its true potential of providing time series of abundance for tuning stock assessments.

2. Certification of results.

- While some efforts have already been devoted to document the methods used in the survey (survey manual and draft sampling assistant manual), additional documentation of methods is needed to ensure consistency over time. In this regard, no detail should be spared. Many details were given in the presentations during the review. These details should be incorporated in the survey manual.
- The current survey design of mixing random stratified sampling with fixed stations needs to be revisited based on the objectives of the program. In particular, the panel recommends that the number of fixed stations be reduced to the bare minimum. In each stratum, the deleted fixed stations would be replaced by random stations. If fixed stations need to be retained for secondary purposes, consideration should be given to adding a corresponding number of random stations to achieve the initial sampling intensity (1 station per 40 sq. nautical miles) so that the primary objective is not compromised.
- Preliminary results of abundance time series are incorrectly shown due to changes in survey design and inappropriate statistical analysis. The additional depth strata and the use of fixed stations in the stratified random sampling calculations mean that the time series are neither consistent nor correct.

- Secondary results of biological information have already been produced from the survey and are being used for management purposes.

3. Data accessibility and dissemination of results.

- The final annual reports and the procedures and protocols manual, provide sufficient information to judge the quality of the data and is understandable to end-users. However, further documentation of methods is required to ensure that drift does not occur over time.
- Project description and the data are available on the web, however, some fields are not yet included in the data and meta-data is missing.

4. Project partnerships.

- Partnership was one of the strongest parts of this project. The panel felt that there was a very strong sense of commitment, shared responsibility and cooperation between the various partners.
- Involvement of commercial fishermen from the beginning has helped during project development, survey trawl design, during field sampling, and with getting buy-in of results from the commercial sector.
- Difficulties with the lobster fishermen have been overcome through open communication. Difficulties with the Downeast lobstermen continue, although there has been an evolution of acceptance. The partnership, constant communication and outreach must continue in this area. This work is crucial to the project success. The panel noted that the trend could be easily reversed and cooperation may falter if Downeast fishermen receive negative stock assessment results from the survey.
- As more data are collected, working with federal agencies and other partners will help with data analyses. This collaboration would help increase the value of the work and could result in further refinements to the survey.

5. Project impacts.

- The project has demonstrated that conducting an inshore trawl survey in the coastal waters of Maine and New Hampshire is possible, something that was previously considered impossible.
- The results will be that long time series of abundance indices for coastal waters of Maine and New Hampshire could be included in stock assessments of many commercially important stocks. The impact on the stock assessments will be stock dependent, but the increase in information will be beneficial to the understanding of the fisheries regardless of the resulting change in management.

6. End-Users.

- Federal and state stock assessment analysts, commercial and recreational fishermen and, the environmental community will benefit from a long time series of abundance data for many coastal species. The survey also provides a platform for collaborative work with universities in coastal waters.
- The bubble plots of survey catch per tow over time by species will show fishermen areas of concentration and how they change over time.
- With a long time-series, these data will be useful in detecting changes in the coastal ecosystem of the Gulf of Maine. This would be of interest to the public at large.

7. Overall rating.

- The panel rated the project as excellent. This project has demonstrated that a trawl survey is possible and needed for coastal waters of Maine and New Hampshire. Long term funding will now be required to ensure that the project persists long enough for the time series to become valuable to stock assessments. Project personnel overcame many obstacles and difficulties while maintaining high scientific standards.

8. Future research.

- This project should not continue to be funded on an annual or short term basis. Long term, more secure funding is required to ensure that useful time series of abundance can be generated for stock assessments. The Northeast Consortium and the Cooperative Research Partners Program have done their part to fund and develop this pilot program. These funding sources are designed to address fisheries issues, primarily through short-term projects. This project is among those that deserve long term funding and funding sources that are designed to address longer term research should be explored.
- Some small field research projects that could be conducted to improve the analysis of data collected to date include: changes in net geometry towing with versus against the tide and changes in net spread using different warp to depth ratios especially at shallower depths. Creating a warp to depth table using the door spread would be valuable for creating a consistent towing protocol. These issues should be given fairly high priority so that any changes can be implemented as soon as possible.
- The survey was initially conducted by two vessels and they have alternated in the first years of the survey. Since 2004, one vessel (F/V *Robert Michael*) is being used and the second (F/V *Tara Lynn*) is used as back-up. The two vessels are virtually identical: they are of the same mold and are similarly equipped (engines, winches, etc). While the panel considers that it is unlikely that there would be significant differences in fishing efficiency between the two vessels, some may raise this issue particularly if results from the survey give rise to contentious issues. In the absence of a comparative fishing experiment, survey results may be open to question. Because the F/V *Tara Lynn* was last used a few years ago, this would not be a major issue for future stock assessments since data from this vessel could be omitted in stock assessment models. However, a comparative fishing experiment using the

side by side method would be valuable in answering the potential fishing vessel comparability and would be important if F/V *Tara Lynn* is used again and often in the future

- Some computer simulation analyses that could improve the survey include: determining whether subsampling of lobsters can be achieved (currently all lobsters are sampled), determining the optimum number of tows per stratum based on variance calculations, and sample size needed for vessel comparisons.

9. Additional comments and guidance.

- This project has suffered from having too many objectives. As a pilot project it has clearly demonstrated the ability to conduct a trawl survey in coastal waters of Maine and New Hampshire. A future challenge will be transitioning this project from its current state to a long term survey with one overarching objective. It is also possible to attain many secondary objectives, but they should not be allowed to interfere with the primary objective.
- The Northeast Consortium is not the correct funding source for such a long term survey and should state this clearly in its review of the project. Better documentation of the states in-kind contributions would improve the probability of getting federal long term funding. Participants and managers of stock assessments in the region need to participate in discussions of how best to sample the Gulf of Maine. It was also noted that there may be economies of scale when all the surveys currently conducted in the general area are considered. However, the Maine-NH survey is unique in its coverage of the coastal waters of Maine and New Hampshire.
- Throughout the review, the phrase “not enough time” was used many times as a reason for needed work not being completed. This is understandable given the staffing levels and amount of work involved. A long term source of funding would free a significant amount of time that is currently devoted to report writing for current fund providers and grant writing for the next year’s funding.

Specific Terms of Reference

1. Survey design.

- The combination survey design of stratified random sampling with fixed stations needs to be revisited.
 - While statistically this design can be used to estimate population abundance and its uncertainty, it is highly unlikely that it can be done well in this situation. This is because the statistical analysis requires estimation of the bias introduced by using fixed stations. This estimation of bias must be conducted for each stratum. Stratum will have only one to five random tows and two fixed tows which is clearly insufficient to robustly estimate the bias introduced by fixed stations.
 - Estimation of time series of abundance for stock assessments should be made using only the randomly selected stations. Fixed stations can be useful for other purposes, but should not be included in the data used for time series of abundance. Justification for each fixed station should be clear.

- Project leaders will need to decide how much of their resources they want to devote to the two types of stations (random and fixed) and allocate appropriately. The panel considered the current level of 35% fixed stations too high.
- Difficulty caused by fixed gear, rough bottom, and strong tides.
 - Continued cooperation from lobstermen and other fishing interests is required and pivotal for the success of this survey. While strong measures such as requiring all traps to be pulled prior to the survey could be used, these could also create a backlash against the survey similar to that received at the beginning. Positive incentives might work much better. Outreach will continue to be most important action and will need to be unrelenting. In this regard, the staff at MEDMR has done an outstanding job.
 - The net used seems good for the conditions encountered on the survey. The bottom trawl used is appropriate for the range of marine organisms that are sampled. The speed of trawling is an issue in the stronger tides, and the trawl may be undersampling adult fish relative to juveniles because of the low towing speed (2.5 knots). Larger fish tend to be able to swim faster and a higher proportion (relative to juveniles) may be able to avoid capture. In itself, this is not a major issue for stock assessments so long as the trawl efficiency is sufficient to obtain representative samples and is relatively constant.
 - Survey documentation and discussions during the review indicated some variation in towing protocol (e.g. towing speed was cited as 2.2 to 2.3 knots at times and 2.5 in other). Establishing a consistent towing protocol is important. Towing speed, distance traveled (tow duration) and door spread are the parameters suggested for the protocol. Towing speed should be fixed and should not be allowed to vary too much between tows (suggestion +/- 10%), because the speed over ground of the trawl may produce changes in efficiency through escapement. Door spread and distance towed are needed to calculate area swept which could be among the standards for tow quality assessment. A formal protocol using the existing NetMind system (a real-time trawl monitoring and mensuration system) to determine the correct door spread combined with the GPS system to determine the towing track will ensure the consistency of tow quality. Overall, towing speed, towed distance, and door spread need to all be within an acceptable narrow range.
 - The current use of the NetMind system to determine when the trawl is fishing correctly is excellent and should be continued. The NetMind system is a valuable tool for this project. Using this system to quickly determine the net configuration can eliminate tows which are of a poor quality. Developing a protocol for an acceptable range of door spread would be valuable. Creating a table of towing warp lengths/depth to obtain correct door spread would be valuable. This would result in using the NetMind system for one of its intended uses and eliminate the practice of using an arbitrary and faulty convention of the 3:1 warp to depth ratio.
- Consider dropping one season if long term funding is not adequate to conduct survey in both spring and fall.
- Change name from “Inshore Groundfish Survey” to something like “Inshore Bottom Trawl Survey” to more accurately reflect the wide range of species encountered and analyzed.
- Level of coverage (tows per square mile) is good, if all tows are selected randomly (see discussion above).

- Use of two vessels can always be questioned, but in this case seems unlikely to be adding a large amount of variance to survey because the two boats are so similar. A simple side by side comparison study might eliminate some of the questions. The comparison might be conducted on bottom clear of obstructions where the boats can tow adjacent to one another. The gear should be the survey gear, but even a capacity comparison of equal groundfish gear might provide some answers regarding the fishing efficiencies of the two vessels (see also item 8 in the Northeast Consortium General Criteria)
- Percentage of total area that was originally excluded as “untowable” should be reported.
- Office disqualification of tows is a necessary procedure but needs to be better documented both in terms of process and total number of randomly selected tows impacted. If the number of disqualified tows changes a lot over time it would cause concern with the indices of abundance.
- Strata selection appears to be appropriately based on depth and changes in bottom sediments.
- It would be useful to establish detailed guidelines to determine when a haul should be declared invalid. For example, this could include a description of the location and extent of damage to the trawl, entanglement with fixed gear and other instances that would result in a haul being classified null.

2. Biological sampling.

- A schedule for intensive sampling of different species or characteristics should be created because some detailed information (e.g. maturity stages, age reading material) cannot be collected for all species in one survey.
- Subsampling of lobsters should be considered. If this is done, then a nonrandom sampling method such as measuring every second or third lobster would be most appropriate due to the difficulty of getting a random sample of lobsters.
- Subsampling schemes for species other than lobster match those used by NMFS and are appropriate.
- Length frequencies for species that exhibit differential growth between sexes (e.g. flatfish, white hake, etc) could be collected by sex. This is particularly useful when age data are to be applied to the length frequencies. Decisions on collecting sex-specific length data for sexually dimorphic species could be made on a case by case basis in consultation with stock assessment scientists.
- If age material or other parameters are collected on the basis of length, it would be important to determine and document the stratification method (e.g. 1 per cm, etc).

3. Data recording, archiving, and editing.

- The panel considered that the on-board data collection and processing was good, especially the proofing of datasheets after each tow. However, there is a need to have more complete documentation of the process.
- Codes need to be added for tow quality (similar to the NMFS rating system) and document reasons a tow would be rejected and redone.

- Fields need to be added to the database to identify fixed and random stations and tow length
- Weather could be recorded following international standards.
- There is an important need to add metadata to the database and to create a data dictionary.
- Raw data should be in database with queries used to generate expansions.
- Backups should be made of electronic data (e.g. NetMind, CTD data) more frequently, preferably after each tow, but at a minimum at the end of each day.
- The development of NetMind datalogs is a good initiative and should continue because this may help improve ability to standardize tows.
- Data should only be entered once, not twice as is current practice for some data.
- The NMFS audits should be used once the data is in Oracle database to identify outliers and data inconsistencies.
- There is a need to get the CTD data into MARVIN so these are accessible to other researchers.
- It would be an improvement to record on the datasheets the name of the persons measuring and recording so that analysts can look for individual effects in data. This could be important particularly if a number of volunteers or less experienced personnel participate in the survey.

4. Survey operations.

- The amount of public outreach is exceptional and the only way this survey can be completed. Staff members are commended for their dedication to public outreach as it helps not just this specific survey but science in general.
- The current use of the NetMind system to get out of trouble early is appropriate. It is important to use the NetMind system to determine if the gear is functioning properly. If it is not functioning properly, a tow can be aborted and restarted without wasting too much time. Adhering to the towing protocol, where door spread, towing speed and distance traveled are specified, thus resulting in relatively consistent swept area, should help reduce variation in catchability. If the NetMind system is used in new ways in the future, it is important not to use the system to improve catchability (e.g. increasing door spread above the maximum or some other maneuver). Regarding door spread, increasing speed to achieve the target door spread is not acceptable, however changing warp length would be acceptable.
- Possible solutions to heavy tides causing shape of net to change are not obvious. Increasing the speed over the bottom within the tolerance of the towing protocol can help but, if the increase required is greater than specified in the protocol, it could confound other issues, such as the herding ability of the net for a given time. It may be better to repeat the haul at a more suitable time (slack tide) although it may not always be practical. Using the above towing protocol parameters would help to determine tow quality in heavy tides.

5. Utility of data.

- It is not recommended to try to calculate conversion factors between this survey and either the NMFS or Massachusetts surveys, because differences in gear used will make this

exceedingly difficult. The survey nets are very different and any conversion factor between them would be a source of questioning the results. There is also usually no reason for this because almost all stock assessment models can utilize multiple indices of abundance.

- There is a need to manage the public's expectations that appears to be present already. These data will not bring only good news for the fishermen and they should be prepared for both good and bad news.

- Age data for many species will be required for stock assessment purposes. Currently, there is no systematic collection of material for age determination during the survey. The best approach is to collect age samples to generate an age-length key for the fish sampled in the survey. The next best is to borrow an age-length key from another survey. The use of age-slicing should be a last resort. However, given that many species will be mainly ages zero, one, and two, length information may be sufficient to separate the ages without an age-length key in a number of species.

- Length frequency data should be expanded to account for strata areas.

- In 2008, NMFS scientists will be conducting benchmark assessments for all the groundfish stocks in the area. Results from this survey would be quite helpful to a number of the assessments as time series of abundance. In this regard, it would be important to establish contact soon with the respective stock assessment scientists to ensure that the important parameters are collected.

- Collections of ichthyoplankton data are time consuming and could be dropped in favor of more bottom trawl tows or for collecting biological parameters of the various species. The interpretation of ichthyoplankton data in the area which is characterized by strong tides and the sampling intensity could be discussed with experts in this field. This collection should not come to the detriment of the main objective of the survey.

Appendix A

Northeast Consortium General Evaluation Criteria

1. **Project success:** Did the project accomplish its stated goals and objectives?
2. **Certification of results:** Is there adequate description of the approaches to experimental design, methods, and data analysis? Were these approaches appropriate? Are there other approaches that the participants should have considered or used? Are the data accurate, precise, and believable? Are the results and conclusions well supported by the data and statistically valid? Can the results and conclusions contribute to a sound basis for management decisions and policies?
3. **Data accessibility and dissemination of results:** Are the data available through the Northeast Consortium Fisheries and Ocean Data Management System? Are the data being served via another internet-accessible database? If so, are the data formatted suitably for data integration by the Northeast Consortium database? Is the final report complete, sufficient, of high quality, and understandable to end-users?
4. **Project partnerships:** Consider the degree to which the project was of mutual interest to participants and whether partners were key participants throughout the course of the project, including project design, data collection and analysis, and application of the results or products. What were the most and least successful aspects of the partnership? Were all parties equally interested and engaged in the project?
5. **Project impacts:** What impacts has the project had or could it have? What are the potential effects on fishing practices; socio-economics; and fisheries, coastal, and ocean management?
6. **End-Users:** Being as specific as possible, who could benefit from knowing about the research? How can a fishing sector incorporate any new information from the project? Which fishery management organization, working group, or plan development team could use the data?
7. **Overall rating.** Rate the overall project as excellent, very good, good, fair, or poor. Explain the reasoning behind the rating.
8. **Future research.** Is additional research needed to answer the original questions posed by the project? Are there obvious avenues of further research that should or must be pursued? Should this future research be a high priority for the Northeast Consortium?
9. **Additional comments and guidance.** Provide any additional comments that will assist the Northeast Consortium in evaluating this project.

Appendix B
Specific terms of reference for the review of
the Maine-New Hampshire Inshore Groundfish Trawl Survey.

1. Review the various survey designs used, including their strengths, weaknesses, and potential biases. Consider transect selection, survey area estimation, biomass estimation, and partitioning by size/age class and by species. Recommend any changes to current survey design and timing given the results of the review.
2. Review the biological sampling aspects of the surveys. Recommend modifications if necessary.
3. Review the data recording, archiving, and editing methods. Recommend modifications if necessary.
4. Review the survey operations conducted in each year and comment on the credibility and consistency of the methods used. Provide recommendations on improvements to these methods.
5. Provide recommendations on the utility of the data in current and future biomass assessments and management (interoperability of the data with the Massachusetts Inshore Survey and the NMFS survey).

Appendix C

Agenda for the meeting

August 22, 2005

8:00 - 8:45	Meeting of the panel
8:45 - 9:00	Project participants arrive
9:00 - 9:15	Welcome and introduction
9:15 - 10:00	Project background
10:00 - 12:30	Survey design
12:30 - 1:30	Lunch at Maine Department of Marine Resources
1:30 - 2:00	Industry participation/public outreach
2:00 - 5:00	Survey operations, data collection, and other methods

August 23, 2005

8:00 - 8:10	Arrival
8:10 - 8:40	Review of yesterday's discussion
8:40 - 10:00	Biological sampling
10:00 - 11:00	Data processing and editing
11:00 - 12:15	Survey results and biomass trends
12:00 - 1:00	Lunch at Maine Department of Marine Resources
1:00 - 2:30	Survey results and biomass trends (cont.)
2:30 - 4:30	Reporting
4:30 - 5:00	Wrap-up

Appendix D List of presentations

August 22, 2005

9:15 Project Background: Presentation and open discussion of survey beginnings and rationale, context within other Gulf of Maine Surveys, vessel selection, and staff and partners (Linda Mercer and Bob Tetrault).

10:00 Survey Design: Presentation and open discussion of areas of interest, spatial extent, timing, and transect design (John Sowles and Sally Sherman).

1:30 – 2:00 Industry Participation/Public Outreach: Presentation and open discussion of the project industry-science partnerships through each stage of the project as well as project outreach to the fishing industry (John Sowles and Sally Sherman).

2:00 Survey Operations and Data Collection: Presentation and open discussion of equipment, gear types, and shipboard methods. Discussion of matters pertaining to the manual and future survey methods (Sally Sherman).

August 23, 2005

8:40 Biological Sampling: Presentation and open discussion of sampling operations, sampling locations and restrictions, and sample data recording methods (Sally Sherman).

10:00 Data Processing and Editing: Presentation and open discussion of the processing of data from edited transects to biomass estimates (Kerri Stepanek).

11:00 Survey results and biomass trends: Presentation and open discussion of the interpretation and application of results and conclusions (Sally Sherman).

2:30 – 4:30 Reporting: Open discussion of project reporting in the four final reports and the methods manual.

Appendix E

List of Participants

Name	Affiliation
David Beutel	Fisheries Operations Supervisor/Fisheries Extension Specialist Department of Fisheries, Animal and Veterinary Science Rhode Island Sea Grant URI Fisheries Center, East Farm Kingston, RI
Josh Carloni	New Hampshire Fish and Game, Durham, NH
Yong Chen	Associate Professor, University of Maine, Orono, ME
Ghislain Chouinard	Head, Marine Fish Section, Department of Fisheries and Oceans, Gulf Fisheries Centre, Moncton, NB, Canada
Jeff Flagg	Net builder, Portland Trawler Supply Co., Brownfield, ME
Rachel Gallant	Fisheries Specialist, Northeast Consortium, University of New Hampshire, Durham, NH
Sam Galli	Captain of F/V <i>Tara Lynn</i> , Portland, ME
John Hoey	Manager, Cooperative Research Partners Program, NOAA Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA
Christopher Legault	Research Fishery Biologist, NOAA Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA
Linda Mercer	Director, Resource Management, Maine Department of Marine Resources, Boothbay Harbor, ME
Chris Moore	Acting Director, Cooperative Research Partners Program, NOAA Fisheries, Northeast Regional Office, Gloucester, MA
Curt Rice	Captain of F/V <i>Robert Michael</i> , Portland, ME
Sally Sherman	Chief Scientist, Maine Department of Marine Resources, Boothbay Harbor, ME
John Sowles	Ecology Division Director, Maine Department of Marine Resources, Boothbay Harbor, ME
Keri Stepanek	Assistant Scientist, Maine Department of Marine Resources, Boothbay Harbor, ME
Robert Tetrault	Commercial fishing vessel owner, T/R Fish, Inc., Portland, ME

Reviews of the mid-Atlantic supplemental finfish survey and the cooperative monkfish survey

March 24th 2006

Chris Bonzek, James Ianelli, Robert Mohn,
and Chris Moore (Chair)

Introduction

The following report was compiled after 1.5 days of presentations and discussions about two different studies which employ commercial trawl vessels for conducting scientific surveys. The first survey concentrated on doing a number of trawl samples across depth contours (transects) at up to four locations (but consistently two) at different times of year to supplement NMFS survey efforts. This survey used a fixed station design with additional mid-transect stations included according to pre-specified criteria. For the purpose of this report, this survey is referred to as the Supplemental Finfish Survey (SFS). The second survey reviewed was designed with specific goals to better cover the depth and range of monkfish and is referred to here as the monkfish survey. This survey was conducted in 2001 and 2004 and extended the NMFS strata. Station locations were selected on a random basis and subsequently fixed.

An external Panel was invited to review these surveys following terms of reference given as attachment 1. The organization of this report follows the terms of reference for each survey separately in subsequent sections. The Terms of Reference items 5-7 were related since they dealt with the scientific issues and assessment applications. Hence, for our discussions below they are combined.

Supplemental Finfish Survey

1. Design and objectives

The stated goals of the SFS were to use commercial gear for scientific surveys and aid in the interpretation of availability due to seasonal and depth distribution patterns. Further considerations on survey design are presented below. In general, the survey design and approach provides supplemental information compared to the NMFS stratified random sampling approach. The SFS results in samples collected at finer resolutions along depth contours and over seasons compared to the NEFSC surveys.

The "domain of inference" for this survey is very limited. For stocks of fish and invertebrates that are relatively sessile, this survey may reflect only local abundance patterns rather than population-level trends. For more mobile stocks this survey is likely to be highly variable. Also, the utility of this survey as an index is likely to be poor for species that may be at the edges of their distributions.

2. Biological sampling

In general it seems good as presented. The cruise reports presented extensive figures on the samples collected, and should be a useful reference for users. However, it was unclear how the allocation of biological sampling was balanced against doing more stations. Better communication with prospective users would help to determine a reasonable balance. A comparative study with NMFS survey data (from different times of the year and/or areas) could demonstrate added utility of this survey.

3. Data processing

Also seems sufficiently good as presented. The Panel was concerned that institutional memory of issues with data are currently lacking. A meta-data approach (to catalogue and provide added descriptions of the survey) was suggested as a way to avoid misuse of data. As funds become available, electronic systems for data collection (e.g., as in the NMFS survey) may help reduce time spent on these aspects (and may be able to allocate more effort in biological data collection).

4. Survey comparability and continuity

Important survey protocol changes affected the ability to compare the first year with subsequent years. Thereafter, the protocols seemed stable and the surveys should be comparable. The Panel felt that emphasis on tow distance was overstated, because these are measured and can be corrected. It may be more important to standardize tow speed since some species' catchability may be affected. The change in vessels from November 2004 was well documented and since the same gear and methods were adopted the potential for discontinuity was thought to be minor.

The Panel appreciated the efforts at diagnostics for gear performance, in particular, the PCA to detect potential outliers. This confirmed issues related to net mensuration equipment malfunctions in some transects. This will also help establish a record of data quality issues for future users.

5.-7. Scientific approach and utility for assessments

The potential utility of this survey in assessments was not demonstrated. A recent assessment on silver hake attempted to include results from this survey. However, an external review panel (CIE) felt that the assumptions for this application required more study, i.e., they note problems of calibration with NMFS surveys. There was some indication that the study provided some important results on seasonal availability that could impact how *Illex* squid are currently assessed. The Panel felt that direct inclusion of these survey results in a standard stock assessment context would require careful consideration and would be unlikely to have a large influence on results. The main utility of this survey within assessments is more likely to provide descriptive or qualitative patterns on seasonal and along shelf distributions. Such patterns may help interpret other survey and fishery data. In particular, species poorly sampled by NMFS survey gear may benefit from the SFS information (e.g., estimates of relative gear efficiency/catchability).

The presenters and the Panel noted that more analysis of these survey data is needed to evaluate the biological relevance. This would also help evaluate the survey utility survey in general.

Precision estimates were lacking in both the cruise reports and in the presentations.

The cruise reports shows two figures for each species by station and depth, one is for kg/km² and the other is kg/swath. The documentation on exactly how the second calculation was done is unclear. Presumably this scales the data to derive an overall abundance estimate along the transect.

There was a lengthy discussion and presentation on using adaptive stations to learn more about key species after the fixed stations were completed. The study used a strict rule based on catch-rate ranks to determine where to add stations between those already completed.

The presenters argued that the analysis on the utility of doing "adaptive" stations was worth the extra effort since binomial tests suggest that certain species were biased.

The presenters assert that inclusion of adaptive stations has the following benefits:

- Minimization of bias in stock estimates.
- Swath area estimates reveal tendency to underestimate stock abundance with reduced sampling intensity.

While including adaptive stations result in higher biomass estimates along the swath of a transect for some species, it is unclear to us that this in fact minimizes bias or reveals a tendency to underestimate abundance. Many fish species are known to have high levels of spatial correlation and this process would inherently bias adaptive stations (as they are selected) upwards. The Panel feels that since these adaptive stations are not independent representations of abundance, doing statistical tests (binomial as presented) are inappropriate.

The Panel encourages analysis on the sampling variability and further study on the consequences of selecting additional stations using their criteria.

8. Survey cost effectiveness

The Panel had difficulty judging the cost effectiveness of this survey. The presenters detailed some costs, but judging the benefits requires further analysis. Given the information presented, the cost-per-station appears to be higher for this survey compared to NMFS and the cooperative monkfish survey. The Panel felt that the general approach to fund cooperative research through "research set-asides" was innovative. Also, this survey provides information that is not available through other projects or programs. However, the extent that it has or will be useful in assessments has not been demonstrated. The Panel feels this data has been underutilized for either management or scientific purposes. The Panel did not address the issue of future utility of this survey after the NEFSC surveys undergo significant gear and stratification changes in approximately 2008.

Cooperative Monkfish Survey

1. Design and objectives

For the monkfish survey, the goals were clearly specified to improve the current survey efforts to better cover the range and habitat area of monkfish. The Panel felt that the "domain of inference" was better than that covered by the standard NEFSC surveys, but that further study on the depth distribution is warranted. Stations were selected based on a stratified random sampling design but used a mix of industry-selected locations and random within-strata locations. The presenters evaluated the effect of potential bias due to non-random selections and concluded there appeared to be little or no bias.

The Panel recommends that the survey timing be better oriented to suit the assessment process (SARC), i.e., it may be preferable to have the survey occur the year before the SARC so that the data can be used in a more timely fashion.

The stated survey objectives were generally well met. The objectives important for assessment purposes (absolute abundance and calibration with NMFS surveys) received adequate attention and detail.

2. Biological sampling

The biological sampling in the monkfish surveys follow NMFS protocols and was adequate. The Panel was encouraged to learn that data on species other than monkfish were also routinely collected.

3. Data processing

The shift to electronic recording capabilities in the 2004 survey was an obvious benefit for processing data. The monkfish survey data incorporation into the NMFS database was lagging, but analyses have been able to proceed. The data processing appears to be improving and the Panel felt the system was adequate but will require continued attention.

4. Survey comparability and continuity

The presenters are to be commended on the efforts to provide direct comparisons with standard NMFS surveys. The shift from two to one vessel between the 2001 and 2004 surveys provides some cause for concern, especially since target tow speed between the boats was different and the length of the survey period was substantially different (much longer in 2004). The degree to which 2001 results can be compared to 2004 was considered. In both years analyses of efficiency were conducted using depletion experiments. The Panel commends this effort and feels that this helps resolve issues of continuity and comparison with other surveys.

The Panel recommends that results on these efficiency studies be used in considering future research survey nets on the new RV. The experiment comparing rock-hopper gear with flat-net gear provided the needed conversion for monkfish efficiency. The video work also provided insight on aspects of gear catchability.

5.-7. Scientific approach and utility for assessments

There were adequate descriptions on the experimental design, methods, and data analysis. In particular, the monkfish survey presentation included substantial information on estimation precision. The documentation included careful consideration on the effects of survey design (i.e., the benefits of stratified-random sampling versus simple random sampling designs). The stratified random sampling design demonstrated a substantial improvement over simple random sampling in terms of reduced variance.

The authors presented a detailed analysis on efficiency (catchability) based on depletion experiments. A total of 7 depletion experiments were conducted in the 2001 and 2004 surveys. These provided a range of biomass estimates that can be used to complement values from assessments.

The general design (broad-scale stratified random sampling) of this survey is very close to the current design of the NEFSC surveys and for that reason has a number of advantages. This should ease its incorporation into the assessment process (providing biological advice for management). This survey averaged about 10 monkfish per tow whereas in the NEFSC standard survey caught about 1 or fewer monkfish per tow.

The different duration needed to execute the surveys may not affect the survey utility (since monkfish don't appear to undertake extensive migrations). However, the protracted length of a survey may be inefficient for staffing and other reasons.

8. Survey cost effectiveness

As with the other cooperative survey, the Panel had difficulty judging the cost effectiveness of this survey. The presenters detailed some costs, but judging the benefits requires further analysis. The Panel believes that these data are well suited to be directly included into assessment analyses and therefore hold utility for management. The cost per station appears to be efficient compared to standard NEFSC surveys. This survey enhances current survey efforts in important ways. The additional depth strata included are clearly important since more of the habitat for monkfish is covered. Future studies should continue to emphasize encompassing the range of this species distribution. The Panel did not address the issue of future utility of this survey after the NEFSC surveys undergo significant gear and stratification changes in approximately 2008.

Conclusions

Both the Supplemental Finfish Survey and the Cooperative Monkfish Surveys used commercial gear which had much higher catch rates for most species of interest. Commercial gear also has the advantage of being familiar to Industry and a better chance of "buy-in". The Supplemental Finfish Survey differed significantly from the NMFS surveys in design which means that it might provide information that they cannot. On the other hand, this divergence would tend to make it more difficult to include the results. The monkfish survey was designed similar to the NMFS, but has the advantage of a more efficient net and slightly deeper strata. Although the incorporation of the Cooperative Monkfish Survey results into an assessment should be easier, their use has been limited to date.

Survey products seem to be available and reliable, the principal impediment to their endorsement is the demonstration of their utility, either in the provision of management advice or in the support of broader scientific studies.

Attachment 1

TERMS OF REFERENCE FOR REVIEWS OF THE COOPERATIVE MONKFISH SURVEY AND THE SUPPLEMENTAL FINFISH SURVEY TARGETING MID-ATLANTIC MIGRATORY SPECIES

1. Review the survey design with respect to the project goals and objectives, highlighting any strengths, weaknesses, and potential biases. Evaluate the domain of inference (or sampled population) for the survey. Consider transect/station selection, survey area estimation, biomass estimation, and partitioning by size/age class and by species. Recommend any changes to the current survey design and timing given the results of the review.
2. Review the biological sampling aspects of the surveys, including accuracy of subsampling procedures and length/age structure sampling designs. Recommend modifications if necessary.
3. Review the data recording, error checking, archiving, and editing methods. Recommend changes, if necessary.
4. Review the survey operations conducted in each year and comment on the utility, appropriateness, and consistency of the methods used. Identify and evaluate any methods used to ensure comparability of survey observations across years and, if applicable, within years [especially if different nets/vessels have been used]. Provide recommendations on improvements to these methods.
5. Are there adequate descriptions of the approaches to experimental design, methods, and data analysis? Are these approaches appropriate? Are there other approaches that the participants should have considered or used? Are the results and conclusions well supported by the data and statistically valid? Review specific data and analyses from the survey and indicate how these measurably improve stock assessments for various species.
6. Evaluate measures of precision, and assess the gain in precision associated with the sampling design relative to simple random sampling and other designs.
7. Provide recommendations on the utility of the data in current and future biomass assessments and management. This includes the interoperability and comparability of the data with data from other fishery-independent surveys (*e.g.*, NMFS bottom trawl surveys, etc).
8. Is the survey cost effective relative to the information obtained. Could it be more cost-effective? If so, how? If the survey is not cost effective or provides only marginal information/data to that obtained from other surveys [or available from other sources], should the survey be done at all? Are there other survey or non-survey related data inadequacies where funding would be more appropriately invested to improve stock assessments?