Report to CIE

of

Bottom Trawl Survey Workshop
October 31 – November 1, 2006
Seattle, WA

R. K. Mohn
32 School St
Waverley, N.S.
Canada

Executive summary

The primary theme of the Workshop was the integration of the new (since 2003) shelf/slope survey into the assessment of stocks that have been previously tuned to data from shelf and/or slope surveys. Five presentations covering six stocks were made. Also, a single presentation was made on the other main topic, a comparison of design-based aerial expansions to estimate survey abundance to a GLMM (general linear mixed model) approach.

While the Workshop arrived at "default" positions on all the terms of reference, more definitive conclusions would have helped assessors (and reviewers) in the upcoming assessment cycle in saving time in data preparation and assessment review. In the case of full assessments, the default concerning integration of the new survey series is that the new shelf/slope cannot be used to artificially extend the shelf or slope series without a demonstration that this was supported by the data for this stock. The onus is on the assessor to show that such a fusion into a single series is warranted. The Workshop also concluded that the GLMM approach was preferred, and assessors are encouraged to have their post-stratifications defined for the GLMM by March 2007. For updates, the new series is not to be fused with earlier series, and the GLMM is not to be used unless it was in the assessment of record.

The preference for the GLMM model over the design-based approach was largely because of its reduced sensitivity to large outliers and because of its increased flexibility to post-stratify on variables of potential interest. These conclusions were derived by a Panel that had no other models under consideration than the GLMM and "plain vanilla" design-based estimates. Also, there were no members present that were antagonistic to the GLLM or advocates of another approach. The GLMM model was reviewed earlier this year at the Groundfish Data Modelling Workshop and had been used and reviewed in STAR assessments in 2005.

The importance, and the pervasive nature, of the survey data in NWFSC stock assessments deserved broader participation than was the case. The Workshop can be summarized as having too few participants, too few case studies, too few scientific issues and too few divergent points of view. This being said, the participants were productive and the presentations were relevant. A valuable, though limited, review was performed that would have been better with more participation. I would have liked to have seen more case studies including more awkward stocks which might have been more revealing; that is, highly aggregated and rare species which would be expected to have more impact on the binomial model within the GLMM approach.

Background

The stated goal of this workshop is to provide stock assessment authors with guidance regarding the incorporation of data from the Northwest Fishery Science Center (NWFSC) shelf-slope survey into 2007 groundfish assessments. One of the participants reworded this into a more operational version; that is, that the goal was to agree on some of the data preparation protocols so that the approaches are not all different during the preparation for and review during the upcoming series of STAR Panels. The Terms of Reference (ToRs) are given in Appendix B. After I received them, they were slightly rewritten and the rewritten version was used by the Workshop. This is mentioned as they were often referred to by number in the consensus notes which uses the revised (four instead of five) ToRs

The main scientific issue of the Workshop was the integration of the new shelf/slope survey series into assessments that had used either slope, shelf or a combination of them as indices of

abundance and size or age frequency in tuning assessment models. The new survey series could be incorporated into assessments as a new series, or as an extension to an existing series. If the new survey is kept separate, the integration will be in the sense of its relationship to the other indices within the population model and standard diagnostics would apply. It would be several years before the power and selectivity of the new series could be defined. If the new series is transformed into an extension of an exiting survey, extra care will have to be directed to the analysis of residuals, especially in the vicinity of the transition. As the gear, protocols, and converge were different in the new series, *a priori* it would be expected to be difficult to demonstrate the validity of such an extension.

The GLMM model was also presented for review as an alternative to the design based estimates traditionally used. However, scientific issues did not arise on this topic. To some degree, this was because the GLMM method had been reviewed earlier in the year at the Groundfish Data Modelling Workshop and also had been used and reviewed during STAR assessments in 2005.

The Panel composition was as follows:

Jason Cope (UW)
Owen Hamel (NWFSC, SSC)
Jim Hastie (NWFSC)
Tom Jagielo (WDFW, SSC)
Isaac Kaplan (NWFSC)
Aimee Keller (NWFSC)
David King (AFSC)
Shirley Lee (NWFSC)
Pete Leipzig (FMA)
Jim Likes (FWS, Ret.)
Stacey Miller (NWFSC)
Robert Mohn (CIE)
Brad Pettinger (OTC)
Andre Punt (UW, SSC)
Victor Simon (NWFSC)
Ian Stewart (NWFSC)
Theresa Tsou (WDFW)
John Wallace (NWFSC)
Mark Wilkins (AFSC)

The meeting was well conducted, and minutes were taken of the proceedings. Staff members, either presenters or other interested personnel, were all most helpful and responsive to the few requests made. Five presentations covering the new surveys using six stocks as case studies were reviewed. Also, a presentation was made on the binomial-GLMM model as a comparison to the design-based approach. Because of the number of presentations and the number of reviewers, the agenda was quickly covered and the meeting adjourned a day early. A consensus set of points was prepared before adjournment.

Description of review activities

All the supplied material was reviewed before the Workshop. The presentations were in the form of PowerPoint files and no draft text was available. All sessions of the Workshop were attended

and several requests for complementary analysis were made. Notes were made during the presentations and they are summarized below. Final versions of the presentations were placed on the FTP site but no additional text was provided either for the presentations or for the minutes complied during the meeting.

Summary of presentations

The Workshop began with the Chair, Jim Hastie, making introductions and introducing the background for the Workshop. There have been several series of surveys on the West Coast beginning in the late 1970s: The Triennial surveys (Shelf waters from 1977-2004 every third year using various vessels), the Slope surveys (in most years between 1988 – 2001 using the Miller Freeman), and the NWFSC Slope surveys (from 1999-2001 using various vessels). See Appendix C, Table C2, for a summary table containing more details about these surveys. In 2003, the NWFSC initiated a survey to cover both shelf and slope waters which does not match either of the older series in terms of trawling protocol or the areas covered. See Appendix C, Table C1, for a comparison of the triennial and the new shelf/slope surveys. The main issue was how to integrate the new series with the older ones that have been used to calibrate assessment models. It was also hoped that an agreed set of data preparation protocols could be adopted to expedite the upcoming STAR process, either for updates or full assessments. The two principle metrics for comparison of survey results were the abundance time series and length frequencies. Comparison of length frequencies was somewhat data limited in that only one year, 2004, had both the triennial and new shelf/slope surveys.

The first species to be presented was canary rockfish. This assessment is sex specific and heretofore used the triennial survey. In comparing the two surveys, a slide showed the linear transact design of the old triennial survey and the random and deeper distribution of the new survey. The fine scale distribution of the canary rockfish was demonstrated in the next slide where for 2004, positive catches from the new survey were seen in between the linearly distributed triennial sites, but very few superimposed on them. No explanation was given for this observation.

Both design based and GLMM indices of abundance were presented for both the triennial and shelf/slope surveys. The three years of the shelf/slope survey followed similar trends but the design based was sensitive to individual large tows in 2004 and 2007 and it had means. It would have been nice to summarize these data with X-Y plots with the respective error bars. This comment applies to all such design-based and GLMM comparisons of abundance data. The GLMM estimates were geometric, rather than arithmetic, means, so it is expected that they would be smaller.

The triennial surveys had nine points (1979-2004) and again showed a similar pattern except for scaling (see Figure D1). When fit to the population model, the GLMM data had a better fit (RMSE of 0.55 versus 0.39 when data are fit as separate indices), with most of the difference in the 1980 and 1983 points.

I requested a re-run with a common q for the two surveys. This was performed the same day. There was some difficultly as SS2 would not allow two observations from a single survey in one year (2004). The author moved the shelf/slope points for 2003 and 2004 ahead one year to miss the triennial. Although not an ideal basis for consideration because of the shifted surveys, constraining the two as a single survey degraded the fit by about 50 likelihood points, suggesting strongly that they had to be kept separate.

I also requested a summary slide showing the effects on biomass trend to show sensitivity/importance of choosing to use one or two surveys. The author was reluctant to show this because he did not want to make the decision *post hoc*. I emphasized that I was only asking for the magnitude of the impact, not to choose one over the other. This request was also quickly reported back to the Workshop, and it was seen to have very little impact, relative to the uncertainty in the terminal year. This sensitivity test was valuable and should have been done for the other species used as case studies.

The next stock to be reviewed was arrowtooth flounder. The presentation considered only length frequency data between the two surveys and concluded on this basis that they should be treated as separate series. Panel discussion after the presentation suggested that only 2004 data from the shelf/slope should be used in the comparison. The author re-worked his analysis with this suggestion and concluded that the agreement was better than previously indicated.

English sole was then presented, which is scheduled to be an update in the upcoming STAR series. Its only tuning index has been the triennial series, and the species is assessed with northern and southern components. A comparison of design-based and GLMM estimates of the shelf/slope survey for the three years available showed them to be just about indistinguishable. Unlike rockfish, this sole is frequently caught and the binomial treatment of zero catches is a very small factor in the GLMM estimate. Also, very large tows do not appear to play the role they did for canary rockfish (see Figure D3).The same similarity was also seen when the shelf/slope estimates were handled both ways, although the figure which has only three points has not been included in the appendix.

An update presents special problems in that only the triennial series was used in the last assessment, as in 2004 there were only 1 or 2 surveys available. Slide 22 of the presentation showed that neither the North nor South components were well fit. The standard error (SE) of the indices and mean square residual error (MSRE) differed by over a factor of two even though the input SE had already been doubled as a partial balancing attempt. So while four years of shelf/slope survey data might help the poor fit (the q and selectivity looked similar to the triennial series), such an analysis is contrary to the spirit of an update. On the other hand, the current depletion is of the order of 85%, so the need of a full assessment is unlikely and updating with fishery data should suffice.

Darkblotched rockfish are found from 50 to 250 fathoms (fm), a range covered by the triennial survey. The slope survey of 100 fm and deeper also samples the deeper waters of their distribution. The new shelf/slope survey combines the old surveys so the appropriate sets can be taken out to extend them for this assessment. The author attempted to link both the shelf and slope surveys to the new shelf/slope survey and found that there was too much inter-annual noise to allow conclusions to be drawn using design-based indices. He also felt that GLMM approach might help.

Neither the sablefish author nor the presentation was available, although a presentation of the work was made by the Chairman. Sablefish are a slope species but move to shelf as they age. It was expressed that there may be different q's in slope and shelf strata that may complicate the transition to the new survey. The hope was to split the new survey into shelf and slope portions and use them to extend both series. Again, the data did not seem to support this initiative as the data seemed even more disjointed than those for English sole

The final presentation was on the GLMM (General linear mixed model) method as an alternative to the traditional design-based stratified abundance estimates. This is a two part procedure. The first part is a binomial model of the zero and non-zero catches. Then, the non-zero catches are modeled in the GLMM. GLMMs are attractive because they are typically less sensitive to extreme values, and they can incorporate other stochastic components (for example, random vessel effects). In the one example presented, the vessel effect variance component was about one-tenth of the error variance. The GLMMs also allow post-stratification on other variables of interest. The author presented average fish weight as a function of depth or latitude as an example.

The software is still under development; it cannot yet perform the binomial and positive catch rate models simultaneously. Also, the author noted, that the analysis is not yet fully Bayesian. Also, a formal error analysis in terms of AIC was presented to compare the various error models (gamma, lognormal or inverse Gaussian) used in the positive catch portion of the analysis for 11 species The ΔAIC's were quite large, often of the order of hundreds to thousands, and tended to favour the gamma model. It is unfortunate that more of the results from these 11 species were not available.

This presentation also had a number of useful comparisons on the statistical characteristics of various surveys.

Summary of findings

Consensus conclusions of the Workshop were captured in point form and are reproduced with annotations in Appendix E. Also, I paraphrase the main points in this section. These are essentially the Panel's conclusions, at least as I understood them.

The first ToR concerns the survey protocols. These were nicely summarized in a pair of tables that are presented in Appendix C. Table C1 contains a comparison of the triennial survey and the shelf/slope survey. An analogous comparison to slope surveys would also be a valuable compilation. I mentioned this at the workshop but was told that this was not a priority for this review. As an adjunct to that, Table C2 is a summary for the years, areas, vessels, and other information among the various surveys used in West Coast assessments. Although there were no gear technologists at the Workshop, it was felt that the principal differences had been reviewed and that there were important differences between the surveys. Presentations at the workshop mentioned catchability and selectivity of the gear, size and type of net and footrope, tow duration, tow speed, and tow site selection. The importance of these differences on various indices from each stock remains to be seen and may well benefit from a meta-analysis over species of similar habits and habitats. It was reported that all the biological sampling needed was still being collected partially due to the shorter tows in the new survey. In some cases, sampling is directed to get fewer age samples as the agers can not do them all.

The second ToR addressed the ability to extend the older surveys using appropriate depths from the shelf/slope survey for stocks that were, and are to be, assessed by tuning with shelf data and for stocks that were tuned with both. For the shelf stocks, the possibility of selecting those tows of less than 100 fm and using them as a continuation for the triennial series was examined using canary rockfish. It was concluded that there appeared to be substantial differences in the numerical and spatial properties between the two surveys. When q was forced to be the same, there was a statistically significant degradation of fit using design-based estimates. For the deeper

dwelling darkblotched rockfish, the slope portion of the new survey could be separated out as one series to compare with the older slope data and an additional new 30-100 fm index could be generated. The arrowtooth flounder will need more analysis.

The third ToR concerned the inclusion of the NWFSC shelf/slope survey into updates. The consensus was that shelf/slope survey data cannot be used to extend the indices of abundance in an update. It was not demonstrated that the older series could be extended, and indeed the burden of proof is to show that this can be done. As the other series have been discontinued, only catch-based data can be used if update status is to be maintained. The question of using GLMM estimates in updates when design-based had been used in the assessment also was rejected by the Workshop. I fully agree with this firm position regarding updates.

The final ToR was a comparison of the GLMM and design-based estimates of abundance from surveys. The presentation used data from arrowtooth flounder, canary rockfish, and the north and south canary rockfish stocks. The Workshop concluded that the GLMM was the preferred method, and that assessment authors should request their post-stratification to Tom Helser early in 2007. As the software is not distributed, he will be performing all the binomial-GLMM fits, as well as his own assessments. It was not made clear why the software has not been distributed. Finally, there was some discussion of the need to conduct a further GLMM if it is decided that the surveys can be combined at least to perform some sensitivity trials.

The goal mentioned in the background statement was to provide guidance, and this was certainly done. However, it would have been done better with greater and more varied participation. The more ambitious goal of producing agreed upon data preparation protocols awaits further analysis.

Conclusions/Recommendations

Although I was in general agreement with the conclusions drawn by the Workshop, a couple of points need to be enlarged upon and emphasised. Some of the technical topics may already have been addressed in the other off-season Workshops which I did not attend. As the upcoming STAR series, and perhaps the next couple of series as well, is transitional until the new survey series can stand alone in the assessments with confidence, more care will be required in terms of alternate runs and sensitivity analysis. The attempts at extending older series which were reviewed are not encouraging. Similarly, with regards to assessments using the GLMM for the first time, the sensitivity of the migration to this model should be presented. An example of a graphical presentation of such a sensitivity of the GLMM on the data and on the subsequent modeled population is shown at the end of Appendix E. While I agree with the Workshops defaults on integration, the impacts of any new formulations should be explored and reported.

It is unfortunate that more participants with other case studies and more points of view were not available for this Workshop. Recent travel restrictions were cited as at least a factor contributing to the low attendance. Although the conclusions drawn by the Workshop were supported by the presentations, the breadth and depth of the work available and the review given were compromised. For example, there were no advocates for models other than the GLMM and nor were any comparisons made except to “vanilla plain” design based areal expansion. Although only these two models were mentioned in the ToRs, other viable models must exist and deserve consideration. Also, I raise a minor point regarding the presentation of design-based and GLMM results: A scatter plot would have been interesting in terms of the linearity and any intercept.

Balancing the objective function while comparing the GLMM and design-based estimates was mentioned only once - in the English sole presentation. For both models (design-based and GLMM) and for both components of this stock the SE to RMSE ratio was about 0.5, and this was after the SEs had been already doubled. It is not known to what degree, although probably not too large an effect is expected, the conclusions are biased using unbalanced formulations.

Although the representative case studies were presented (a rockfish, a sole, full assessments, and updates) these were not enough to reach conclusions about whether the results would form species based clusters. Perhaps assessors of similar species (in terms of data requirements) can communicate among themselves before the STAR process to share advances in survey data preparation and, to some degree, homogenize the techniques and their presentation.

There was only one example of the impact of GLMM vs. model-based in an assessment, and this was done in response to a requested re-run. The implications for abundance model selection need to be carried to the end products, ex. depletion estimates. If, as this instance showed, the sensitivity is not great, then the urgency to convert all assessments to the new GLMM estimates is reduced. This does reduce however, the need to examine enough stocks to be secure in such a conclusion. Nor does this suggest lessening the urgency to convert to a superior model once it has been clearly identified.

Within the design based estimates, and to a lesser degree with the GLMM, there is still the issue of what is the best point estimate between the arithmetic mean, geometric mean, and mode. This question came up a couple of times without any attempts to address it. Such a fundamental question should be resolved.

When the triennial and shelf/slope surveys (design-based estimates example) were forced into a single series with a common q and selectivity, the fit degraded significantly. This should be repeated for other stocks and with the GLMM estimates.

The Workshop's conclusion regarding updates was a strict adherence to the spirit of updates. I fully agree with this. During the 2004 STARs, the definition of updates was allowed to become fuzzy from time to time which resulted in lost review time, and stocks that were treated somewhere in between a full assessment and an update.

Appendix A. Bibliography of Materials Provided.

Before the review the Panel was provided with electronic copies of the following documents. The documents were maintained on an FTP site and were available throughout the meeting. (ftp://ftp.afsc.noaa.gov/S_Miller/WC_GroundfishDataModelingWorkshop_2006/)

The PowerPoint files which were provided before and during the meeting are listed in A.2

.

A.1 Materials made available prior to meeting

Workshop Reports

Keller, A.A., V.H. Simon, B.H. Horness, J.R. Wallace, V.J. Tuttle, E.L. Fruh, K.L. Bosley, D.J. Kamikawa and J.C. Buchanan. DRAFT. The U.S. West Coast Bottom Trawl Survey of Groundfish Resources off Washington, Oregon, and California: Estimates of Distribution, Abundance, and Length Composition in 2003.

Weinberg, K.L.,M.E. Wilkins, F.R. Shaw and M. Zimmermann. 2002. The 2001 Pacific West Coast Bottom Trawl Survey of Groundfish Resources: Estimates of Distribution, Abundance, and Length and Age Composition. NOAA Tech. Mem. NMFS-AFSC-128, pp 149.

Published Material

Helser, T.E., A.E. Punt and R.D. Methot. 2004. A generalized linear mixed model analysis of a multi-vessel fishery resource survey. Fish. Res.70 (251-264)

Lai, H-N. and T. Helser. 2004. Linear mixed-effects models for weight-length relationships. Fish. Res.70 (377-387)

Other

Anon. NWFSC Bottom Trawl Workshop Draft Agenda

Anon. NWFSC Bottom Trawl Workshop Terms of reference

V. Simon, A Keller and M. Wilkens. MS. Summary table of Triennial Shelf Survey and NWFSC Shelf/Slope Survey.

A.2 PowerPoint presentations.

The authors (if identified) and title are from the first slide or each presentation.

Anon. Bottom trawl survey workshop summary.

Helser, Thomas. Generalized Linear Mixed Model Analysis of NMFS West Coast Bottom Trawl Surveys

Kaplan, Isaac. Arrowtooth flounder - Comparison of Triennial Ssurvey from FRAM survey.

Stewart, Ian and Tom Helser. A comparison of the NWFSC and Triennial shelf surveys for canary rockfish.

Stewart, Ian and Tom Helser. A comparison of the NWFSC and Triennial shelf surveys for English sole.

Appendix B

Consulting Agreement between the University of Miami and Robert Mohn

Statement of Work

NWFSC Bottom Trawl Survey Workshop
Background

The Northwest Fisheries Science Center (NWFSC) began a slope survey in 1998, and expanded coverage to include shelf depths in 2003. Prior slope and triennial shelf surveys were discontinued in 2001 and 2004, respectively and the NWFSC shelf-slope survey is currently the only coast-wide bottom trawl survey conducted for west coast groundfish. The NWFSC shelf-slope survey covers the depth range of the previous slope and triennial shelf surveys and extends latitudinal coverage to the Mexican border. The data from slope depths of the NWFSC survey have been used in previous assessments. However, the data from shelf depths (>183 m) of the NWFSC shelf-slope survey were not incorporated into the 2005 cycle stock assessments because there were only two years of data available when the assessments were completed. For the 2007 assessment cycle, four years of data will be available from the shelf depths of the NWFSC shelf-slope survey and will provide the only new fishery-independent information for many of the assessments.

The NWFSC and the Pacific Fishery Management Council (PFMC) will hold a workshop to address the incorporation of the NWFSC shelf-slope bottom trawl survey data into stock assessments on Oct. 31- Nov. 2, 2006 in Seattle, Washington. An independent expert is requested to provide expert advice on various methods for including these data in the upcoming stock assessments.

The goal of the bottom trawl survey workshop is to provide stock assessment authors with guidance regarding the incorporation of data from the NWFSC shelf-slope survey into 2007 groundfish assessments. Primary objectives include:

- Review survey protocol and data collected by the NMFS bottom trawl surveys: Alaska Fisheries Science Center (AFSC) & NWFSC slope surveys (1990-2002), AFSC & NWFSC shelf triennial surveys (1977-2004) and NWFSC shelf-slope survey (2003-2006)

- Evaluate the ability to treat the AFSC & NWFSC triennial shelf survey and comparable depths of the NWFSC shelf-slope survey as a single index of abundance, particularly for species where only shelf survey data were included in previous assessments.

- Evaluate alternative methods for including AFSC and NWFSC survey time series in 2007 assessments, particularly where both shelf and slope survey data have been included in previous assessments.

- Evaluate if recent data from NWFSC shelf-slope survey data, which haven't been included in previous assessments, can be included in update assessments (i.e. widow rockfish and English sole) as a new time series or by appending new data to time series

included in the previous assessment model. If recent survey data are not included in the updates, there may not be any additional coast-wide survey data informing the assessment.

• Compare biomass and variance estimates generated using a design-based swept area approach and model-based (Generalized Linear Mixed Models) approach.

The consultant should possess expertise in sampling theory, sampling design and statistical analysis of groundfish bottom trawl survey data using the Delta and Generalized Linear Model. The consultant should also have expertise in statistical and mathematical modeling of fish population dynamics with emphasis on integrated age and size-structured models, analysis of categorical length data from groundfish surveys, and using groundfish survey data to improve precision in stock assessments.

Consultant's duties should not exceed a maximum total of 12 days: several days prior to the meeting for document review; the 3-day meeting; and several days following the meeting to complete the written report. The report is to be based on the consultant's findings, and no consensus report shall be accepted.

The consultant's tasks consist of the following:

1) Become familiar with the background materials;
2) Actively participate in the workshop discussion to be held Oct. 31-Nov. 2 in Seattle, WA;
3) Provide guidance on the best methods to incorporate the new bottom trawl survey index into the 2007 stock assessments;
4) Complete a final report after the completion of the workshop; and
5) No later than 16 November 2006, the review panel's report shall be submitted to the CIE for review1. The report shall be sent to Dr. David Die, via email at david.die@rsmas.miami.edu, and to Mr. Manoj Shivlani, via email at mshivlani@rsmas.miami.edu.

Submission and Acceptance of Reports
The CIE shall provide via e-mail the panel's final report in pdf format by 30 November 2006 to Dr. Lisa Desfosse (lisa.desfosse@noaa.gov) for review of compliance with this Statement of Work by NOAA Fisheries and approval by the COTR, Dr. Stephen K. Brown. The COTR shall notify the CIE via e-mail regarding acceptance of the report. Following the COTR's approval, the CIE shall provide the COTR with a pdf version of the final report with a digitally signed cover letter.

1 Each written report will undergo an internal CIE review before it is considered final.

Annex 1: Contents of Reviewer Reports

1. The reports shall be prefaced with an executive summary of findings and/or recommendations.

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

3. The reports shall also include as separate appendices the bibliography of all materials provided and any papers cited in the Reviewer's Report, along with a copy of the statement of work.

Please refer to the following website for additional information on report generation:
http://www.rsmas.miami.edu/groups/cimas/Report_Standard_Format.html

The Terms of Reference (ToRs) as given at the Workshop were slightly different than the ToRs given to this reviewer. Presumably those for the Workshop were a slightly later version. At any rate, the Workshop addressed the ToRs below in a point by point fashion to form a consensus which was compiled into a PowerPoint file and made available on the FTP site cited above.

Workshop Terms of Reference as presented to and used by the Workshop

The goal of the bottom trawl survey workshop is to provide stock assessment authors with guidance regarding the incorporation of data from the NWFSC west coast groundfish bottom trawl survey into stock assessments, particularly those that will be conducted in 2007. Primary workshop objectives include:

1. Review survey protocols and data collected by the NMFS west coast groundfish bottom trawl surveys: AFSC & NWFSC triennial shelf surveys (1977-2004), NWFSC slope survey (1998-2002), and NWFSC shelf-slope survey (2003-2006).
2. Evaluate methods for including AFSC and NWFSC survey time series in stock assessments focusing on:
    - Examination of differences in catchability and selectivity between the NWFSC shelf-slope survey and the triennial shelf survey.
    - The ability to treat the AFSC & NWFSC Triennial shelf survey and comparable depths of the NWFSC shelf-slope survey as a single index of abundance, particularly for species where only shelf survey data were included in previous assessments.
    - Alternatives for including the NWFSC shelf-slope survey in assessments which have previously utilized both shelf and slope survey indices of abundance.
3. Evaluate whether recent data from NWFSC shelf-slope survey should be included in update assessments (i.e. English sole) only if they can be treated as a new time series, or whether the new data can be used to extend time series included in previous assessment models.
4. Compare biomass and variance estimates generated using a design-based swept-area approach and model-based (Generalized Linear Mixed Models) approach. Evaluate the merits of these approaches for individual species or species groups.

Appendix C. Summary Tables of Trawl Comparisons Extracted from Presentations.

Table C1 contains a comparison of the triennial survey and the shelf/slope survey. Table C2 is a summary for the years, areas, vessels and other information among the various surveys used in West Coast assessments.

	AFSC Triennial Shelf	**NWFSC Shelf/Slope**
Survey Design		
Year range	1977-2004	2003-06
Depth range	1977: 50-250+ fm / 90-460 m 1980-92: 30-200 fm / 55-366 m 1995-2004: 30-275 fm / 55-500 m	30-700 fm / 55–1280 m
Latitudinal range	1977: 34º00'N – US/Canada border 1980-86: 36º48'N - 49º15'N 1986: 36º48'N - US/Canada border 1989-2001: 34º30'N - 49 º 40'N	32 º 30' - 48 º 10' N
Latitudinal stratification	Various: 1977, 1980-83, 1986, 1989-92, 1995-2004	
Station allocation	Transect – track lines are spaced at ~10 nautical mile intervals	Stratified random block
Station selection	Systematic-random design	Randomly selected without replacement
Search time	~120 minutes	60 minutes sequentially for each of 3 cells per station
Depth zones in survey design	30-100 fm / 55-183m 101-200 fm / 184-366m 201-275 fm / 367-500m	30-100 fm / 55-183m 101-300 fm / 184-549m 301–700 fm / 550-1280m
No. of vessels / year	2	4 (in 2004 only 3 vessels were used)
Total number of vessels	16	7
Vessel class	Quite variable in early years (1977-1995): ranged 76 ft-125 ft More recent years (1989-2004): Alaska Class Commercial Trawlers	West Coast Commercial Trawlers
Vessel size	65'-147'	65'-92'
Vessel horsepower	<500-1,710 horsepower	400 - 600 horsepower
Gear/Tow Protocol		
Trawl type	High-opening Nor'Eastern trawl	4-panel Aberdeen-style
Trawl dimension	See diagram	See diagram
Net material	1977-1986: Nylon 1986-2004: Polyethylene	Polyethylene
Mesh size (net)	5 inch	5 ½"
Mesh size (codend)	3.5 inch	5"
Mesh liner	1.25 inch	2"
Headrope	89' (27.2 m)	85'
Footrope	121' (37.4 m)	104'
Roller gear	120' rubber bobbin roller gear, with 14" bobbins with 4" disk spacers	None – solid footrope
Door size and weight	2.1 × 1.5 m steel V-doors weighing approximately 567 kg each	5' × 7' steel V-doors
Wire specs	Specifications were not set during	1200 fm of 5/8" steel-core wire rope

	early surveys; 5/8 and ¾ inch diameter and 800 m length specifications were set for later surveys	
	AFSC Triennial Shelf	**NWFSC Shelf/Slope**
Scope	Varies non-linearly with depth. Scope set by skipper in early years and by results of empirical settling experiments since 1992 (95?)	Varies non-linearly with depth
Trawl warps	Tows were made with winch brakes set at wire marks.	
Towing Speed	3.0 ± 0.2 knots (speed over ground)	2.2 ± 0.5 knots (speed over ground)
No. minutes net on bottom	30 minutes	15 minutes
Sensors routinely deployed? (post 1998)	SCANMAR acoustical net mensuration system since 1986. Bathythermograph (since 1992) and bottom contact sensors (since 2001)	Yes
Sampling Protocol		
Sub-sampling protocol	1977- about 1995: Whole-haul sampled catches weighing ~1.2 mt or less Since about 1998: Whole-haul all catches	* See manual
Selection of tows for biological sampling	All	All
Length samples – random or stratified?	Random	Random
Age samples – random or stratified?	Some random, most stratified. Varied by year, species.	Random

Table C1. Summary table of Triennial Shelf Survey and NWFSC Shelf/Slope Survey. This table was completed with input from Victor Simon and Aimee Keller (NWFSC) and Mark Wilkins (AFSC).

Survey	Year	Vessel	Dates	Latitudes	Depths	Net	Gear	Knots	Min Perio	Len	Age
Shelf (Triennial)	1977	P.Raider/Tor./Com./D.S. Jordan	7/4-9/27	34°00'-Border	50-250	nylonN	roller	3	30 day	Y	N
	1980	Pat San Marie/Mary Lou	7/12-9/28	36°48'-49°15'	30-200	nylonN	roller	3	30 day	Y	Y
	1983	WarriorII/Nordfjord	7/7-10/3	36°48'-49°15'	30-200	nylonN	roller	3	30 day	Y	Y
	1986	Alaska/Pat San Marie	7/9-9/30	36°48'-Border	30-200	nylonN, polyN	roller	3	30 day	Y	Y
	1989	Pat San Marie/Alaska	7/7-9/29	34°30'-49°40'	30-200	polyN	roller	3	30 day	Y	N
	1992	Alaska/Green Hope	7/12-10/7	34°30'-49°40'	30-200	polyN	roller	3	30 day	Y	N
	1995	Alaska/Vesteraalen	6/8-9/6	34°30'-49°40'	30-275	polyN	roller	3	30 day	Y	Y
	1998	Dominator/Vesteraalen	6/1-8/9	34°30'-49°40'	30-275	polyN	roller	3	30 day	Y	Y
	2001	Sea Storm/Frosti	6/1-8/27	34°30'-49°40'	30-275	polyN	roller	4	30 day	Y	Y
	2004	Morning Star/Vesteraalen	5/26-7/28	34°30'-Border	30-275		roller	4	30 day	Y	Y
P.o.p	1979	C. Horizon-Wash./New Life-Or.	4/18-5/2	44°37'-Border	90-260	nylonN,400E,mys	roller	3	30 day	Y	N
	1985	Marathon	4/3-5/28	44°37'-Border	90-260	nylonN	roller	3	30 day	Y	N
Slope	1988	Miller Freeman	11/28-12/14	44°05'-45°30'	100-700	polyN	mudsweep	2	30 24 hr	Y	N
	1990	Miller Freeman	10/26-11/15	40°30'-43°00'	100-700	polyN	mudsweep	2	30 24 hr	Y	N
	1991	Miller Freeman	10/21-11/18	38°20'-40°30'	100-700	polyN	mudsweep	2	30 24 hr	Y	N
	1992	Miller Freeman	10/17-11/12	45°30'-Border	100-700	polyN	mudsweep	2	30 24 hr	Y	N
	1993	Miller Freeman	10/14-11/8	43°00'-45°30'	100-700	polyN	mudsweep	2	30 24 hr	Y	N
	1995	Miller Freeman	10/30-11/16	40°30'-43°00'	100-700	polyN	modmudsw	2.3	30 24 hr	Y	N
	1996	Miller Freeman	10/28-11/13	43°00'-Border	100-700	polyN	modmudsw	2.3	30 24 hr	Y	N
	1997	Miller Freeman	10/20-11/25	34°30'-Border	100-700	polyN	modmudsw	2.3	30 24 hr	Y	N
	1999	Miller Freeman	10/14-11/19	34°30'-Border	100-700	polyN	modmudsw	2.3	30 24 hr	Y	N
	2000	Miller Freeman	10/10-11/9	34°30'-Border	100-700	polyN	modmudsw	2.3	30 24 hr	Y	Y
	2001	Miller Freeman	10/12-11/8	34°30'-Border	100-700	polyN	modmudsw	2.3	30 24 hr	Y	Y
NWFSC slope	1999	S.Eagle,C.Jack,M.Leona, B.Horizon	7/3-9/24	35°-48°10'	100-700	Olivine twine	Aberdeen	2.2	15 day	N	N
	2000	S.Eagle,C.Jack,Excalibur,C.Pride	7/3-9/23	35°-48°07'	100-700		Aberdeen	2.2	15 day	Y	Y
	2001	S.Eagle,C.Jack,Excalibur,L.Stalker	7/2-9/28	35°-48°08'	100-700		Aberdeen	2.2	15 day	Y	Y
	2002	S.Eagle,C.Jack,Excalibur,M.Julie	6/25-9/24	32°51'-48°07'	100-700		Aberdeen	2.2	15 day	Y	Y
NWFSC shelf-slope	2003	B. Horizon,C.Jack,Excalibur,M.Julie	6/24-10/23	32°34'-48°27'	13-734		Aberdeen	2.2	15 day	Y	Y
	2004	BJ Thomas,Excalibur,Ms.Julie	5/27-10/16	32°35'-48°22'	29-781		Aberdeen	2.2	15 day	Y	Y

Table C2. Summary of surveys from O. Hamel – Darkblotched rockfish presentation.

Appendix D. Examples of GLMM vs design-based estimates of abundance extracted from Helser's presentation.

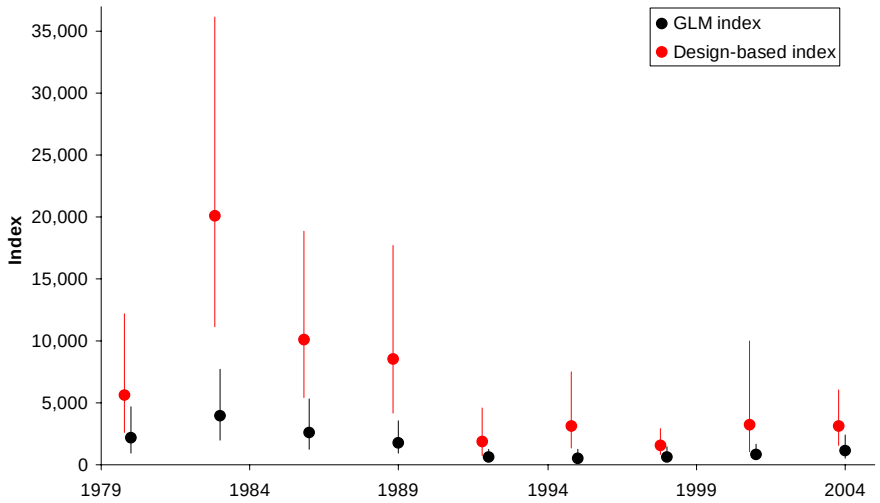


Figure D1. Triennial and shelf/slope survey comparison using canary rockfish from Helser's presentation.

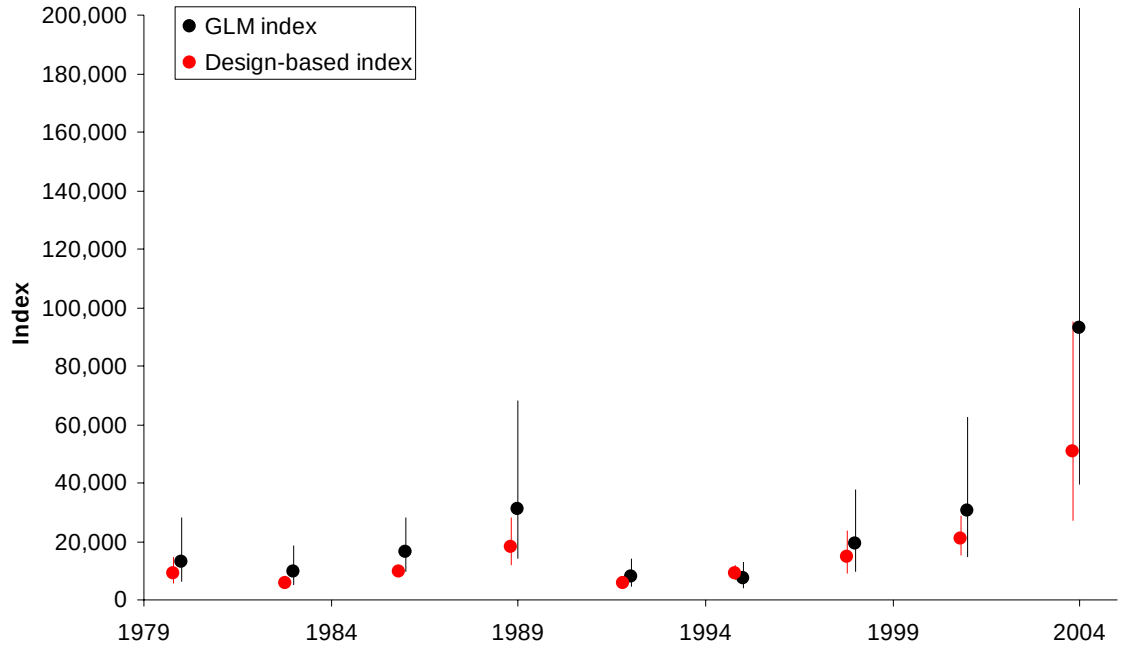


Figure D2. Triennial and shelf/slope survey comparison using arrowtooth flounder from Helser's presentation.

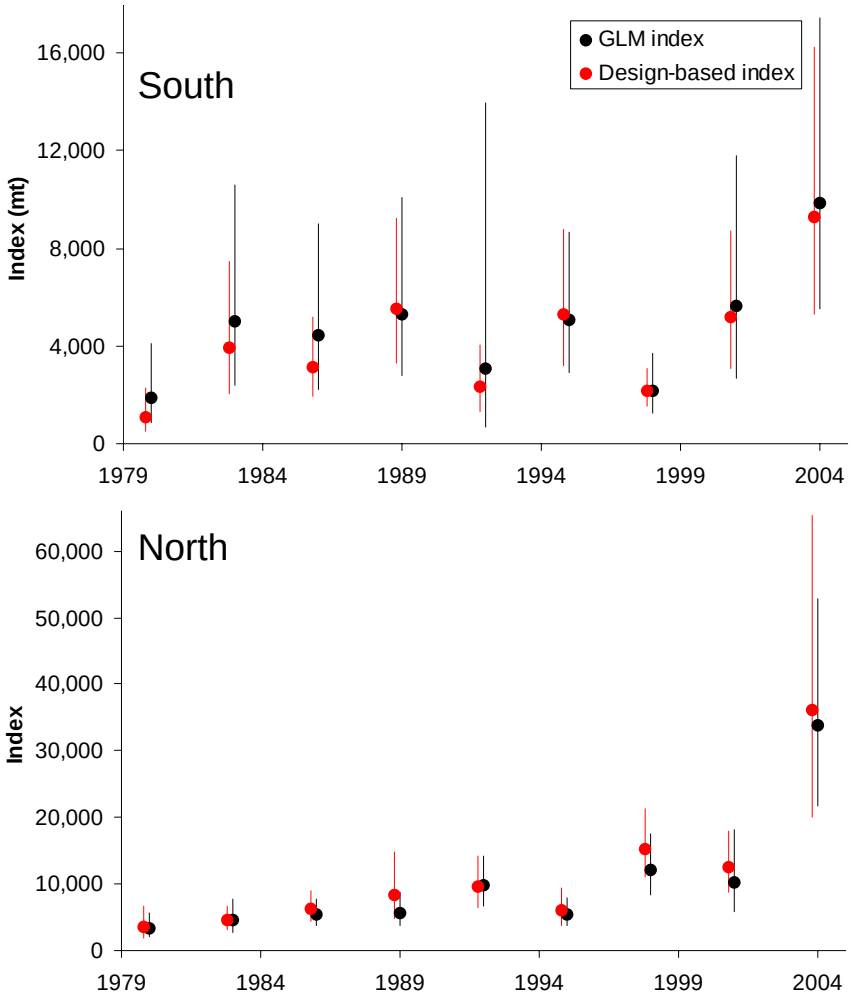


Figure D3. Triennial and shelf/slope survey comparison using English sole from Helser's presentation.

Appendix E. Annotated summary of Workshop conclusions/recommendations.

The Workshop concluded by capturing the points of consensus on a series of PowerPoint slides. As a text version is not available, the points are presented below taken in point form taken off the slides. I agreed with the conclusions but wish to emphasize a couple of points. The conclusions were often presented as "defaults", meaning that the onus is on the author to defend any other usage. My annotations are in italics to avoid confusion as to source.

Note the numbering of these ToRs is as used by the Workshop and differs slightly from those in Appendix B.

ToR # 1 Survey design/ protocols

- Differences exist between triennial and NWFSC shelf/slope survey protocols/gear (include table of differences)
- Some of these differences may contribute to changes in catchability and selectivity
  - Towing Speed
  - Size and Type of Net and footrope
  - Duration of Tow
  - Trawlable vs untrawlable areas (tow selection)
- Although it is difficult / impossible to disentangle the effects of various changes in protocol and gear
- Effects on catchability and selectivity different among spp.

I was asked how we dealt with changes in survey gear in Atlantic Canada. When we had a vessel change (the trawl gear and protocols retained) in the 1980s, we had several hundred paired tows to use for calibration. However, it was not for several years for some species before the impact of the changed vessel could be determined. The NWFSC situation is more difficult as it has a shorter data series and more pervasive changes. In the case of the shelf/slope survey, it is new vessel, new gear and new protocols which would suggest that extension of either old series, either slope or shelf, would be considered only after careful analysis and justification.

ToR # 2 Survey design/ protocols

- Triennial and Shelf/Slope ("Combo") Surveys are different time series and should be included separately in assessments based on analyses seen for canary, english sole, darkblotched and arrowtooth
  - This conclusion based on fundamental differences in survey protocols and performance
  - The possible options for exploring use/combination of surveys are:
  - Slope spp.
    - Continuing slope time series and add new shelf (<100 fm) as new time series (default)

- This is not a long term solution because will lose Conception area for some species and there may be a cost for separating the time series as the length of the time series increases
- Two series –old slope (1998-2002) and combo (2003-06)
  - If going to have "combo" as new survey, need to make sure that selectivities make sense relative to NWFSC slope survey

Shelf spp.

- Q and Selectivity different (default)
- Q and Selectivity same
- Q different and Selectivity same

- Include examples of plots comparing the surveys (have Isaac, Owen and Ian include these in write up…)

- Canary rockfish (full)
  - Retain these surveys as separate indices
    - There appear to be substantial differences in the numeric and spatial properties of catch between the two surveys
    - Model fit to length-frequency data is degraded when survey differences are ignored, although the time-series is short and relatively uninformative
    - Forcing Q to be the same for triennial and NWFSC shelf/slope results in statistically significant degradation of model fit (preliminary analysis using design based estimates)

--note here for Ian to include some text on missing juveniles in triennial transects

This ToR outlines the methods of integration under consideration. The default integration is as a new series. If it is modeled as having the same q and selectivity, it is as an extension of the existing survey. Separate q's and the same selectivity is an intermediary position as would be same q and different selectivity, although this was not proposed at the Workshop. In stocks that are not near a critical level, the defaults may be used alone. For those that are, sensitivity tests should include at least the other options stated in ToR #2. The metrics for these sensitivities would include model likelihoods, the point estimates and their uncertainties, and as usual posteriors are preferred.

<u>ToR #3 – Updates</u>

- English sole
  - If update, will not use NWFSC "combo" data – include workshop analysis as an appendix
    - We haven't seen any compelling reason to combine the surveys into one time series (i.e. extension of triennial)

    - There is enough complexity associated with including the combo survey data as an extension of the triennial, that it would no longer be considered an "update"
  - Fishery catch, age / length data will be included in update

- Widow rockfish
  - Didn't see raw data, but should be considered same as English (i.e. don't use new survey data unless doing a full assessment)

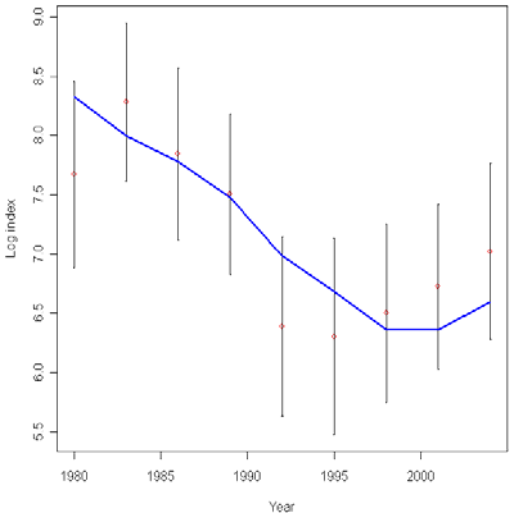
I strongly supported this conclusion that strict adherence to the concept of Updates be maintained.

ToR #4 GLMM Approach

- Full assessments
  - Based on historical performance and workshop case studies, GLMM is the preferred method for all survey data
  - Authors are strongly encouraged to evaluate and request the appropriate post stratification for GLMM by early-March
- Update assessments (e.g. English sole)
  - Use design-based estimates for triennial shelf survey as done in prior full assessment

Similarly to the comments on ToR #2, in stocks that are near a critical level, the impact of the choice of data preparation (GLMM or design) needs to be presented for review. An example of how this may be presented follows which was taken from the canary presentation. These slides show the magnitude of the effect of GLMM on the data and on the subsequent estimated population.

GLMM Mean SE = 0.38, RMSE = 0.39



Mean SE = 0.39, RMSE = 0.55