REVIEW OF NOAA PROTOCOLS FOR GROUNDFISH BOTTOM TRAWL SURVEYS

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EXECUTIVE SUMMARY

The National Oceanic and Atmospheric Administration (NOAA) Protocols for Groundfish Bottom Trawl Surveys consist of an extensive collection of material that aims to improve the standardization procedures of groundfish assessment surveys. It follows in a tradition that extends back to the period when such surveys began to be undertaken (see e.g. Byrne et al. 1981). The collection of protocols gives an illustrative presentation of the large variety in equipment, problems, and solutions presently represented in the US surveys. The initiative to develop a more streamlined approach is certainly sound. In the report that follows, I present my impression of the proposed protocols based on the available literature and my own experience in the field. My comments are given first as more general input to the outcome of the National Trawl Survey Standardization Workshop (NSW) and thereafter as more detailed remarks relating to the individual survey protocols.

It is my general impression that the NSW protocols overemphasize some gear measurement procedures while ignoring others. A particular example is the warp length protocols, which are given a great deal of attention. On a more long-term basis, these problems will only have a minor impact when modern technology solutions are eventually put into practice. Although such technology is partly introduced in the individual survey protocols, the NSW guidelines do not include general information about trawl instrumentation, their placement and maintenance, and the utilization of their data.

To be efficient, trawl procedures need to be simple and clear. Some of the individual surveys go into such great detail that users risk being confused. Overly detailed protocols also increase the probability that users will ignore some details. In addition, information that is outside the main goal of the survey protocols, although of importance to the overall survey outcome, should be eliminated and only referred to when needed.

A critical element for standardization success is the human factor. Thus, the NSW protocols should pay some more attention to this under Protocol 3.

NSW Protocol 4 states that the details of construction plans and drawings of the net and rigging should be at least at the ICES recommended standard level (ICES 1989). However, the material presented in the different protocols is of varying quality, and generally does not satisfy the degree of detail requested.

The NSW proposes that a standing working group follow up the work on trawl survey protocols. This is a constructive initiative, but the document does not indicate any directions for the group's future development. Due to the great variety of equipment and procedures in use today, I would have expected that this document would have contained a future-looking perspective that gave some signals about the development of trawl standardization. This lack will be of importance for Protocol 5: *Changes in Regional Trawl Survey Protocols,* which contains constructive information documenting regional changes that move towards a national standard. This item is not handled in any of the survey protocols.

BACKGROUND

Trawls have been used as a means for obtaining a relative measure of abundance for more than 100 years (Fulton 1898). The use of the commercial catch-per-unit-effort (CPUE) became common in the post World War II period, but the rapid development of gear and vessels made the data collected less applicable for scientific purposes. Standardized scientific surveys came into use in the 1960's, and the US East Coast Survey, run by the Northeast Fishery Science Center (NEFSC), was the first serious, long-term effort using this new approach (Byrne *et al.* 1981). The idea of standardizing all technical aspects of surveying has always been considered valuable, but the specific details and the routines to follow to obtain standardization have not always been well defined. The lack of such routines may cause problems in the consistency of survey time series, and may also reduce public confidence in the reliability of scientific advice on management issues (see e.g. www.fishresearch.org/Articles/2002/12/Albatross.asp).

It is therefore timely that a protocol initiative be taken, and I am confident that the US effort in this field will be an important step toward a world wide effort to improve global survey standardization. Such standardization will improve data quality. As these data provide the basis for scientific advice concerning the management of commercial exploitation of marine resources, there is no doubt that this task deserves attention.

Currently available technology and the level of scientific understanding of the underwater environment set the framework for any standardization process. It is a challenge for any new evaluation of survey standards to judge to what extent further advances in technology and knowledge could improve standards against the cost of consistency with the available survey time series. Will improvements in future data quality outweigh the loss of consistency?

In the following report, I evaluate the proposed NOAA protocols guidelines for bottom trawl surveys under the above perspectives. Further, I review the individual survey protocols and evaluate how they have put the NOAA guidelines into practice.

DESCRIPTION OF REVIEW ACTIVITIES

My evaluation is split in four activities. Reading and evaluation of the document and making notes has taken most of the time. Reviewing some of the relevant literature has been necessary to put my comments into a scientific perspective. I have also discussed some of the important, general issues with some of my colleagues (both within and outside my institute). Finally, substantial time has been spent organizing, formulating and writing my notes into a report.

SUMMARY OF FINDINGS

General comments

The main goal of the protocols is to ensure that survey catchability remains constant over time. This is "*achieved by ensuring consistency in the sampling efficiency of the trawl, which in turn, can be achieved by ensuring consistency in construction and repair of the trawl and the procedures used in its operation"*. This statement hardly holds with respect to the evidence provided in the literature where it has been shown that changes in catchability exist. Various explanations are given (Sissenwine and Bowman, 1978; Byrne *et al.*, 1981 Collie and Sissenwine, 1983; Pennington, 1985; Pope 1988; Shepherd 1988; Godø and Wespestad, 1993, Hjellvik *et.al*. 2002). The literature also contains proposals for handling the problem (Pennington, 1986, Pennington and Godø 1995, Hjellvik *et.al*. 2002). Nevertheless, there is no reason to doubt that standardization is currently the most likely remedy for controlling the problem, although this should not become an obstacle for giving survey protocols a normal scientific evaluation associated with advances in scientific knowledge and technology.

The skeleton of protocols proposed by the National Trawl Survey Standardization Workshop (NSW) is certainly a timely initiative. However, one aspect is totally lacking. This relates to the use of trawl instrumentation as an integral part of the standardization. Most of the surveys use some kind of trawl instrumentation, but the protocols and procedures for their use are imprecise, and their importance to the survey is often unclear. Since the mid 1980's, it has been demonstrated that purely technical gear standardizations cannot give a standard sampling unit because gear configuration is affected by many different environmental factors (see e.g. Engås and West 1987; Godø and Engås 1989; Anon 1992; McCallum and Walsh 1995). There has been a substantial international effort towards a standardization using trawl instrumentation (Anon 1992, McCallum and Walsh 1995). Thus, as I see it, there is a strong need for a new protocol in the guidelines from the workshop on "Application of trawl instrumentation in standard trawl surveys".

This point leads to another important issue. Presently, the idea of standardization merely concerns technical definitions and specifications. When introducing trawl instrumentation standards, an important next step is to determine to what extent one also needs to standardize the actual trawl geometry and performance based on information from direct observations (see e.g. Fig. 1 of the Bering Sea Shelf survey). Some of the operational procedures mention target spread and height of trawl, but no fixed values are provided.

Thus, while many of the survey protocols already do use these measurements for validation of trawl geometry and performance, there is a lack of a systematic approach to dealing with this information. In several surveys, trawl instrumentation information has been directly included in the trawl protocols in an extended trawl survey standardization (see Engås 1994; MacCallum and Walsh 1995). With respect to the ultimate goal of "*ensuring consistency in the sampling efficiency of the trawl"*, inclusion of the standardization of trawl geometry and performance based on actual measurements will substantially raise the quality of the survey data. Although this is probably outside my mandate, I would like to mention some sensors that did not seem to be in use in the surveys mentioned here. Asymmetry and speed sensors can help to standardize trawl geometry and speed through water. Inclusion of such sensors is of utmost importance if the goal is standardization of *catching efficiency*.

The NOAA national protocol guidelines are clear and to the point on what should be included in standard operational protocols, in that bottom trawl surveys "*should include only issues influencing the trawl process and to exclude those influencing the subsequent sub-sampling of the catch"*. Unfortunately, most of the regional operational protocols do not follow this guideline. The degree of details varies among the centers, with some being too detailed while others are too brief. Further specific remarks are included under the individual protocols.

In the NSW Protocol 4, it is underlined that the level of detail in the construction plans and drawings of the net and rigging should be at least as specific as the ICES recommended standard (ICES 1989). The material presented in the different protocols is of varying quality and probably none satisfies the degree of detail requested.

A critical element for success of standardization is the human factor. Thus, the NSW proposed protocols should pay more attention to this under Protocol 3. One of the most important elements is that good teamwork exists between officers/crew and scientists, i.e that the scientists have a good understanding of the mechanics of trawling, and that the officers and crew understand the basics of good biological data collection. Seminars and other type of teaching (e.g. visits to flume tanks) are typical initiatives to help with this process. Some of the survey protocols contain elements of this (ex. The NEFSC protocols) but general guidelines could be useful to underline the importance of this factor.

Under the recommendations concerning the implementation of the protocols, the NSW proposes a standing working group to share experiences and to coordinate the development of national and regional standards and protocols. The great variation in the standards for the different surveys presented here underscores the clear need for this activity. The US, with its multitude and variety of survey experiences, is in a unique position to advance the development of standards. The establishment and function of this standing working group could thus not only be important for the US standardization but also for the development of global standards. In this context, I am a bit surprised that the recommendations put so much emphasis on the *Wire Rope Specification Standards,* as these are only important for an old technology type of standardization. At the same time,

very little emphasis is placed on auto-trawl/trawl instrumentation standardization, which will probably be very important in future surveys. Altogether, it seems as though consideration of current technology problems have hindered constructive discussion on potential future developments. Protocol 5 (*Changes to Regional Survey Protocols*) should include some constructive guidelines that take into consideration expected modifications to protocols in order to improve the national standardization in the future.

Specific comments for each protocol

Below I have tried to present my comments systematically without too much repetition. Numbered comments are cross-tabulated in a table with the protocols against the different trawl survey (Table 1). The various comments are listed under the table.

Table 1. A cross tabulation of the comments relating to specific protocols and surveys.

Survey	Protocol 1	Protocol 2	Protocol 3	Protocol 4
Eastern Bering Sea Shelf Bottom Trawl Survey	Generally OK See minor comment (C1)		C3. Trawl instrumentation C4. Fishing configuration	C10. Gear description C11. Maintenance
Gulf of Alaska Bottom Trawl Survey	Generally OK See minor comment (C1)	Generally OK See minor comment (C2)	C3. C4 C5. Station allocation C12. Scope rat.	C10 C11
Aleutian Islands Bottom Trawl Survey	Generally OK See minor comment (C1)	Generally OK See minor comment (C2)	C3. C6. Trawl sp. C7. Tow dur. C5. C12.	C10 C11
Eastern Bering Sea Upper Continental Slope	Generally OK See minor comment (C1)	Generally OK See minor comment (C2)	C3. C8. Bottom contact C9. Coding	C10 C11
West Coast Slope Bottom Trawl Survey	C13 Diverg. in layout		C14. C15. Tow duration etc.	C10 C11
Antarctic Bottom Trawl Survey	C13 C16. Marking		C17. Third wire C18. Speed	C10 C11

C1: Under “calibration of warp measurement devices,” in the third paragraph, the protocol instructions repeat what is to be done but not how many times, and they say nothing about what level of variation is accepted.

C2: In the last sentence of protocol 2, it is instructed that all vessels use the same warp length difference to trigger an alarm. This might be a non-optimal solution, as varying currents and bottom conditions, etc. will affect the activity of the auto-trawl system.
C3: The use of trawl instrumentation measurements as criteria for making decisions on tow duration and quality of haul is defined under several procedures. No description of the trawl instrumentation actually used or the associated routines for their utilization are provided. Such procedures should include: Type of instrumentation, treatment of instruments, placement on trawl, logging procedures, data evaluation, what to do if instruments are lost or are malfunctioning.
C4: item G. First sentence – "As fishing configuration is normally obtained after touchdown"… This sentence should be rewritten.
C5: item E. As I understand the objectives, the procedures of making station allocations should be described elsewhere. This part should be simplified to include only information relating to operations during the survey.
C6. Having a target speed of 3 knots over the ground sounds risky, as it is pointed out that the trawl is sensitive to speeds above 3 knots. Any current against the tow direction will give unstable bottom contact and reduced efficiency. It is thus likely that a slightly lower target speed would stabilize catching efficiency.
C7. A tow duration of 15 minutes demands highly accurate starting and stopping of the haul. Modern bottom contact sensors with continuous online information being collected during the tow are needed to secure a safe operational procedure under short tow duration. It was unclear to me if the current procedure secured the needed accuracy.
C8. Bottom contact is to be evaluated/determined by the FPC. To secure a standard, there must be some criteria. This needs clarification under items D and F.
C9. Setting a coding system for trawl performance seems like a good idea. Here, a description without the coding system is provided; thus, it cannot serve the purpose of the procedure.
C10. Gear construction and description: Each gear description should contain enough details for any net producer to be able to make an identical net. The NSW proposal suggests details to the level described by ICES (ICES 1989). This proposal is not fulfilled by most of the trawl descriptions in the individual protocols, and needs further attention. Although this does not fall in my mandate, I would like to comment on the actual construction of the trawls. Several trawls used the same or similar large mesh size in all nettings (4") in front of a codend with a small meshed liner. This seems inappropriate for a sampling trawl that is supposed to give a consistent representation of the available fish (see. e.g..: the 83-112 Eastern Trawl).

The AFSC has a fairly good description of its gear, although I doubt the specifications of its trawls meets the ICES standard. The others, however, were even sketchier. This problem needs to be corrected, and some kind of uniformity between descriptions would be an advantage.

The NWFSC trawl specifications lack details relating to component specification, and there were no checklists (although the procedure indicated that these are under preparation).

The SWFSC trawl specifications lack details on component specification.
C11. Good trawl maintenance needs efficient and controllable routines. Some of the described procedures will be difficult to operate effectively due lack of space and the

unstable environment onboard a survey vessel. Here are some suggestions: All nets should have an individual tag and a history log describing accidents, repair, and approximate use (number of hauls). Control measurements should be done on land before and after the cruise by use of checklists similar to those described in Anon (1992) and those given for the rigging by the AFSC. All gear should have similar checklists for both the rigging and the trawl. A trawl log giving details of accidents and repairs might be a good way of securing their standard and indicate when a gear replacement should take place.

C12. The scope ratio table is lacking

C13. The layout is inconsistent. The NOAA standard protocols have a good layout. All individual survey protocols should follow this layout. Because the marked survey protocols have taken other approaches, comparisons are confusing and more difficult.

C14. Operational procedures not encompassed by the NOAA protocols should not be included (e.g. the safety and conflict procedures seem inappropriate here).

C15. Tow duration etc. This survey operational protocol does not specify or incompletely describes items a, c, d in Protocol 3 of the NOAA standard. Item d is described in general terms, but the final decision on scope ration is decided by the real time trawl instrumentation data and the experience of the skipper. I have great sympathy for this pragmatic approach that tries to fully exploit the available information. On the other hand, these procedures do not follow the master guidelines. Better specification of the details in the utilization of the trawl instrumentation is needed, particularly with respect to evaluation start and stop of the tow. Direction of tow is not mentioned. Again, with 15 minute tows, the results will be very sensitive to the tow's start and stop and also to the steadiness of the bottom contact. An ITI bottom contact sensor giving continuous real time bottom contact information would make the proposed procedure more viable.

C16. Physical marking of warps is not specified in B4-B6.

C17. If I have understood correctly (as it is not well specified), in this survey a third wire is used to connect a trawl sonar attached to the head line of the trawl. This is a valuable tool for evaluating trawl performance but the pressure used on the wire might change the gear geometry and the quality of the bottom contact of the ground gear. The stretch in this wire should therefore be specified.

C18. Instrumentation to determine trawl speed is not specified. Scope ratios are lacking (lacking what?).

C19. The NEFSC presents the most detailed and voluminous survey protocol. As indicated by C13, it does not follow standard layout. Further, the amount of detail sometimes makes it very difficult to keep track of the important points. In my experience, survey protocols must be straightforward to be efficient. The procedures outlined here sometimes appear like instructions for newcomers. Such material should, of course, be part of the general training program of survey participants. Also several procedures outside the scope of this manual are included, such as details of the on deck sampling and biological data evaluation. I think that a streamlining of the content, and a reorganization according to the NOAA general guidelines, would be a substantial improvement.

C20. The details given for the ITI trawl instrumentation go far beyond what is needed. Most of the technical details could have been placed in an appendix to give the appropriate focus on the key operational aspects.

C21. Towing speed. Different devices for measuring speed are available but no specific procedure tells what instrument to use to decide towing speed. The target towing speed is 3.8 knots, which seem very high for the applied trawl. Is this speed correct? A comment possibly outside my mandate: If the speed of 3.8 knots is correct, maybe a re-evaluation of speed should be considered as I expect high escape of some species and particularly small individuals due several factors (e.g. low filtering capacity of codend, high escape under the net, low herding efficiency etc.).

CONCLUSIONS/RECOMMENDATIONS

The NSW has prepared a good base for a national standardization of bottom trawl survey protocols, although it is my general impression that the NSW overemphasizes some gear measurement procedures (warp measurements) and ignores others.

The individual procedures should be more in line with the NOAA guidelines. The individual survey protocols do cover most of the needed items, but reorganization of their information, and for some surveys a focus around the key subjects is needed.

The NOAA guidelines suggest that gear specifications should be at the level recommended by ICES. Hardly any of the survey protocols fulfil this demand. Additional effort is needed to achieve this goal, and standardization among surveys is recommended. Further improvement in checklists and maintenance routines are also proposed.

The NOAA guideline lacks a protocol for trawl instrumentation. Some procedures are already in use in the individual surveys, but both the technical and the application descriptions are not very satisfactory generally. There is a need for general guidelines with appropriate follow up in the various surveys.

The recommendation of the NSW to continue the work on a national standardization is supported (by whom or what? Specify where the support comes from). For this work a perspective that gives some signals about future directions for the development of trawl standardization is needed.

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APPENDIX I

Material supplied:

Anon 2003. Trawl Protocols Review Statement of Work for Dr. Olav Rune Godø (attached)

Stauffer, G. 2002. NOAA Protocols for Groundfish Bottom Trawl surveys of the Nation's Fishery Resources. Alaska Fisheries Science Center, December 2002.

Shivlani, M. Two mails with general information about the process and the above documents.

STATEMENT OF WORK

Consulting Agreement between the University of Miami and Dr. Olav Rune Godø

January 7, 2003

Background

Trawl surveys conducted by or for National Oceanic and Atmospheric Administration (NOAA) Fisheries provide crucial fishery-independent data for assessing the status of many federally managed stocks. Therefore, the credibility of these surveys, including the credibility of the methods used to conduct them, is of great importance to the management process. In late summer 2002, it was brought to NOAA's attention that the trawl warps used to deploy the nets in the trawl surveys conducted by the NOAA Ship *Albatross IV* between the winter of 2000 and spring of 2002 were not properly measured and marked, which caused the nets to be towed with more cable out on one side than on the other. The discrepancy ranged between 1 inch at 100-m cable out to nearly 6 feet at 300-m cable out. This mis-alignment may have affected net configuration and net functioning, which could have affected the resulting data.

Because of the above problem, Vice Admiral (Ret.) Conrad C. Lautenbacher, Jr., Under Secretary of Commerce for Oceans and Atmosphere and NOAA Administrator, released a memorandum on September 16, 2002, which outlined five points to be addressed. Points 3 and 5 are relevant to this peer review, and are reproduced below.

> "(3) The Director, OMAO [Office of Marine and Aviation Operations] and the AA [Assistant Administrator] for NOAA Fisheries will review current protocols and directives regarding trawl survey operations, determine what changes are needed, and publish a new protocol. The objective of this effort is to ensure that all aspects of preparation for trawl surveys and trawl survey procedures are consistent and in keeping with the highest quality standards to provide for survey accuracy and consistency from one survey to the next. Action to be completed within 90 days [i.e., by December 16, 2002].
>
> "(5) NOAA Fisheries, in coordination with OMAO will convene an independent panel (non-federal government employees) to review our revised trawl survey procedures and provide recommendations for improvement. Final report will be made public upon completion of this comprehensive review. Action to be completed within 180 days [i.e., by ca. March 16, 2003]."

This independent peer review will cover the protocol document prepared under Point 3, and will fulfill the independent review requirement of Point 5. The trawl protocol document was developed in accordance with Point 3 of Admiral Lautenbacher's

December 16, 2002 memo. Preparation of the document was coordinated by the Alaska Fisheries Science Center, and involved personnel from all the NOAA Fisheries science centers, the Office of Science and Technology, and OMAO.

Specific

The consultant will be provided a copy of the protocol document and shall require a maximum of five days to read the document and to produce a written report. No travel shall be required for the review, and no consensus report shall be accepted.

The written report shall consist of an executive summary of findings and recommendations, and a main body consisting of background; description of review activities; and findings and recommendations for improvement. The report shall also include as separate appendices all literature cited in the review, and a copy of this statement of work.

In keeping with the requirements in Point 3 of Admiral Lautenbacher's memorandum, the consultant shall specifically address whether the protocols ensure that all aspects of preparation for trawl surveys and trawl survey procedures are consistent and in keeping with the highest quality standards to provide for survey accuracy and consistency from one survey to the next. If problems are identified, the consultant shall provide specific recommendations to address each problem.

The consultant shall be responsible for the following tasks:

1. Reading the trawl protocol document, which will be provided in advance;

2. No later than January 31, 2003, submit the written report[1] (see Annex I) addressed to the "University of Miami Independent System for Peer Review," and sent to Dr. David Die, via email to ddie@rsmas.miami.edu, and to Mr. Manoj Shivlani, via email to mshivlani@rsmas.miami.edu.

[1] The written report will undergo an internal CIE review before it is considered final. After completion, the CIE will create a PDF version of the written report that will be submitted to NMFS and the consultant.

ANNEX I: REPORT GENERATION AND PROCEDURAL ITEMS

1. The report should be prefaced with an executive summary of findings and/or recommendations.

2. The main body of the report should consist of a background, description of review activities, summary of findings, conclusions/recommendations, and references.

3. The report should also include as separate appendices the bibliography of all materials provided and a copy of the statement of work.