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Compte rendu 2011/071

Pacific Region

Région du Pacifique

Proceedings of the Pacific Region Science Advisory Process for Spiny Dogfish (*Squalus acanthius*) in British Columbia, Canada

Processus d'avis scientifique régional pour l'aiguillat commun (*Squalus acanthius*) en Colombie-Britannique, Canada

May 17, 2010
Nanaimo, British Columbia

17 mai 2010
Nanaimo (Colombie-Britannique)

Greg Workman
Chair

Greg Workman
Président

Fisheries and Oceans Canada / Pêches et Océans Canada
Science Branch / Secteur des Science
3190 Hammond Bay Road
Nanaimo, BC V9T 6N7

April 2012

Avril 2012

Canada

Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings include research recommendations, uncertainties, and the rationale for decisions made by the meeting. Proceedings also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

Avant-propos

Le présent compte rendu a pour but de documenter les principales activités et discussions qui ont eu lieu au cours de la réunion. Il contient des recommandations sur les recherches à effectuer, traite des incertitudes et expose les motifs ayant mené à la prise de décisions pendant la réunion. En outre, il fait état de données, d’analyses ou d’interprétations passées en revue et rejetées pour des raisons scientifiques, en donnant la raison du rejet. Bien que les interprétations et les opinions contenus dans le présent rapport puissent être inexacts ou propres à induire en erreur, ils sont quand même reproduits aussi fidèlement que possible afin de refléter les échanges tenus au cours de la réunion. Ainsi, aucune partie de ce rapport ne doit être considéré en tant que reflet des conclusions de la réunion, à moins d’indication précise en ce sens. De plus, un examen ultérieur de la question pourrait entraîner des changements aux conclusions, notamment si l’information supplémentaire pertinente, non disponible au moment de la réunion, est fournie par la suite. Finalement, dans les rares cas où des opinions divergentes sont exprimées officiellement, celles-ci sont également consignées dans les annexes du compte rendu.

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K1A 0E6

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CSAS@DFO-MPO.GC.CA

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SUMMARY

A regional advisory process meeting was held May 17, 2010 in Nanaimo, British Columbia (BC) to conduct a science peer review of the status of spiny dogfish (*Squalus acanthius*) in British Columbia, Canada. The science review was conducted in response to a request from DFO Fisheries and Aquaculture Management (FAM) for advice regarding the current stock status and appropriate fishery reference points for the inside (Groundfish Management Area 4B) and outside (GMA 3C, 3D, 5AB, 5CDE) stocks. This species has recently been reviewed by the Committee on the Status of Wildlife in Canada (COSEWIC) and the fishing industry has expressed interest in pursuing eco-certification for the directed longline hook fishery.

A generalized Schaefer and Pella-Tomlinson surplus production model was applied to the inside and outside stocks to estimate the current biomass and equilibrium B_{MSY} and F_{MSY} reference points. Inputs to the models included annual landings data beginning in 1935 and discard data beginning in 1966. Available stock indices varied by stock but included catch per unit effort (CPUE) data available from the commercial longline hook and trawl fisheries. Fishery-independent indices included spiny dogfish CPUE derived from a targeted spiny dogfish longline hook survey, the Hecate Strait trawl survey, the International Pacific Halibut Commission longline hook survey, and the National Marine Fisheries Service trawl survey. A suite of 16 model fits was performed for each stock to evaluate the impacts of various choices of fixed or estimated leading parameters which included the intrinsic rate of increase, r, carrying capacity, K, and the shape parameter, m, of the surplus production model. Freely estimated parameters tended towards their upper constraint bounds in most cases for fits of the model to the outside stock data. Similar estimation behaviour was obtained for the intrinsic rate of growth parameter for the inside stock.

Model results suggested there is insufficient contrast in the stock index data to provide productivity and scale information for the two stocks when using a surplus production model formulation. Consequently the results of the modeling were not recommended as the basis for advice to fishery managers. Advice to fishery managers for the inside stock was provided based on average long-term catch history consistent with the Sustainable Fisheries Framework policy. No changes to current management for the outside stock were identified.

SOMMAIRE

Une réunion du processus de consultation régionale a eu lieu le 17 mai 2010 à Nanaimo, Colombie-Britannique (C.-B.), pour entreprendre un examen scientifique par les pairs de l'état de l'aiguillat commun (*Squalus acanthius*) en Colombie-Britannique, Canada. L'examen scientifique a été effectué en réponse à une demande de consultation formulée par Gestion des pêches et de l'aquaculture du MPO concernant l'état du stock actuel et les points de référence qu'il convient d'établir pour les pêches menées dans les eaux intérieures (zone de gestion du poisson de fond 4B) et pour celles menées dans les eaux extérieures (GMA 3C, 3D, 5AB, 5CDE). Le Comité sur la situation des espèces en péril au Canada (COSEPAC) s'est penché dernièrement sur cette espèce, et l'industrie de la pêche s'est montrée favorable à l'instauration de l'écocertification pour la pêche dirigée à la palangre.

Un modèle généralisé de production excédentaire de Schaefer et de Pella-Tomlinson a été appliqué aux stocks des eaux intérieures et des eaux extérieures afin d'estimer la biomasse actuelle et d'établir les points de référence pour la B_{RMS} et la F_{RMS}. Les données utilisées pour créer le modèle comprennent notamment les débarquements annuels depuis 1935 et les rejets depuis 1966. Les données sur les prises par unité d'effort fournies par les palangriers et les chaluts de fond et par divers relevés scientifiques ont été utilisées comme indices de l'abondance relative. Les indices d'abondance indépendants de la pêche comprenaient notamment les captures par unité d'efforts selon un relevé de la pêche à la palangre de l'aiguillat commun, le relevé au chalut du détroit d'Hécate, le relevé de pêche à la palangre de la Commission internationale du flétan du Pacifique et le relevé au chalut du National Marine Fisheries Service. Seize ajustements de modèle ont été effectués pour chaque stock afin d'évaluer l'influence de divers choix de paramètres directeurs fixes ou approximatifs qui portaient entre autres sur le taux intrinsèque d'accroissement (r), la capacité de charge (K) et le paramètre de forme (m) du modèle de surplus de production. Dans la plupart des cas d'ajustement de modèle pour les données sur les stocks des eaux extérieures, les paramètres évalués librement penchaient vers les limites supérieures de contrainte. Des estimations semblables des paramètres de modèles du taux intrinsèque d'accroissement de la population des eaux intérieures ont été trouvées dans la documentation.

Les résultats des modèles incitent à penser que les données indicielles sur les stocks ne sont pas suffisamment contrastées pour déboucher sur des renseignements relatifs à la productivité et à l'abondance des deux stocks lorsque l'on utilise une formulation fondée sur le modèle de surplus de production. C'est pourquoi les résultats de la modélisation ne sont pas recommandés pour fournir des avis aux gestionnaires des pêches. L'avis fourni aux gestionnaires des pêches dans le cas des stocks des eaux intérieures repose sur les antécédents moyens de captures à long terme, conformément au Cadre pour la pêche durable. Aucun changement n'est recommandé dans le cas des stocks des eaux extérieures.

INTRODUCTION

A Pacific Region science advisory process peer review of stock assessments for spiny dogfish (*Squalus acanthius*) in British Columbia was conducted in Nanaimo (BC) on May 17, 2010. The Terms of Reference for the science review (Appendix 1) were developed by the CSAP office, Pacific Region in response to a request for advice from Fisheries Management (FAM). Notifications of the science review and conditions for participation were sent to identified industry associations, non-governmental organizations, and First Nations organizations with an interest in spiny dogfish in British Columbia in April 2010.on (Appendix 2).

A working paper was prepared and made available for review by meeting participants on March 24, 2010:

Spiny dogfish (Squalus acanthius) assessment and catch recommendations for 2010. V. Galluci, I. Taylor, J. King, G. McFarlane, and R. McPhie.

The meeting began at 9:30 AM, Monday, May 17, 2010. Chair G. Workman welcomed participants and explained room arrangements. The Chair reviewed the CSAP process and rules of exchange for the meeting. The Terms of Reference for the spiny dogfish working paper were reviewed (Appendix 1). Meeting participants were asked to introduce themselves (Appendix 2). The agenda (Appendix 3) was tabled for approval and the Chair noted that rapporteur duties were assigned to R. McPhie (Science, Pacific Region). Presentation and review of the spiny dogfish working paper followed with consideration of the working paper closed at 4:00PM. Expected outcomes as a result of this science review process include this Proceedings document, a Science Advisory Report, and a Research Document.

The proceedings presented in this series focus on the main points discussed in the presentations and deliberations stemming from the activities of the science advisory regional Committee. The regional review is a process opened to all participants who are able to provide a critical outlook on the status of the assessed resources. In this regard, participants from outside the DFO are invited to take part in the Committee's activities. Proceedings also focus on recommendations made by the meeting participants.

CONTEXT

Spiny dogfish have been commercially exploited since the 1870s in British Columbia with fishing occurring primarily in the Strait of Georgia and off the southwest coast of Vancouver Island. Landings of 5,000 to 32,000 t were realized from 1937 to 1950 to supply shark livers for vitamin A production. Beginning in late 1970's a food market for dogfish developed with annual landings ranging from less than 100 in 1976 to almost 5,000 t in 2003. Following the Pacific Fisheries Adjustment and Restructuring program of the late 1990s there has been resurgence in the targeted spiny dogfish fishery. The fishery currently operates coast wide and is managed primarily by an Individual Vessel Quota (IVQ) system.

The last comprehensive stock assessment for Pacific spiny dogfish was completed in 1988 (Saunders 1989). Updated stock assessment and harvest advice was requested by FAM for the inside and outside management areas in response to (*i*) increased catches of spiny dogfish over the last 10 years relative to the 1990s, (*ii*) review of this species by the Committee on the Status of Wildlife in Canada (COSEWIC), and, (*iii*) industry interest in pursuing eco-certification. The inside area consists of most of the sheltered waters east of Vancouver Island in Groundfish Management Unit 4B, while the outside area includes all other waters coast wide. Estimates of current abundance and recommended fishery reference points were requested. Science advice should be consistent with "*DFO Sustainable Fisheries Framework*" (SFF) policy and "*A fishery decision-making framework incorporating the Precautionary Approach*" (PA) policy (DFO 2009).

SPINY DOGFISH (*SQUALUS ACANTHIAS*) ASSESSMENT AND CATCH RECOMMENDATIONS FOR 2010

The working paper was presented by authors J. King, S. McFarlane V. Galluci (via conference call), I. Taylor (via conference call) and R. McPhie. The presentation was organized into seven sections:

- General biology, growth and maturity characteristics, stock structure;
- Fishery history;
- Assessments and management history;
- Review of input data;
- Stock assessment methodology, parameter choices and sensitivity runs;
- Reference points and characterization of stock status; and
- Conclusions and recommendations.

The authors reported that spiny dogfish are ovoviviparous with a gestation period of 2 years. Females produce between 2 and 16 pups at about 26-27 cm length at birth. Spiny dogfish are a long-lived species with maximum ages in the Pacific population of about 80-90 years and a maximum size of 130 cm. Age-at-maturity for females is approximately 35-36 years, corresponding to approximately 94 cm length.

From 1870 to 1916, spiny dogfish were harvested for their liver and body oils, and high demand for vitamin A created substantial liver fishery with annual landings of 5,139 to 31,187 t from 1937 to 1950. Landings diminished markedly thereafter due to stock declines, market shifts and production of synthetic vitamin A. Landings began to increase by 1977 as demand for spiny dogfish as food fish revived and have ranged between 139 t (1986) and 4,952 (2003) since 1980. Management occurs via an Individual Vessel Quota (IVQ) system in two stock areas: an inside stock inhabiting the Strait of Georgia (Statistical Area 4B); and an outside stock inhabiting all remaining coastal areas (Statistical Areas 3C, 3D, 5A, 5B, 5C, 5D, 5E).

Annual landings data were available beginning in 1935. Discard data were available beginning in 1966. Discard mortality was calculated using a 6% rate for longline hook gear and for trawl gear an average annual rate related to tow duration was applied to the annual discarded catch. Relative stock indices were based on catch per unit effort (CPUE) data available from the commercial longline hook and trawl fisheries and from several research surveys. Longline CPUE was available beginning in 1980 for the inside stock and 1996 for the outside stock. Fishery independent indices varied by stock area but were based on spiny dogfish CPUE derived from a targeted spiny dogfish longline hook survey (1986, 1989, 2004, 2008), Hecate Strait trawl survey (11 years1984-2003), the International Pacific Halibut Commission longline hook survey (1998-2008), and the National Marine Fisheries Service trawl survey (7 years, 1980-2001).

A generalized Schaefer and Pella-Tomlinson surplus production model was applied to each stock to estimate the current biomass and equilibrium B_{MSY} and F_{MSY} reference points. The intrinsic rate of population increase, *r*, was bounded between 0.017 and 0.07 based on values provided in the primary literature. The carrying capacity, *K*, was bounded at 1.67 kt (inside stock) and 3.33 kt (outside stock) by prorating the estimated coast-wide biomass prior to the liver fishery in the 1940s to each stock area based on an estimate of the amount of spiny dogfish habitat. The form of the surplus production model was determined by fixing a shape parameter to m = 1 (Scheafer) or m = 3 (Pella-Tomlinson). A suite of 16 model fits was performed for each stock to evaluate the impacts of various choices of fixed or estimated parameters, (*r*, *K, m*). Freely estimated parameters tended towards their upper constraint bounds in most cases for fits of the model to the outside stock data. Similar estimation behaviour was obtained for the intrinsic rate of growth parameter for the inside stock.

The authors recommended the adoption of model fits with intermediate values of r = 0.043 and *K* freely estimated as the basis for management advice (Runs 9-10 of Table 15-16 of the working paper). Runs 9 and 10 corresponding to the Schaefer and Pella-Tomlinson models, respectively, gave the following results for the inside stock:

- the yield limit for the inside stock derived from the Schaefer model is 525 t and the limit derived from the Pella-Tomlinson model is 168 t;
- biomass at maximum sustained yield, B_{MSY}, ranged from 58,370 to 59,077 t;
- the ratio of exploitable biomass in 2009 to B_{MSY}, B_{2009}/B_{MSY} ranged from 0.65 to 0.47, and;
- fishing mortality at MSY, F_{MSY}, ranged from 0.022 to 0.033.

The analogous fits to the outside stock data resulted in the following outputs for the Schaefer and Pella-Tomlinson, respectively:

- the yield limit for the outside stock derived from the Schaefer model is 5,964 t and the limit derived from the Pella-Tomlinson model is 10,087 t;
- biomass at maximum sustained yield, B_{MSY}, ranged from 166,667 t (solution on constraint)) to 209,987 t;
- the ratio of exploitable biomass in 2009 to B_{MSY}, B_{2009}/B_{MSY} ranged from 1.64 to 1.48; and
- fishing mortality at MSY, F_{MSY}, ranged from 0.022 to 0.033.

As an interim alternative to model-based results the authors suggested that long-term average annual yield could be used to guide harvest decisions where (*i*) average annual catch for the inside stock over the last 25 years is 1,050 t; and (*ii*) average annual catch for the inside stock over the last 25 years is 1,900 t.

DISCUSSION OF REVIEWS

The Committee considered reviews by S. Campana (DFO, Bedford Institute of Oceanography) and P. Rago (National Marine Fisheries Service, USA). A summary of the major issues identified by each reviewer is included below.

SUMMARY OF REVIEW 1

Reviewer 1 judged the assessment to provide a thorough presentation of historical fishery and survey data, and correct implementation of the surplus production model. However, he questioned the choice to apply the Schaefer or Pella-Tomlinson model under equilibrium conditions and recommended that a discussion of the possibility of overly optimistic results be added to the working paper. The reviewer asked for clarification on the rationale for choosing the surplus production model over an age-structured assessment, suggesting previous spiny dogfish assessments had been age-structured or had at least used age-length keys to develop an age-structured analysis.

The reviewer recommended that the values of likelihood components, model diagnostics, residual plots, and goodness of fit tests be included in the working paper to allow model adequacy to be evaluated. He cited concerns about the limited contrast in the abundance index series and the lack of indices from the initial years of exploitation. This concern was noted in particular for the outside population where contrast in yield curves is low within each of the $m = 1$ (Scheafer) and $m = 3$ (Pella-Tomlinson) cases. He concluded that only the commercial longline CPUE series is driving model likelihoods. This could be either because this series is the only index series exhibiting some contrast, or because most of the data observations come from commercial longline hook fishing. He suggested that various weightings of the likelihood components corresponding to stock indices be investigated to allow other commercial and survey indices to play more than a negligible role.

The reviewer commented extensively on the choice of the intrinsic rate of growth parameter, r. He stated that assuming an r value of 0.07 was inappropriate given the higher growth rate and productivity of spiny dogfish in European and North Atlantic waters where values typically range from 0.03 to 0.04. Pacific spiny dogfish have the slowest reported growth, and greatest age at maturity, of all dogfish populations in the world making them the least productive (Campana et al. 2009). He stated that setting r=0.043 was not suitable as an intermediate choice and is certainly not precautionary, citing a meta-analysis of r values and elasticities for 41 shark populations (Cortes 2002) where the north east Pacific population of spiny dogfish was close to being the least productive on the list at a ranking of 25 out of 41 populations. Consequently, he recommended that r be bounded by 0.17 and 0.43, rather than 0.17 and 0.07 and concluded that $r = 0.03$ is a more likely value based on Smith et al. (1998) who estimated $r = 0.034$ for the more productive North West Atlantic population.

The reviewer identified a number of concerns regarding data inputs. He questioned why trawl catch per unit effort (CPUE) from the 1980s had not been included in the analysis, as was the practice in previous analysis by King and McFarlane (2009). Two comments were provided on discards. First he concluded that the discard mortality estimates appeared very low in comparison to those applied for Atlantic spiny dogfish and suggested that the basis for the discard mortality rates be supplied, e.g. clarify whether the source was field observation or controlled lab experimentation? He acknowledged that the surplus production model could not use juvenile bycatch data but noted that the mortality of juveniles could still influence the population trajectory. Consequently he suggested these data be reported in the working paper.

The reviewer requested the rationale be provided for (*i*) assuming a 1:2 breakdown of carrying capacity, *K*, between inside and outside populations, and (*ii*) dividing unassigned landings equally between inside and outside stocks rather than on the basis of reported landings. He suggested that differences in the growth and maturity schedules of male and females be reported. Various length frequency analyses were requested such as those reported by Taylor and Galluci (2009), presentation of length frequencies from commercial longline fishing, and comparison of length frequencies from the pre-1975 period (if available) with more recent data.

The reviewer disagreed with the arguments provided to conclude that the inside population has been stable over the last 25 years with a potential increase in juvenile fish to the bottom habitat, and that long-term yields of about 1,000 t could be maintained without stock decline. His view was that inspection of catch data, downward shifts in length frequencies, and an increase in a relative abundance index are insufficient evidence.

SUMMARY OF REVIEW 2

Reviewer 2 concluded that the working paper represented a thorough analysis of relatively data-poor stocks, with the analyses providing a good basis for estimation of population scale and bounds on productivity. He cautioned that experience in the US was that fisheries where catches were dominated by females can have long-range implications when the stock is fished hard, and particularly for rebuilding from depleted levels. He advocated modest harvest levels coupled with monitoring programs. The reviewer noted that in the U.S. fishery about 42% of female mortality and at least 80% of male mortality results from discarding and he raised concerns about the effects of underestimation of discards in the past, and the potential for future increases in the discard rate.

He noted that the fishery-independent indices of relative abundance lack contrast and therefore do not contribute much information to estimating stock trend or response to fishing mortality. Consequently, he remarked that based on inspection of Figure 4 (7 in final paper) of the working paper, model fitting matches the relative abundance series at the end of the time series post-1950 but cannot resolve whether the stock is small and productive (high *r*) or large and unproductive (low *r*). With reference to results in Tables 15-16 of the working paper, the reviewer noted that when either *r* or *K* are fixed model estimates are driven to the parameter bounds. He suggested that additional information on population scale might be drawn from comparing model results with swept-area estimates from the National Marine Fisheries Service triennial survey or groundfish multi-species synoptic surveys to determine if the model indicates capture efficiencies greater than one.

The reviewer concluded that the estimates of fishing mortality at maximum sustained yield, F_{MSY}, appeared reasonable if the mortality is applied to the whole stock, but stated that the Pella-Tomlinson model with $m = 3$ is unreasonable for a slow response species like dogfish.

The reviewer offered a number of suggestions on alternatives to the equilibrium surplus production model including Bayesian surplus production models and the recently developed depletion corrected average catch (DCAC, http://nft.nefsc.noaa.gov/DCAC.html) model for data poor situations. The DCAC method corrects MSY estimates for depletions that may have occurred as the resource was fished down, in this case prior to 1950.

Reviewer 2 agreed with the decision to exclude survey index series with high average coefficients of variation (CVs) but noted that down-weighting the high CV surveys with inverse variance weighing has been applied elsewhere. He requested clarification on the rationale and analyses that supported the decision to restrict data used for commercial CPUE indices to trips with at least 60% dogfish in the catch. During the presentation of the review, he noted that the sensitivity of model outputs to this data selection threshold should be tested using alternative percentages since this commercial indices, particularly the longline hook index, appears to dominate the survey indices.

The authors stated their view that the long history of relatively stable catches (aside from some brief periods of high catches) suggested that the advantages of fitting a non-equilibrium production model would not be large in this case, particularly for the inside stock. The authors agreed to include a table of likelihood component estimates and model diagnostics in revisions to the final document. The authors stated their preference that model configurations with $r = 0.07$ would be retained because it is a published value although they agreed that it is an extreme value for this species. The authors clarified that the 1:2 allocation of K to inside and outside areas, respectively, was based on an approximation of spiny dogfish habitat largely drawn from the work of Ketchen (1969).

A Science participant referred to the discard and discard mortality estimates provided in Tables 7 and 8 of the working paper and suggested adding estimates for the recreational fishery where spiny dogfish are commonly intercepted. The authors responded that creel survey estimates were likely of low reliability, but suggested that future analyses determine the availability and reliability of catch estimates derived from both the recreational fishery and commercial salmon gillnet fishery. For the latter fishery, FAM has requested that the catch of spiny dogfish be recorded by fishermen because of the potential magnitude of the catch. A Science participant suggested the omission of these data should be clarified in the working paper and that further explanation was required for trawl fishery discard estimates. He noted that trawl discard data are logbook estimates for the inside stock and for the outside stock prior to 1996. He commented that generally logbooks contained discard data only when a large catch was encountered so that overall discard mortality could be grossly underestimated. Similarly, he stated that hook and line logbooks are likely to under report spiny dogfish catch. He noted that in particular the directed longline halibut fishery could represent a significant amount of spiny dogfish catch dating to the 1930s which is not well documented, i.e., halibut logbooks were focused on recording the halibut catch prior to integration of the groundfish fisheries in 2006. It was suggested that a table of catch data omissions be included in the working paper describing the rationale for their exclusion and a subjective assessment of their potential magnitude which is likely to be substantial. The table should include other potential sources of stock index data such as the groundfish multi-species synoptic trawl surveys. The authors responded that they had excluded the multi-species surveys because the series had a maximum of three survey years and the survey coefficient of variations (CV) values were relatively large.

A reviewer noted that the commercial longline hook CPUE was the dominant stock index and asked whether the assumption of constant catchability over time was reasonable given changes to fishing gear which were known to have occurred for the Atlantic fishery. The authors responded that there was a change from J-hooks to circle hooks in the mid-1990s and that standardization for that change had been conducted using the method described in King and McFarlane (2009).

GENERAL DISCUSSION

The Chair reviewed the requirements of the working paper identified in the Terms of Reference (Appendix 1), asked that discussion be framed around the questions raised by the reviews before opening general discussion to the Committee.

A Science participant asked if hook saturation and competition had been analyzed when developing the hook and line abundance indices, and suggested that gear saturation might be a problem for dogfish if abundance increases. The authors responded that no attempt had been made to adjust for saturation effects.

An industry participant asked what effect underestimation of catch mortality would have on biomass estimates, suggesting that the stock would have to be larger to support additional removals not currently included in the analysis. Various Committee members suggested it would be difficult to determine the effects without doing the analysis since r and K could trade-off, i.e., larger removals could be explained by a larger estimated initial stock size or by larger estimates of productivity. A Science participant pointed out there is not much contrast in abundance indices which tend to cover the most recent portion of the time series. Thus, the model has difficulty resolving productivity and unfished exploitable biomass as noted by the reviewers. Consequently, the prospect for estimating (r, K) simultaneously within parameter bounds is unlikely. A reviewer noted that the estimates of K tend to the upper bound of the constraint and suggested developing a swept-area estimate of absolute abundance to compare to model estimates of stock size. The authors responded that the two possible trawl gear surveys (NMFS and Hecate Strait survey) do not cover the geographic range of the outside stock and a time series of trawl survey data is not available for the inside stock.

A FAM participant asked if it was possible to develop a set of alternative future catch levels with the corresponding probability of exceeding some performance statistic rather than providing a specific, single harvest level. The authors responded that decision tables would require projections of future stock performance at each future catch level, and that no projections were completed for this assessment.

A Science participant asked about the ratio of males to females in survey data versus the commercial fishery, citing concerns about excessive fishing mortality on females. The authors responded that port samples from the inside commercial fishery yielded about 57% females and the research surveys yielded about 40% females. An industry participant noted that the fishery is targeted on males for the inside fishery due to market and that time of day dramatically affects CPUE and should do so for both commercial and survey fishing. A Science participant suggested that the electronic monitoring or logbook data beginning in 2006 might give more accurate estimates of discarding in the longline fishery.

A FAM participant suggested that the model diagnostics would be required before the suitability of the model fits to provide the basis for management advice could be assessed. In response, a Science participant stated his view that the diagnostics would not help resolve model choice in that the outputs were not driven data but were instead largely determined by the fixed priors on (r, K) and whether the Schaefer or Pella-Tomlinson form of the production model was assumed. Another Science participant re-iterated a reviewer's comment that the $r = 0.07$ appears to be implausibly high and $r = 0.043$ appears to be at the high end of plausible range. He added that those choices and the upper bound on K drive the analysis and reflect the consequences of the hypotheses about (r, K) proposed in the working paper. An industry participant suggested that a Bayesian analysis be undertaken to develop better priors. The authors suggested that future assessments might look to the development of Bayesian approaches for the Atlantic or Alaskan spiny dogfish populations.

The authors commented on their choice to provide 25 year catch history alternatives to the production model outputs, citing (*i*) the limited model choices available given the paucity of age-structured data, and (*ii*) the tendency for (r, K) to hit the upper bound of the constraint when freely estimated. However, the catch history for the species is long and shows periods of relative stability including the food fishery period beginning in 1978. In addition both commercial and survey abundance indices are available during this period and the directed survey index does not show a persistent decline.

The authors suggested that the outside stock currently had a modest directed fishery and believed catch history to be too restrictive and should not be used as guidance to harvests in preference to model outputs. For the inside stock, the authors suggested that either catch history or model outputs could be used as guidance. A Science participant pointed out the difficulties of selecting a preferred model run given the parameters may be fixed or on the upper bound of a constraint and outputs are largely dependent on the choices of parameters (r, K, m) rather than the stock index data. He suggested that Bayesian model formulations be used for the next assessment to avoid the use of "hard" priors and to help determine whether there is any information in the data to resolve scale and productivity.

A reviewer questioned whether average catch over 25 years would be sufficient to accommodate the life history of this species and suggested using average catch since 1945 rather than a shorter time series. A Science participant noted that that the generation time of spiny dogfish would be long and fishing effects may take a long time to materialize. An author noted that the total catch estimates are likely underestimated so that averages from catch history may underestimate the actual removals.

In summary, the Committee expressed reservations about model outputs due (*i*) the lack of contrast in stock indices resulting in model estimation difficulties in determining stock productivity and scale, and (*ii*) inadequate representation of uncertainty when using the selected implementation of the production model. Therefore the Committee suggested that on an interim basis harvest advice should be guided by the average catch from 1978 to 2009 for the inside stock. For the outside stock, the Committee did not identify any changes to the current TAC and management system. The Committee concluded that average catch should not be used for more than a five year period, and that both stock of spiny dogfish should be re-assessed within five years.

The Committee also noted that the discard mortality rates applied to commercial fishery discards are based on values applied in the management plan that are not supported by research studies. It is likely that the discard mortality rates are underestimated and therefore total removals from both stocks are underestimated. Fishing mortality due to salmon troll, seine and gillnet fisheries, recreational fisheries, and under-reporting of discards in commercial longline hook and trawl logbooks also contributes to underestimation of past removals.

REVIEW OF TERMS OF REFERENCE

The Chair opened discussion on whether the working paper had met the requirements of the Terms of Reference (Appendix 1).

The Committee noted that many of the model fits resulted in the estimates of *r* and *K* that were on the upper constraint of the parameter bounds. This suggests that there is little information in the data, i.e., contrast in the abundance indices, to provide scale information for the two stocks. Model mis-specification may also contribute to similar results. For these reason, the results of the modeling are not recommended as the basis for advice to fishery managers. Consequently, the MSY-based reference points estimated by the model should not be used to formulate advice to managers. Revisions to the working paper should include the addition of likelihood statistics and model fit diagnostics, consideration of reviewer's comments, a detailed description of catch omissions and comments on the potential effects of for gear saturation in the abundance indices.

Advice to fishery managers for the inside stock is provided based on average catch history, trends in survey results and expert opinion, consistent with the DFO policy "*Fishery decision-making framework incorporating the Precautionary Approach", as described in Canada's Sustainable Fisheries Framework.* Specifically, this policy directs that in the absence of model-based estimates of MSY-based reference points or analytical proxies, that empirically-based values can be used, such as average long-term yield or average fishing mortality (or an index of fishing mortality), which did not lead to stock decline over a productive period. Committee conclusions and recommendations are provided below:

1. The Committee did not identify an immediate conservation concern for spiny dogfish in either management area;

2. For the inside stock, the Committee recommended that catches be based on the average yield of 1,579 t between 1978 and 2009 which is the period of the modern food fish fishery. The current total allowable catch is 3,000 t however landings have averaged about 1,000 t since 2000 and slightly exceeded the 1978-2009 average in only one year since 2000;

3. For the outside stock, the Committee noted that the catch of spiny dogfish has averaged 1,082 t since 2000, which is substantially below the current TAC of 12,000 t. Current harvests are taken primarily by a small, low-capacity directed longline hook fishery and a small non-targeted trawl catch. Neither fishery is expected to expand in the near future therefore no change to the current management approach is identified;

4. The Committee recommended that given the data and model uncertainties documented by the working paper and review, an updated stock assessment should be conducted as soon as resources permit and that current advice should updated within 5 years.

It was recommended that the working paper be revised and published as a CSAS Research Document series. Consideration of the Pacific spiny dogfish stock assessment working paper was closed by the Chair at 4:00PM on May 17, 2010.

POST SCRIPT – COMMUNICATION CHALLENGES

Neither the first nor second authors, nor either of the reviewers, nor several committee members where able attend this meeting in person. To facilitate participation, particularly for the authors and reviewers, a "Webinar" was set up. Unfortunately due to technical issues, Web participants were unable ask or answer questions, they were only able to view the presentations and listen to the discussions. An interim solution was to have the authors participate via conference call, while this facilitated some discussion dialogue was still limited. All Webinar participants expressed disappointment with the process and asked that for future meetings efforts be made to ensure in-person participation by authors and reviewers.

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APPENDIX 1. TERMS OF REFERENCE FOR THE MEETING.

Terms of Reference

Pacific Spiny Dogfish Assessment
Regional Science Advisory Process
Centre for Science Advice Pacific – Groundfish Committee

Pacific Biological Station
Date: May 17, 2010
Nanaimo, BC

Chairperson: Greg Workman

Background

The last partial stock assessment of dogfish was conducted in 1994/95 and the last full assessment was completed in 1989. Since the Pacific Fisheries Adjustment and Restructuring (PFAR) program of the late 1990s, there has been a resurgence in the targeted spiny dogfish fishery, particularly amongst the hook and line sector. The fishery currently operates year round, in all areas of the coast, and is managed by Individual Vessel Quota (IVQ). Given the increased pressure on this resource over the last decade, the fact that the directed dogfish fleet is applying for Marine Stewardship Council (MSC) eco-certification, and that this is a species that is currently being assessed by the Committee on the Status of Wildlife in Canada (COSEWIC), an updated stock assessment and harvest advice has been requested.

The Groundfish Management Unit requested catch advice for all management areas of the Pacific coast, including the Strait of Georgia, as well as coast wide estimates of abundance. Consistent with DFO's evolving implementation of the Sustainable Fisheries Framework, Policy on the Application of the Precautionary Approach, estimates of the target stock reference, as well target harvest rate will be provided.

Objectives

Peer review the draft working paper "Spiny Dogfish Assessment (*Squalus acanthias*) and Catch Recommendation for 2010".

Products

- CSAS Proceedings document;
- CSAS Research document;
- CSAS Science Advisory Report.

Location and Date

Nanaimo, BC, Pacific Biological Station, Seminar Room

Participation

Approximately 25 participants representing the following groups will be invited:

- DFO Science;
- DFO Fisheries & Aquaculture Management;
- Aboriginal communities / organizations;
- Provincial governments;
- Industry.

APPENDIX 2 LIST OF PARTICIPANTS

*List of invited and attending participants at the May 17, 2010 CSAP Science Advisory Process review of spiny dogfish (*Squalus acanthius*) in British Columbia, Canada. Symbols indicate the invitee attended (√) or participated by Webinar (w) or conference call (c).*

Last Name	First Name	Affiliation	E-mail Address	May 17
Ackerman	Barry	FAM, Groundfish Management	Barry.Ackerman@dfo-mpo.gc.ca	√
Brekke	Heather	FAM, Recovery Planner	Heather.Brekke@dfo-mpo.gc.ca	√
Campana	Steve	Science, Maritimes Region	Steven.Campana@dfo-mpo.gc.ca	W
Edwards	Andrew	Science, Groundfish Section	Andrew.Edwards@dfo-mpo.gc.ca	√
Eros	Carole	FAM, Species at Risk Coord.	Carole.Eros@dfo-mpo.gc.ca	√
Fargo	Jeff	Science, Groundfish Section (ret)	jfargo@shaw.ca	
Haigh	Rowan	Science, Groundfish Section	Rowan.Haigh@dfo-mpo.gc.ca	√
Holt	Kendra	Science, Groundfish Section	Kendra.Holt@dfo-mpo.gc.ca	√
Joyce	Marilyn	Science, CSAP	Marilyn.Joyce@dfo-mpo.gc.ca	√
Ketchen	Keith	Science (ret)	keidor@shaw.ca	√
King	Jackie	Science, Groundfish Section	Jackie.King@dfo-mpo.gc.ca	√
Kronlund	Allen	Science, Groundfish Section	Allen.Kronlund@dfo-mpo.gc.ca	√
MacConnachie	Sean	Science, SARA	Sean.MacConnachie@dfo-mpo.gc.ca	√
McFarlane	Sandy	Science (ret.)	Sandy.McFarlane@dfo-mpo.gc.ca	√
McPhie	Romney	Science, Groundfish Section	Romney.McPhie@dfo-mpo.gc.ca	√
Mawani	Tamee	FAM, Groundfish Management	Tameezan.Mawani@dfo-mpo.gc.ca	√
Ou	Wan Li	FAM, Groundfish Management	wan-li.ou@dfo-mpo.gc.ca	√
Stanley	Rick	Science, Groundfish Section	Rick.Stanley@dfo-mpo.gc.ca	√
Tadey	Rob	FAM, Groundfish Management	Robert.Tadey@dfo-mpo.gc.ca	√
Workman	Greg	Science, Groundfish Section	Greg.Workman@dfo-mpo.gc.ca	√
Yamanaka	Lynne	Science, Groundfish Section	Lynne.Yamanaka@dfo-mpo.gc.ca	√
External				
Argue	Sandy	Province of British Columbia	sandy.argue@argusbioresources.ca	√
Bohun	Ken		ken.bohun@cfnation	√
Boyes	David	CIC, Halibut	mcboyes@telus.net	√
Cooper	Ernie	World Wildlife Fund	ecooper@wwfcanada.org	√
Chalmers	Dennis	Province of British Columbia	Dennis.Chalmers@gov.bc.ca	√
Edwards	Dan	United Fishers & Allied Workers	danedwards@telus.net	√
Gallucci	Vince	University of Washington	vgallucc@u.washington.edu	C
Mose	Brian	Commercial Industry Caucus, Trawl	bmose@nanaimo.ark.com	√
Rago	Paul	National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole	Paul.Rago@noaa.gov	C
Renwick	Mike	BC Dogfish Hook & Line Industry Association	mrenwick@telus.net	√
Starr	Paul	Canadian Groundfish Research and Conservation Society	paul@starrfish.net	W
Taylor	Ian	Northwest Fisheries Science Center	Ian.Taylor@noaa.gov	C
Turris	Bruce	Canadian Groundfish Research and Conservation Society	bruce_turris@telus.net	√
Wallace	Scott	David Suzuki Foundation	swallace@davidsuzuki.org	√

APPENDIX 3. DRAFT AGENDA FOR THE MEETING.

Agenda

Review of spiny dogfish assessment and catch recommendations for 2010
Pacific Regional Science Advisory Process

17 May, 2010

Seminar Room, Pacific Biological Station
Nanaimo, B.C.

Chairperson: Greg Workman

Review of:

Spiny dogfish (Squalus acanthias) assessment and catch recommendations for 2010. V. Gallucci, I. Taylor, J. King, G. McFarlane, and R. McPhie

Rapporteur: R. McPhie

9:30	Introductions and CSAS procedures	Chair
	Review Terms of Reference	Chair & participants
10:00	Presentation of working paper	Authors
10:45	Reviews & authors' responses	
12:00	***Lunch Break***	
1:00	Continued review of spiny dogfish assessment	Participants
4:00	***Adjourn***	

APPENDIX 4. FULL TEXT OF REVIEW ONE

Reviewer Comments on:
SPINY DOGFISH ASSESSMENT AND CATCH RECOMMENDATIONS FOR 2010

The spiny dogfish assessment prepared by Gallucci et al. presents a carefully documented analysis of BC dogfish population dynamics, with a reconstruction of past population abundance. The surplus production models that were used were treated appropriately, and the assessment document was well written. I was particularly impressed with the extent to which the historical data were explored, and the range of survey results which were considered. Overall, I consider this to have been a very good effort.

I have appended a number of comments and suggestions below. Some of the comments are intended merely to clarify points in the assessment document. However, there are a number of areas where some additional data sources, model variations or statistical analyses would have provided useful insight into the status of the dogfish population. Where possible, I suggest that these additional analyses be incorporated into the final assessment. The key areas deserving serious consideration are as follows:

- Use of an equilibrium surplus production model (Schaefer model): I'm not aware of any recent papers or stock assessments which advocate the use of a Schaefer model under equilibrium conditions, presumably because few fish stocks are in equilibrium. Even the overviews of Quinn and Deriso (1999) and Haddon (2001) suggest a non-equilibrium assumption. I guess there's not too much that can be done about this at this stage. At a minimum though, the possibility of overly optimistic results resulting from this model should be discussed.
- Lack of model diagnostics: The authors are experienced modellers, so I know they must have run off many model diagnostics and goodness of fit tests. However, none of these diagnostics were included in the assessment document, making it impossible to evaluate the adequacy of the models. The time series plot of modelled abundances made it clear that there was limited contrast in the data, and no abundance indices from early years, which is a bit alarming. At a minimum, I think we'd want to see the basics such as catch and CPUE vs effort plots. Also observed vs predicted and the residuals.
- Selection of *r* values: Model runs using an *r* value of 0.07 not only seem inappropriate and unnecessary, but have the potential to distort the interpretation of the results. I'm not aware of anyone working with spiny dogfish who seriously considers that an *r* of 0.07 is anything close to reality. Given that the growth and productivity of spiny dogfish in European and North Atlantic waters is considerably higher than that in the northeast Pacific, and given that almost all of the Atlantic values are around 0.03-0.04, even the "intermediate" value of 0.043 used in this assessment doesn't seem very intermediate, and is certainly not precautionary. Cortes (2002) prepared an exhaustive list of *r* values and elasticities for 41 shark populations, including both the NW Atlantic and NE Pacific populations of spiny dogfish. The NE Pacific population was very close to being the least productive of the entire list, and was 4% less productive than the NW Atlantic population. In contrast, an *r* value of 0.043 would have placed it 25th out of 41 populations, which is relatively high. Even Smith et al. (1998) concluded that *r* for the more productive NW Atlantic population was 0.034, which is lower than the intermediate value used here. Therefore, I suggest deleting all of the *r* =0.07 options and using the 0.17 and 0.043 runs as the envelope for the preferred output.
- Historical data: Although I appreciate the difficulties of locating historical data for this stock, I was puzzled by the fact that other studies have found and used data that was not used here. An example of this would be the trawl CPUE series from the 1980s used by King et al. (2009). Those historic estimates would be very important in providing contrast to this model. Why did King et al consider those data appropriate, but the assessors did not? Also, where is the comparison with the length frequencies from the 1940s, as reported in Taylor and Galluci (2009)?
- Likelihood component weightings: Only the commercial longline CPUE series appears to be driving model output, either because it's the only data set with any contrast, or because most of the

observations come from longlines, and thus it's driving the likelihood. Have you tried weighting the likelihood components so that some of the other indices play something other than a negligible role?

- Basis for inside:outside ratio: What was the basis for the 1:2 breakdown between inside and outside stocks? Since that ratio is assumed throughout the assessment, it would be good to know if there's anything solid behind it.

More detailed comments and suggestions follow:

Page 7 under 'Globally': Spiny dogfish populations are also found in the south Atlantic and the south Pacific.

Page 8 under 'Reproduction': Here and elsewhere, the type of length measurement needs to be defined. In other areas, total or fork length are used. But if I understand correctly, the measurement used for BC dogfish is total length with the caudal fin depressed. This needs to be stated. A conversion factor for the other measures would also be helpful so that comparisons with published work is possible.

Page 9 under 'Age': Are there differences in growth rate between males and females? Also, state the size and age at maturity of males

It's worth noting that the northeast Pacific dogfish have the slowest reported growth, and greatest age at maturity, of all dogfish populations in the world, making them the least productive (Campana et al. 2009).

Page 16, top: It seems odd that the unassigned landings were divided equally between inside and outside stocks. Why were they not assigned based on the proportion of reported landings, as was done earlier?

Page 16, under 'Discards': These discard mortality estimates seem very low compared to Atlantic estimates. It is worth noting in the text what the basis for the IFMP discard mortality estimates is: are they actually based on experiment or observation?

Page 17 under 'CPUE': Surely there must be some CPUE data from the pre-1980 portion of the fishery. That would be very useful in increasing data contrast.

King et al. (2009) presented a trawl CPUE series which included values from the 1980s. Those historic estimates would be very important in providing contrast to this model. Why did King et al consider those data appropriate, but you did not?

Page 18, top: Although the model may not be able to use juvenile bycatch values, juvenile bycatches may still influence the population trajectory if they are of sufficient magnitude. The annual tonnage of this bycatch should be reported, either here in the text or in a table.

Page 19: Why does the time series in Table 13 start in 1998, rather than 1993?

Page 20, top line: I'm confused by this statement. Weren't the previous dogfish assessments for this stock age-structured (or at least based on age-length keys)? If so, why do you conclude here that it can't be done? And why is it that the dogfish population in the NW Atlantic can be modelled using an age-length relationship, but this one can't?

End of first paragraph: I don't recall such a conclusion for the NW Atlantic dogfish assessment. This should be reworded.

Page 21: All of these equations seem to be garbled; I presume that it is an artifact of the pdf creation process?

Page 25, top paragraph: Cortes (2002) prepared an exhaustive list of r values and elasticities for 41 shark populations, including both the NW Atlantic and NE Pacific populations of spiny dogfish. The NE Pacific population was very close to being the least productive of the entire list, and was 4% less productive than the NW Atlantic population. In contrast, an r value of 0.043 would have placed it 25th out of 41 populations, which is relatively high.

3rd paragraph: Given that the growth and productivity of spiny dogfish in European and North Atlantic waters is considerably higher than that in the northeast Pacific, and given that almost all of the Atlantic values are around 0.03-0.04, the "intermediate" value of 0.043 used here doesn't seem very intermediate, and is certainly not precautionary. Even Smith et al. (1998) concluded that r for the more productive NW Atlantic population was 0.034, which is lower than the intermediate value used here. It's too bad that a more likely value of 0.03 wasn't used for this assessment.

2nd to last paragraph: What was the basis for the 1/3:2/3 breakdown between inside and outside stocks? Since that ratio is assumed throughout the assessment, it would be good to know if there's anything solid behind it.

Page 26, just before Results: Actually, I haven't run into any recent papers which advocate the use of a Schaefer model under equilibrium conditions. Even the overviews of Quinn and Deriso (1999) and Haddon (2001) suggest a non-equilibrium assumption. For that reason, it would probably be best to put more weight on the Pella-Tomlinson results rather than the Schaefer results, even though both assume equilibrium conditions.

Page 27, 1st para: As noted before, an r value of 0.043 is not very intermediate. It is probably 50-100% higher than the actual value. I would suggest at least commenting on the direction that the r=0.017 run would be, for each of the runs, or preferably, deleting the r=0.07 option and using the 0.17 and 0.043 runs as the envelope for the preferred option.

2nd para: Where are all the model diagnostics? And how about the catch vs effort plots upon which the model results are based?

Page 31, 2nd to last para: Were there no length frequencies from the pre-1975 period? Comparison with more recent length frequencies would be very instructive.

Page 32, 2nd para: Wow! That's a pretty substantial conclusion (that the status quo is acceptable) based on a brief summary of some biological sampling. An inappropriate statement perhaps?

Tables 9-10: It would be helpful to have a column showing the effort associated with each of these CPUE values.

Page 63: The colours in the legend do not match those in the figure.

Page 64: Given that all of the indices of abundance are relatively recent, what is driving the model estimate prior to 1980?

Where is the CPUE vs effort or catch vs effort plot? That is the basis for the whole model fit, and needs to be presented. We also need to see model diagnostics.

Page 65: Only the commercial LL CPUE series is driving recent trends. Why? Because it's the only data set with any contrast? Or is it because most of the observations come from the LL, and thus it's driving the likelihood?

Have you tried weighting the likelihood components so that some of the other indices play something other than a negligible role?

How was the assumption of constant catchability by the LL fleet evaluated?

Page 67: Looks like there's virtually no contrast in the data for the outside area (goes from 220-320 mt). That makes the model output very shaky.

Fig 12: It is VERY hard to follow length trends in this format. Can you put all 4 years into a single column, with each sex in a different column?

Also, where is the comparison with the length frequencies from the 1940s, as reported in Taylor and Galluci (2009)?

And where are the length frequencies from the commercial LL fishery? Those should be presented as well.

APPENDIX 5. FULL TEXT OF REVIEW TWO

I've gone through the subject document a few times and have no serious reservations about the report. I think you have done an excellent job of analyzing a fairly data poor stock (or as we sometimes call them, model resistant stocks). You have a done a very thorough job of frisking the available data for its information. The historical catch data provide a good basis for the estimation of scale and various life history analyses provide reasonable bounds on estimates of r. Overall the fishery independent and dependent measures of relative abundance do not seem to have much contrast and therefore cannot be counted on to provide much information on trend or response to removals.

Figure 4 seems to tell most of the story. Without measures of abundance prior to 1950, the model needs to match up with the relative indices near the end of the survey. I think you have characterized the options well--it's either small productive resource (high r) or large unproductive resource (low r). It appears that the model skates toward the parameter bounds when either r or K are fixed (Table 15-16). We have found this in many models--the model can explain patterns best by finding the lowest population size. There seems to be one factor that might provide some additional guidance on scaling--have you compared the model with the swept area estimates from the NMFS triennial survey or the Hecate biannual survey? Does the model suggest capture efficiencies greater than one?

A couple of other issues I will likely ask about tomorrow include:

1) The log likelihood estimates were not presented for any of the models. Would this be useful for model selection via AIC?

2) Would a likelihood profile on m be useful in the PT model?

3) The overall Fmsys appear reasonable when the force of mortality is assumed to apply to the whole stock . The PT model with m=3 is unreasonable for a slow response species like dogfish.

4) If possible, some red face checking of the q's would be useful. The NMFS survey appears to be the only index for which this may be possible.
Would it be possible to look at some likelihood profiles over q.

5) The exclusion of surveys with high average CVs is logical. Sometimes the high CV surveys are downweighted by inverse variance weighting. I'm not a big fan of this, survey variance increases with magnitude--hence we can dampen important signals with downweighting. However, I suspect that someone else will ask this question.

6) Some have advocated using Bayesian methods for surplus production models--did the assessment team consider this a viable approach?

7) Alec MacCall has recently developed a DCAC model--"Depletion Corrected Average Catch" model for data poor situations. It basically corrects MSY estimates for depletions that may have occurred when the resource was fished down--say prior to 1950. If possible, I may try to give it a whirl tomorrow before the meeting. I think it will give a similar and corroborating perspective on your summary.
http://nft.nefsc.noaa.gov/DCAC.html

8) The restriction of CPUE data to trips with 60% or more dogfish seems like it was the product of some external analyses. If so I would be interested in the rationale.

9) Are there any worries about underestimation of discards or concerns that they could increase in the future? In our fishery 42% of female mortality (by weight) and over 80% of males mortality comes from discarding.

10) I think the bottom line conclusions are reasonable. Our experience is that female dominated fisheries can have long range implications for rebuilding. Modest harvest levels, coupled with monitoring seems like a prudent way to go.