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Recovery Potential Assessment of Atlantic Porbeagle Shark Meeting of the Maritimes Regional Advisory Process

22 March, 28 June and 14 July 2005

Aquatic Room
Mic Mac Aquatic Club
192 Prince Albert Road
Dartmouth, Nova Scotia

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October 2005

Évaluation du potentiel de rétablissement de la maraîche – Réunion du Processus consultatif régional des provinces Maritimes

Les 22 mars, 28 juin et 14 juillet 2005

Salle Aquatic
Mic Mac Aquatic Club
192, chemin Prince Albert
Dartmouth (Nouvelle-Écosse)

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octobre 2005

Canada

FOREWORD

These Proceedings are a record of RAP meetings which were held during March – July 2005. The report records as faithfully as possible the contributions and discussion that transpired at the meetings. However, the individual interpretations and opinions expressed at the meeting are not necessarily or in all cases scientifically sustainable or supported by other participants. The discussion summaries document the deliberations, which led to the tabled proposals. No statements are to be taken as reflecting the consensus of the meeting unless they are clearly identified as such. Moreover, additional information and further review may result in a change of decision where tentative agreement has been reached.

AVANT – PROPOS

Le présent compte rendu relate les travaux des réunions du PCR tenue pendent Mars et Juillet 2005. Il reflète aussi fidèlement que possible les contributions et discussions des participants à la réunion. Toutefois, les opinions et interprétations individuelles qui y sont présentées ne sont pas nécessairement ou toujours soutenables sur le plan scientifique, ou appuyées par les autres participants. Le résumé des discussions documente les délibérations ayant abouti aux propositions déposées. Aucune déclaration ne doit être considérée comme une expression du consensus des participants, sauf s'il est clairement indiqué qu'elle l'est effectivement. En outre, des renseignements supplémentaires et un plus ample examen peuvent avoir pour effet de modifier une décision qui avait fait l'objet d'un accord préliminaire.

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ABSTRACT

Three RAP meetings were conducted to assess the recovery potential of NAFO Subarea 3 – 6 porbeagle shark. The first was held 22 March 2005 and resulted in a number of issues that required resolution before final drafting of the status report. The second meeting was held on 28 June 2005, at which further analyses were reviewed and the main points of the status reports discussed. A final meeting was held by teleconference on 14 July 2005 to finalise the content of the status reports. The RAP was guided by a recovery potential evaluation framework that defined three phases, each with a set of objectives to address species status, scope for human-induced mortality and management mitigation and alternatives. This RAP focused on the first two phases.

RÉSUMÉ

On a tenu trois réunions du PCR pour évaluer le potentiel de rétablissement de la maraîche dans les sous-zones 3-6 de l'OPANO. La première, qui a eu lieu le 22 mars 2005, a mis en évidence divers problèmes qu'il fallait résoudre avant d'établir l'ébauche finale du rapport sur le potentiel de rétablissement. Au cours de la deuxième réunion, tenue le 28 juin 2005, on a examiné d'autres analyses et discuté des principales parties du rapport. Une dernière réunion, sous forme de téléconférence ayant eu lieu le 14 juillet 2005, a permis de mettre la dernière main au contenu du rapport. Tout le processus du RAP s'est appuyé sur un cadre d'évaluation du potentiel de rétablissement qui définissait trois phases, associée chacune à un ensemble d'objectifs, portant sur la situation de l'espèce, sur sa tolérance à la mortalité d'origine anthropique et sur les mesures d'atténuation et de gestion possibles. Ces réunions du RAP ont porté sur les deux premières phases.

INTRODUCTION

Porbeagle was designated as endangered by COSEWIC in May 2004 and is in the process of being considered by DFO for listing in Schedule 1 of the Species at Risk Act (SARA). DFO has decided to put porbeagle on the 18 month rather than 9 month listing schedule, which implies that a listing decision would not be made until January 2006. Initial consultations with stakeholders as part of the listing process on porbeagle occurred on 10 March 2005 with further meetings planned. If a species is listed in Schedule 1 of SARA, all activities impacting the species will immediately be prohibited until a recovery plan for that species is in place, unless appropriate permits are obtained. If it is determined that there is an impact on a species incidental to the target activity which will not jeopardize survival or recovery, then these can be permitted until such time as the recovery plan is in place. For both incidental harm and recovery planning, an evaluation of the recovery potential of the species is required.

Three RAP meetings were conducted to assess the recovery potential of NAFO Subarea 3 – 6 porbeagle shark. The first was held 22 March 2005 and resulted in a number of issues that required resolution before drafting of the status report. A second meeting was held on 28 June 2005 to resolve issues raised at the first meeting and discuss the main points to be included in the status reports. A final teleconference was held on 14 July to come to agreement on the contents of the status reports.

At the start of the 22 March 2005 meeting, the chair welcomed the participants (Appendix 1) and then reviewed the purpose of the RAP, which is summarized in the letter of invitation and remit (Appendices 2 and 3). The meetings would be guided by a recovery potential evaluation framework developed in March 2003 and modified in October 2004 (DFO, 2004a). Under this framework, three phases, each with a set of objectives are identified:

1. Phase I: Species Status: evaluate trajectory, status, recovery target and time frame for recovery
2. Phase II: Scope for Human – Induced Mortality: evaluate maximum human – induced harm that would not jeopardize recovery and the sources of this harm
3. Phase III: Mitigation and Alternatives: develop inventory of reasonable alternatives and mitigation measures to minimize human impacts and determine whether recovery would still be jeopardized.

The RAP would focus on phases I and II. DFO Fisheries Management would be addressing phase III.

The products of the RAP would be a Stock Assessment Report, a Recovery Assessment Report, and this Proceedings document. A Research document including the technical background would also be produced. This would be based on working papers considered at the meetings.

The chair then reviewed the agenda (Appendix 4), noting that a number of external experts (J. Baum, R. Mohn, S. Smith, R. Claytor, D. Kehler and S. Harley) had been invited to assist in the review. As S. Harley could not attend the meeting, he sent his comments, which are attached (Appendix 5).

The 22 March 2005 meeting raised a number of issues (Appendix 6) that needed to be addressed before finalization of the status reports. The chair convened a group of experts to examine these issues between the two meetings, the results of which were discussed at the

28 June 2005 meeting (see Appendix 1 for participants and Appendix 4 for the agenda). J. Baum submitted comments on the discussions to date subsequent to the 28 June meeting (Appendix 7). While the intent of this meeting was to complete the content of the status reports, this was not possible to achieve. This was done at a final teleconference on 14 July (see Appendix 1 for participants).

22 MARCH 2005 MEETING

RECOVERY POTENTIAL ASSESSMENT OF ATLANTIC PORBEAGLE SHARK

Working Paper: Gibson, A.J.F. and S.E. Campana. 2005. Status and Recovery Potential of Endangered Porbeagle Shark in the Northwest Atlantic. RAP Working Paper 2005/06.

Rapporteur: D. Beanlands

The presentation was taken into two parts with the first given by S. Campana and the second by J. Gibson. A discussion followed each.

Commercial Landings, Sampling and Effort

The background information and new data added since the last assessment in 2003 was presented. The new assessment considers the resource in three areas: NF-Gulf, Basin and Shelf Edge. The industry pointed out that the model seems to fit portions of time when there is little data and where there is more data, the fits don't seem as well. They questioned the reason for this. It was agreed to leave discussion of the model until after discussion of the catch rates was completed.

It was asked what accounts for the upturn in by-catch. There is a 200 t directed fishery plus a 50 t by-catch limit. Industry participants pointed out that porbeagle are not valuable enough to leave more valuable fish in the water and take porbeagle instead. They felt that the higher by-catch was reflective of higher abundance.

It was asked if there was information on size composition of the by-catch. The perceived increase in abundance might be due to small fish. This would have to be considered at the next meeting. Further on this, it was asked what areas the by-catch came from. It appears to be coming from all areas. The industry felt that a lot came from the Shelf Edge and if true, these fish are more likely to be smaller and so would result in a higher by-catch.

It was noted that there may be ICCAT recorded landings by Japanese Vessels outside the three study areas that are not included in the assessment. It was agreed that that is possible but the catches would likely be very limited. This needs to be pursued.

It was noted that Figure 4 of the working paper shows that the population size for mature animals was high in the 1980's while landings were low. It was commented that this reflects the fact that no one started fishing porbeagle shark until 1992. It was asked if all landings accounted for. The response was that all known landings were accounted for.

There then followed a discussion of fishing patterns. In 2001, the percentage of catch doubled on the Shelf Edge but halved in the Basin. Is this reflecting more effort on the Shelf Edge? Industry responded that it was the Shelf Edge where the fish are. Fishing is now

limited in the basins. Up until 2003, the distribution of catches reflected where the fish were. When the TAC was reduced, the offshore vessels stopped fishing and so did some of the larger inshore vessels. In the South western area of the shelf, there were too many gear conflicts to attract shark fishing, even though the fish were purportedly larger there.

Catch Rate Analysis

It was noted that the 1981 point for all six catch rate (CPUE) series presented were well below the model fit and data. Why are they here? Was a sensitivity analysis completed? Yes, and it showed that the 1981 point had no leverage i.e. did not significantly influence the estimates of population productivity.

It was asked if the catch rate series reflected what is currently going on in the fishery. The CPUE trend for mature individuals was down in all areas. But the trend for immature fish is either stable or increasing. Industry participants felt that they were accurate but didn't reflect the fact that they have deliberately tried to avoid large animals to comply with previous advice by Science. They mentioned that they may be regretting this decision as now their catch rates for immature shark are being questioned. It was replied that considering catch rates by mature and immature sharks separately should reflect change in fishing patterns.

It was asked if these CPUE trends may reflect a change in spatial distribution rather than abundance and had this been adjusted for. In reply, the Southern Nfld. mating grounds accounted for 60% of catch but is now closed. Fishing is now focused in the Scotian Shelf Basins and Shelf Edge. Considering the catch rates by three areas compensates for this change.

It was noted that the model also has difficulty fitting the data from the early 1980's and 1990's. From 1994 to 2004, the fit is good for immature animals on the Shelf Edge but prior to that period, the fit is poor. The concern was whether this is a true reflection of abundance. There seems to be a 'disconnect' between the early and recent years. This could be due to a paucity of data in the early period, recent changes in TAC, and reduced vessel numbers in recent years. It was suggested that emigration and immigration in the three areas is affecting the CPUE. Depth was suggested as a covariate in the model to reflect this process. However, this would be difficult to do as it is confounded with vessel identification and the depth information is not available.

Industry commented that when there were more vessels in the fishery, the catch rates were down. But with a reduced TAC and fewer vessels, catch rates are increasing. It was asked if changes in the fleet composition and fishery timing could be addressed in the CPUE analysis. It can be as long as there was enough information. If it is through selectivity, does this answer the question as to whether the catches, particularly in the Basin area, are due to either gear changes or the absence of appropriately sized sharks? On a related note, the suggestion by S. Harley to smooth the fishery selectivity function particularly for Newfoundland-Gulf area was conducted and made a difference of about 15% but this produces other biological anomalies in the model.

Is it possible to follow individual vessels (CFV's)? That is essentially what the model is doing. How different are the areas where by-catch is happening? It appears that there are similar changes in the swordfish/groundfish by-catch levels. Are these levels measuring anything different than those in the directed fishery? Swordfish and groundfish fisheries are more spread out. There is more seasonal coverage.

The large offshore vessels that are no longer fishing may still be influencing the analysis. This would affect how the model was interpreted in the early years. It was suggested to look at the CPUE analysis to see what effects are there that shouldn't be.

It was commented that it would be helpful to see the fleet effort series broken out like the CPUE series. It would provide a better sense of what has changed in the three areas over time. In reply, the rationale for breaking out the catch rate into three areas was to capture these differences. The model uses the standardized CPUE trends but these are not weighted by subarea per year. There was discussion on the merits of weighting by effort without resolution on the best approach.

There was then discussion on the overall influence of the CPUE time series on the model. How sensitive is the model to the CPUE data? This could be determined by examining the model's behaviour with different weighting of the CPUE data. Another suggestion was that the fishery size composition information was driving the model results. If the catch rates are based on directed longline fisheries and the length frequencies based on directed and by-catch fisheries, then the sparse length frequency data of the 1970's and 1980's could be having a significant effect on the model. To check the effect that this might have, the sample size was divided by 10 to down weight the length frequencies, as was suggested by Harley (external reviewer). The result was a similar pattern with lower estimates and reference points and the population size changing only slightly.

An overall comment was made that there is a need to better communicate with industry on the trends in the catch rates as opposed to those in the porbeagle population. Changes in CPUE could be due a variety of processes including changes in fishing patterns, change in abundance, immigration, emigration etc. Does industry have an explanation for increases in CPUE? Industry responded that the increase in abundance in Basin area is due to fish moving in from the edge. It was felt that the increase was real but there is no agreement on what it is reflecting. Industry asked that the CPUE be presented as combined (mature/immature) and in the same scale for the 3 areas. Fishermen don't divide up their catch by size and maturity. What is important is the total number. Concern was expressed that with a smaller TAC and fewer vessels fishing in fewer areas, we don't have the same broad view of the fishery as we used to.

Tagging

It is important to understand why the tagging indicates an underestimation of large fish and why the survival of the tagged population is higher than the overall survival of the whole population. Information on tag loss and mortality from other studies needs to be considered.

Concern was raised that the tagging data averages the exploitation rate over all areas but the returns are only from two areas. It was suggested that the tagging data be analyzed spatially.

There was a desire to consider the tagging analysis separately from the model. Looking at the tagging data separately might give a clearer view of the contribution of these data to the assessment.

Model

The review by S. Harley had several suggestions which were addressed by the authors. None showed any appreciable effect on the model results.

It was asked why the assumption was made in the model that the catch was removed all at once at mid year when the catch is actually removed throughout the year. In reply, this assumption, known as Pope's approximation, is an appropriate procedure when exploitation rates are low.

What do we know about survivorship in an unfished population? Values for natural mortality (M) are based on a catch curve analysis using the 1961 size composition information, with no correction for selectivity. Preliminary results from an ageing study of individuals from the virgin population show consistency with the M used in the model.

There was discussion on the veracity of the four models presented. It was felt that model four produced the most reasonable fishing mortality estimates but the fit of this model to the data was not good. However, the alpha parameter estimated by the other models did not seem reasonable. It was argued that there was not enough information presented to judge what would be a reasonable value of alpha.

The comment was made that the size composition data are likely having a greater effect on the model than the tagging data. It was suggested that the sparse sampling data in the early years of the analysis are likely driving the model. It was suggested to exclude length data prior to 1996 and run the model from 1996 onward. It was also suggested to run the model with Paloheimo Z's for the specific year range rather than an average. There was an overall desire to examine the relative contribution of each of the model inputs (CPUE, size composition, tagging) on the assessment results. Related to this is the issue of the relative weight given to each source. This would need to be examined at the next meeting.

Concern was expressed that the model may be biased due to the length categorization of mature and immature sharks. Mature fish make up only about 5% of the catch. The suggestion was made that partitioning of the size composition data into three or four groups may be more informative. A suggested categorization was 1-150, 150-200, >200 cm. Finer groupings than used in the current model may better explain size-related trends e.g. recruitment events. It was replied that the suggested categorization was not possible to do for this meeting as the lengths have only been keypunched into the 2 groups: <200 cm and > 200cm. It was recommended that binning the length frequencies should be investigated for the next meeting.

There was a desire to see more model fit diagnostics. These would be produced at the next meeting.

Results

It was generally agreed that the results presented thus far show that the porbeagle resource is slowly recovering.

Industry expressed frustration over the current situation. What has changed so dramatically in resource status since the 2001 assessment? How can there be a lower TAC, fewer boats in the fishery, closure of the Newfoundland/Gulf area to fishing, and yet, even though CPUE is increasing, they may be shut down. Three years ago, industry agreed to a five year recovery strategy and now they have a new model with a more pessimistic outlook. It was asked if the assessment was consistent with those produced in 2001 and 2003 (Campana et. al, 2001; 2003). It was replied that the results were consistent. The base run form the 2001 assessment falls approximately between models 2 and 3. However, there was a desire for a formal explanation of where we are now compared to where we expected to be in 2001.

Reference Points

Reference points (RPs) were presented for the two main indicators used in the model – abundance and fishing mortality. For the two abundance RPs, there was discussion on the appropriateness of SSN_{msy} and $SSN_{20\%}$ as recovery targets. Industry asked which RP would the 250 t TAC from the 2003 assessment relate to, the reply to which was the F_{msy} reference point. The $SSN_{20\%}$ RP was discussed as a potential recovery target. Concern was expressed that the 20% level is based on analyses of boney fishes and may not be applicable to sharks. There was also a concern that if the 20 % RP was used as a recovery target, the fishery would open when it reached this level and abundance would start to decline again. The comment was made that a rule is needed to decide when we are 95% confident that recovery has indeed taken place. It was pointed out that the recovery team has the task of establishing the recovery target and that the analyses presented here are to inform that process. As well, DFO Science is to hold a national workshop soon in which recovery criteria will be discussed.

Projections

The appropriateness of using Bayesian projections with uncertainty around these was discussed. It was considered that this was reasonable.

Workplan

The time frame to complete the follow up work (Appendix 6) was discussed. The comment was that there are many competing interests and DFO Science staff need to meet to evaluate what analyses are possible to complete by summer 2005. Industry expressed concerns over the short time frame and the capacity to undertake the work required.

MITIGATION AND ALTERNATIVES

Following the presentation and discussion on the recovery potential assessment, there was a short presentation by G. Weber of DFO Fisheries and Aquaculture Management Branch on work planned to address phase three of the evaluation framework. He noted that consultations with stakeholders would occur to define mitigation measures that would facilitate the recovery of the porbeagle population. There were few questions following this presentation.

28 JUNE 2005 MEETING

OVERVIEW OF ANALYSES SINCE 22 MARCH MEETING

Working Paper: O'Boyle, R. [ed], S. Campana, J. Gibson, S. Smith, J. Choi, R. Mohn and R. Claytor. Analyses on Issues Raised at Porbeagle RAP of 22 March 2005. RAP Working Paper 2005/10.

Rapporteur: K. Robichaud - LeBlanc

The meeting chair led a presentation and discussion of analyses conducted to address issues raised at the 22 March meeting.

Commercial Landings, Sampling & Effort

At the 22 March meeting, it was noted that some foreign catch (mainly Japanese) may not have been included in the population analysis. The extent of these catches was examined. Observer information is available for only a limited number of trips. Depending on how the small amount of by-catch rates is averaged, 179 – 280 t in 2000 and 2001 were calculated as being reported by the Japanese fleet. A seasonal component (May-June) has been noted, the significance of which is uncertain. Overall, given the uncertainty in the information, it will not be included in the analysis. It was pointed out that if this level of by-catch has remained relatively constant, it would not influence the trends in the population analysis.

Size Composition of By-catch

The available size composition information from observers was presented. The size composition of porbeagle caught as by-catch in the large pelagic fishery (swordfish, tuna) between 2002-2004 was dominated by juvenile fish, primarily age 0-1. There was little by catch of porbeagle in the groundfish longline and gillnet fisheries, and no measurements were available. A question was asked on the use of the shelf edge selectivity for by-catch as fish caught there are generally smaller. It was noted that the farther east and west one goes, the bigger the fish, with moderate size fish in the middle. This results in smaller animals being caught in warmer water (i.e. in the swordfish by-catch) and bigger porbeagle in the colder water further north.

Spatial and Temporal Changes in Fishing Effort

There was discussion at the 22 March RAP meeting on temporal changes in fishing effort, specifically the sentiment that areas of current fishing are significantly different than historically. Therefore, the 1995 – 2004 logbook information was examined. It indicates that effort has contracted to the Basin and Shelf area off central NS. This has implications for further analysis of the CPUE data as the time series is spatially inconsistent and requires treatment of these trends. A more comprehensive analysis of these trends was to be presented later in the meeting.

Catch Rate Analysis (CPUE)

The chair summarized the issues raised at the 22 March meeting on the CPUE analysis (Appendix 6). A number of analyses were attempted to both understand the processes underlying the CPUE information as well as improve its utility in the assessment. These

efforts led to a fundamental reconsideration of how these CPUE data are employed in the assessment.

There was a question regarding the inclusion of immigration and emigration information in the model. It was indicated that there is no information outside the Canadian Zone on porbeagle abundance and thus emigration/immigration processes could not be included in the model. Notwithstanding this, the available information suggests that the majority of the population is accounted for in the model.

There was a suggestion to use the word 'movement' as opposed to 'immigration & emigration' to suggest that fish move around but not in or out of the population. Industry participants commented that the movement is a factor of the fishermen not the fish. Fishermen will go where the fish are. It was pointed out that fishing had been excellent in the area between Georges Bank and Browns Bank but the fleet doesn't fish there now due to gear conflict (lobster and other longline gear, scallop, crab). It is now a shark 'sanctuary'. The best means to determine resource abundance and distribution is to survey in certain areas at the right time of year. Industry participants considered that there are many sharks that are not being accounted for. This area is the heart of the shark fishing where mature fish 90lbs and up are caught. Fishing further east results in catches of smaller ones. Fishermen have seen an increase in CPUE each year and bigger fish each year. The so-called sanctuary may be a cause of this. The comment was made that these observations should be included in the stakeholder perspective of the status reports.

Tagging (Shedding Rates and Mortality Rates)

Tag shedding rates and mortality rates from literature were summarized. From these studies, a 20% shedding rate was estimated. Added to a 5% mortality rate also reported on, a 25% tag loss would be expected. This was considerably lower than the model prediction, a topic that would be returned to later in the meeting.

Model

Biological Processes

The model presented at the 22 March RAP meeting estimated low survival through first year of life. It was desired to have independent confirmation as to whether or not this was credible. Alpha is a product of the number of pups each female produces per year (fecundity) and the survival of these pups to age one. The fecundity of a female is estimated to be 3.9 through observation; much of the variability in alpha is due to survivorship to age one. There are only two studies which have estimated survival through the first year of life of a shark species (Gruber et. al, 2001; Cortés, 1999; 2002). Based upon these, for further modeling of the porbeagle population, a range of alpha estimates was suggested: 3.9 x 0.57 = 2.22 (Gruber-based estimate) to 3.9 x 0.88 = 3.43 (life history-based estimate). It was recommended to fix alpha in the model, rather than to have it estimated.

Calibration

At the 22 March RAP, there was discussion on the binning of the CPUE into immatures and matures (below and above 200 cm) and the desire to see more bins (e.g. length groups 0-50, 50-100, 100-150, 200+ cm) to see if this would resolve the lack of fit of the model to the CPUE data (matures in 1980s and immatures in last 2 – 3 years). However, the processing of the initial input data does not allow further discrimination of the length – based CPUE, and

would likely be inappropriate given the length information had already been included in the model.

There was discussion at the 22 March RAP on the relative weights given to the various inputs into the model. For instance, there are about 5672 sets in the CPUE data set, about 1228 tag releases and 121 returns and about 160,000 length measurements. During the post RAP explorations, an exploratory analysis was undertaken to see if putting considerable weight on the CPUE data that the model changed, the concern being that the size composition information was dominating the output. It did, which illustrated that weighting considerations could change the model output.

It was decided to incorporate all data sources within the model structure. In this way, the impact of the various components on the model output could be objectively evaluated. It also allows investigation of the impact of different weighting of the input components on the model output. This represents a fundamental change to the model that was presented at the 22 March RAP. One related consequence of integration of the CPUE standardization into the model was keeping the CPUE series as kg per hook and not have it split by size (CPUE of immatures and matures). Although presentation of the mature and immature series does help identify trends in the population, the proportions at age are already in the model and inclusion of the CPUE by these proportions would have represented double counting of the length-frequenct data.

Results

At the 22 March RAP, there was discussion on why the perception of resource status had changed so dramatically since the April 2001 assessment, which had been undertaken (Campana et. al., 2001) to form the basis of the 2002-2006 fisheries management plan. Now the resource was being considered for listing as endangered under the Species at Risk Act (SARA). The history of the fishery in relation to the assessment history was summarized as was the recent involvement by COSEWIC. In summary, while harvesting by the Canadian fleet commenced in 1991, it was not until 2001 that the first comprehensive view of stock status could be obtained. By this time, overexploitation was evident. The COSEWIC designation relied heavily on the overexploitation that occurred in the early 1960s, well before Canadian involvement in the fishery. With more data collected since the 2001 assessment, the view of stock status will be more precise. However, perhaps the largest change in the perception of the resource is its designation by COSEWIC as endangered, based on events that occurred in the early 1960s.

Reference Points and Projections

At the 22 March RAP, there was discussion on the recovery trajectories under different harvest rates. It was recognized that while it is the task of the recovery team to choose recovery targets, it is up to this meeting to inform that team on what we consider useful targets. Related to the target is the need to incorporate uncertainty into the projections to allow evaluation of the probability that the target has been achieved. Estimates of uncertainty were thus incorporated into the new projections.

There was discussion on the COSEWIC designation criteria and whether the porbeagle designation accurately reflects these criteria. Industry expressed frustrations with regards to the listing process and the two criteria used as well as industry's time availability to question this process. The meeting chair clarified that we are not hear to challenge the listing process but to determine the recovery potential if the species is listed.

UPDATE ON RECOVERY POTENTIAL ASSESSMENT OF ATLANTIC PORBEAGLE SHARK

Working Paper: Gibson, A.J.F. and S.E. Campana. 2005. Status and Recovery Potential of Endangered Porbeagle Shark in the Northwest Atlantic. RAP Working Paper 2005/06 (revised from 22 March meeting)

Rapporteur: K. Robichaud – LeBlanc

Industry participants requested that the word 'endangered' be removed from the Working Paper title due to issues that they had with the COSEWIC designation.

J. Gibson presented the updated analyses based on the work conducted since the 22 March RAP. Below is provided the main discussion points on the various parts of the analysis. Most of these points were clarifications on the analysis additional to those made in the previous presentation, as no further changes were suggested. Details on the analysis will be documented in the companion research document to these proceedings.

By-catch

Table 2 of the working paper shows that total by-catch for 2001-2002 increased by ~ 60% (i.e. by-catch more than doubled). It was asked if it is known why such a dramatic increase in by-catch of porbeagle and if the modeling takes into account this increase. It was clarified that by-catch is included in the catch. Industry participants from the swordfish association indicated that they believe this increase is related to increased abundance of porbeagle as they don't direct for porbeagle - they direct for swordfish and tuna. Sharks take up space, consume ice and fetch a low value return. It was commented that it seemed coincidental that by-catch increases (2002-2004) corresponded to a new restrictive shark management plan. The suggestion was made to examine the distribution of the swordfish fishery.

This discussion highlighted the importance of considering patterns in by-catch as part of Phase III (i.e., mitigation) of the recovery assessment. The management of by-catch in other fisheries would have an effect on the trajectory of porbeagle recovery.

Spatial Distribution of CPUE

It was asked what happened to see such a large restriction in porbeagle spatial distribution in 2002. In response, new management regulations were put in place that closed the area for protection of spawning grounds. In 2002, the TAC was reduced form 1000t the year before to 250t.

There were questions on the increase in CPUE in 2004. Was it a change in how the fishery occurs? Industry commented that before the TAC drop in 2002, there was competition for berthing space. Vessels had to line up behind each other for an opportunity to fish where the catch rates are good. With less vessels fishing since 2002, competition for the best fishing areas was not as high. The rising price of gas also means more competition for hot spots that are near port.

Model

It was noted that the Model 1 presented was the one presented at the 22 March meeting and uses a CPUE standardization that is done outside the population model. Models 2, 3 and 4 use a different formulation in which the CPUE data standardization is integrated into the population model and are considered better overall treatments of the information.

It was clarified Model 2 presents a lower productivity scenario, Model 3 a middle productivity scenario and Model 4 a higher productivity scenario. As there was not enough information to estimate the alpha term, a range was assumed, thus producing the three productivity scenarios.

There was discussion on the choice of model to best describe the current situation. It was asked whether or not Model 3 (middle productivity) should be chosen for the status reports and discussions based on this model. Another approach would be not pick a model but present the results of the high and low productivity models and state that the model results are likely somewhere between these extremes. It was agreed that the range of model output needs to be reported in the status reports.

It was clarified that the number of spawners is for females only, whereas the total number is for both males and females combined.

Results

Overall, the assessment is now more optimistic than presented at the 22 March meeting. The 2005 estimates of total abundance are about twice those presented then. Notwithstanding this, the population still meets COSEWIC decline criteria. While the present status is not good, the long term outlook is potentially positive. Recent reductions in fishing mortality have slowed (possibly halted) the decline, sources of mortality appear to be clearly identified (in contrast with many species at risk) and sources of human-induced mortality appear controllable, again in contrast with many species at risk. All indications are that porbeagle can recover.

Some industry participants commented that each successive year they see an increase in the size of fish in the Shelf Edge area, with a few bigger sharks observed every year. It was noted that this is consistent with the processes documented in this assessment.

There was discussion of Figure 17 of the working paper and how this time series fits with the COSEWIC criteria. Industry participants considered that COSEWIC designated porbeagle without meeting the three generation criteria. However, it was clarified that the abundance trends are consistent with the COSEWIC designation. Industry would like the model to show where the population would be in 2015 (i.e., 54 year time frame). Industry participants reiterated that one of the criteria COSEWIC used in their assessment of the status of porbeagle shark was that the population of mature females dropped below 10 000 when the criteria (for threatened) is supposed to be total number of mature individuals below 10,000. If that is the case, then the model shows there are currently over 10,000 mature individuals.

Recovery Targets

The issue of what is defined as recovery was once again discussed. The comment was made that the recovery plan will benefit from discussions to be held at a national workshop planned for the end of August 2005 which will review recovery criteria. It was indicated that the

reference points used in the working paper were not recovery targets per sec, but are commonly used reference points for fisheries management and could be used to determine whether or not the population was recovering. It was agreed for the purposes of the current status reports to use the working paper reference points as a guide.

Figure 22 of the working paper presented a series of plots in terms of recovery trajectories under two management scenarios: if porbeagle are managed under SARA starting in 2005 versus continuing the existing shark management plan until 2007 and then managing under SARA. The comment was made that when discussing recovery, it would be useful to keep the COSEWIC three generational period decline criterion in mind. What would be the resource abundance in 2015 as opposed to that in 1961? The influence of different harvest rates on the relative abundance in 2015 could be evaluated. This is possible to examine with the model results.

CONTENT OF STATUS REPORTS

Following a description of the new status report formats by the chair, there was a section by section review of the two draft status reports. Detailed comments were recorded by J. Gibson who was commissioned with rewriting these in time for a teleconference at which they would be finalized. Below are provided the main points made on these status reports.

Stock Assessment Report

Context

The chair indicated that this section is called ‘context’ instead of the traditional ‘background’. It was argued that the information currently contained in this section is really background information.

The suggestion was that the first bullet in the Summary could provide context - Porbeagle are presently designated as “endangered” by COSEWIC with a recommendation that it be listed under Schedule 1 of Canada’s Species at Risk Act. Over-fishing is thought to be the main reason for the decline.’

It was agreed that the first paragraph currently in the ‘Context’ section should be moved to the ‘Species Biology’ section and the second paragraph should be integrated into the ‘Fishery’ section.

Summary

It was clarified that this section is completed once the document is deemed complete. The main points of the document are picked out and added as bullets.

Description of the Issue

It was concluded that the ‘Rationale for Assessment’ is actually the Context. The last sentence of this paragraph was deleted.

Industry participants indicated their desire to have it stated in the fishery section that at one point 100% of the by-catch was from the Canadian fishery. The last paragraph was restructured to state ‘Since early 1990s, porbeagle shark were landed by a Canadian directed longline fishery. Prior to this, they were landed as by-catch in the Canadian

swordfish longline fishery, the Japanese tuna longline fishery, and various inshore fisheries as a small percentage of the catch, but have increased significantly recently'.

Resource Assessment

The suggestion was made to remove bullets describing four variants of models under the 'Key Indicators' section and to rephrase this by reducing the text by highlighting differences in the alpha parameter between the models.

The suggestion was also made to add a sentence at the end of the second paragraph of 'Stock Trends' to indicated the total number of mature individuals in 1961 and also in 2004.

In the 'Current Status' section, it was suggested to redraft, remove all references to model 1 and add more information.

Some bullets were stricken and a few additional bullets were added under the 'Sources of Uncertainty' section:

- Uncertainty in estimated population size
- Uncertainty in dynamics of the fishery

Additional Stakeholder Perspectives

Industry agreed to consult and provide a paragraph for this section.

Conclusions and Advice

Industry participants commented that if porbeagle is listed, it will be endangered for a long time as we will not know another thing about the species. The fishery will be closed and thus there will be no opportunity to monitor population and acquire information.

It was agreed that a concluding paragraph be included on the need for broad scale survey activities.

Management Considerations

The suggestion was to include text on the change in the level of by-catch over time.

Tables and Figures

It was decided to remove tables 1 and 2 from the Status Report (these tables will be in the research document), but to summarize information in bottom right panel of table 2 (models 2, 3 and 4 for series 2005/1961 and 2005/2002) in the text. It was also suggested to replace table 1 with a Figure on exploitation rates (Figure 18 from the working paper).

The group also felt that a map for the beginning of the Status Report was required.

In the CPUE Figures, it was suggested to add box plots of catch-per-unit-effort from the working paper but not in log scale and standardized.

There was discussion on the predictions of the trends Figures depicting mature females. It was again noted that the COSEWIC criteria is for mature individuals, but it was argued that the information for females should also be described.

Recovery Assessment Report

Context

The text contained in this section was deemed appropriate for the Stock Assessmnet Report as well, but it was debated whether or not references to COSEWIC was appropriate. The chair recommended that the same context would be used for both documents.

Summary

As with the Stock Assessment Report, the bullets come from the body of the document once it is complete.

Description of Issue

It was agreed that the remit should be integrated into this section.

Species Biology

It was agreed to make this section the same as that for the Stock Assessment Report.

Assessment of Issue

It was felt that this section would be a synopsis of the Status Report; however, it needed an introduction to the models.

Recovery Targets

There was discussion about the term ‘targets’ as opposed to ‘reference points’. The suggestion was to make reference to ongoing discussions on recovery targets and that these are reference points used in the literature and accepted in fisheries management. In the absence of any accepted recovery targets, these reference points are provided.

Industry requested that the estimates of recovery targets for mature individuals be included along with the female spawner estimates. This was agreed to.

Recovery Potential

Industry would like to see resource size in 2015.

A comment is to be included regarding how the various models/all analyses allowed for an exploitation rate of less than 4% for recovery. However recovery under all scenarios will take in the order of decades.

In the ‘Conclusions about maximum sustainable mortality rate to allow recovery’, industry would like to see the ranges for the three scenarios. The text in the last paragraph was modified to say ‘By-catch landings of 180t in 2005 would correspond to a 4% human-induced mortality in the most pessimistic model - a level above which population recovery is not expected’.

In the ‘Uncertainties’ section it was suggested to add the 2005 population size and uncertainties in the reference points.

Allowable Harm Provisions of Recovery Plan

It was clarified that this is Phase III of the framework.

The chair indicated that this section will be short and all sub-titles will be removed.

Under special considerations, it was felt important to include a statement that without the fishery, the ability to monitor the population would be lost.

Tables and Figures

It was agreed that tables 1 and 2 should be removed but the table on by-catch was useful and should be left in report.

Additional Stakeholder Perspectives

Industry agreed to add commentary to this section.

Conclusions and Advice

It was decided that applicable sections from the previous section should be included here.

14 JULY 2005 TELECONFERENCE

The two status reports could not be completed at the 28 June RAP meeting and thus a teleconference of available participants (Appendix 1) was convened to review the second drafts of these documents. Agreement was reached on the content of the two status reports and another meeting was not considered required. Most of the comments were editorial and intended to clarify the conclusions of the two RAP meetings and do not need to be reported here. One significant addition was the request by the Ecology Action Centre to add its perspective to the Stakeholder Perspective section. In addition, the large pelagic fisheries participant requested to update its submission. Both were agreed to. As well, these were to be reported in the Stock Assessment, but not the Recovery Assessment, Report. It was also agreed that the latter report provide a comprehensive summary of by-catch estimates from Atlantic Canadian fisheries, not just Scotia-Fundy. To the degree possible, this will be done.

Subsequent to the teleconference and during the editorial process of the two status reports, the Canadian Science Advisory Secretariat (CSAS) office in Ottawa, which oversees the RAPs, clarified the purpose of the stakeholder perspectives section. The intent of this section is to provide stakeholders with knowledge gained through experience an opportunity to contribute to the evaluation of stock status. What should be included in this section is information not already covered in the status report. Anecdotal observations on catch rates, distribution, size composition and the like would be appropriate. However, arguments to give more or less weight to one class or another of the indicators or expressing an opinion that the results are too optimisitic or pessimistic are not to be included. In light of this, the submissions of the Fishery and the Ecology Action Centre were removed from the Stock Assessment Report and placed as appendices (Appendix 8) to these proceedings.

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APPENDICES

Appendix 1. List of Participants

Participant	Affiliation/Address	Telephone	Fax	E-mail	22 March	28 June	14 July
Chris Allen	DFO Science, Ottawa	(613) 990-0105		allenc@dfo-mpo.gc.ca	X		
Troy Atkinson	Nova Scotia Swordfishermen Assoc.	(902) 457-4968	(902) 457-4990	Hiliner@ns.sympatico.ca	X	X	X
Julia Baum	Dalhousie University, Halifax	(902) 494-3910	(902) 494-3736	baum@mscs.dal.ca	X	X	X
Diane Beanlands	DFO, Species at Risk Office	(902) 426-3515	(902) 426-2331	Beanlandsd@mar.dfo-mpo.gc.ca	X	X	
Steve Campana	DFO Science, Maritimes	(902) 426-3233	(902) 426-9710	campanas@mar.dfo-mpo.gc.ca	X	X	X
Alan Chandler	Province of Nova Scotia	(902) 424-3665	(902) 424-1766	chandlea@gov.ns.ca	X	X	
Ross Claytor	DFO Science, Maritimes	(902) 426-4721	(902) 426-1682	Claytorr@mar.dfo-mpo.gc.ca	X		
Gretchen Fitzgerald	Ecology Action Centre	(902) 494-2146	(902) 494-3736	fitz@mathstat.dal.ca	X		X
Jamie Gibson	DFO Science, Maritimes	(902) 426-3136	(902) 494-6814	gibsonajf@mar.dfo-mpo.gc.ca	X	X	X
Patrick Gray	Atlantic Shark Association	(902) 475-1111	(902) 477-0563	Packet.fisheries@ns.sympatico.ca	X		
Daniel Kehler	Dalhouise University, Halifax	(902) 494-2146	(902) 494-3736	kehler@dal.ca	X		
David Kulka	DFO Science, Newfoundland	(709) 772-2064	(709) 772-5469	kulkad@mdf-mpo.gc.ca	X	X	X
Andrew McMaster	DFO Res. Manag., Maritimes	(902) 426-4766	(902) 426-9683	mcmasstera@mar.dfo-mpo.gc.ca	X	X	
Arran McPherson	DFO, Species at Risk Office	(902) 426-8503	(902) 426-2331	mcphersona@mar.dfo-mpo.gc.ca	X		X
Bob Mohn	DFO Science, BIO	(902) 426-4592	(902) 426-1506	Mohnr@mar.dfo-mpo.gc.ca	X	X	
Robert O'Boyle, Chair	DFO Science, Maritimes	(902) 426-3526	(902) 426-5435	oboyler@mar.dfo-mpo.gc.ca	X	X	
Stephen Smith	DFO Science, Maritimes	(902) 426-3317	(902) 426-1862	smithsj@mar.dfo-mpo.gc.ca	X		
Ray Walsh	DFO Res. Manag., Newfoundland	(709) 772-2920	(709) 772-3628	walshrp@dfo-mpo.gc.ca	X		
Gary Weber	DFO Res. Manag., Maritimes	(902) 426-1488		weberg@mar.dfo-mpo.gc.ca	X		
Scott Wilson	DFO Science, Maritimes	(902) 426-3318	(902) 426-1506	wilsons@mar.dfo-mpo.gc.ca	X		
Don Hart							X

Participant	Affiliation/Address	Telephone	Fax	E-mail	22 March	28 June	14 July
Kim Robichaud-LeBlanc	DFO, Species at Risk Office	(902) 426-7958				X	
Wayne Stobo	DFO Science, Maritimes	(902) 426-3316				X	
Frank Reyno	A & A Fisheries					X	
Linda Marks	DFO Science, Maritimes	(902) 426-4435					

Appendix 2. Letter of Invitation

Fisheries and Oceans Canada | Pêches et Océans Canada

Science Branch
Bedford Institute of Oceanography
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Tel: (902) 426-3526

Direction des océans
Institut océanographique de Bedford
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Dartmouth, (N.-É.) B2Y 4A2
Tél.: (902) 426-3526

01 February 2005

Dear Invited Participant:

Re: Regional Advisory Process Review on Recovery Potential Assessment of Porbeagle Shark

The prohibitions associated with listed species under the Species at Risk Act (SARA) came into force on June 1, 2004. Porbeagle shark has been proposed for listing, a decision on which will be made early in 2006. If listed, activities that would harm the species would be prohibited and a recovery plan would be required. Decisions made on permitting of incidental harm and in support of recovery planning need to be informed by the impact of human activities on the species, alternatives and mitigation measures to these and the potential for recovery.

To inform decisions relating to listing of Atlantic Porbeagle and its recovery planning, a Regional Advisory Process (RAP) meeting is scheduled for 22 March (Tuesday) to review analyses prepared to meet the objectives stated in the attached remit. We invite your participation in this review which is scheduled to **begin at 9:00AM and conclude at 5:00PM** at the Mic Mac Amateur Aquatic Club.

Thank you for your consideration of this request. I would appreciate confirmation of your participation (either in person or via telephone) in this process to Lynn Cullen @ 902-426-4164.

Yours sincerely,

Original signed by :

Robert O'Boyle
Associate Director of Science;
RAP Co-ordinator

Canada

Appendix 3. Meeting Remit

Background

Atlantic Porbeagle shark had been designated as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and is being considered for listing in Schedule 1 of Canada's Species at Risk Act (SARA). If listed, activities that would harm the species would be prohibited and a recovery plan would be required. Until such a plan is available, section 73 (2) of SARA authorizes competent Ministers to permit otherwise prohibited activities affecting a listed wildlife species, any part of its critical habitat, or the residences of its individuals, if the activity is scientific research relating to the conservation of the species and conducted by qualified persons, or benefits the species or is required to enhance its chances of survival in the wild, or affecting the species is incidental to the carrying out of the activity.

Decisions made on permitting of incidental harm and in support of recovery planning need to be informed by the impact of human activities on the species, alternatives and mitigation measures to these and the potential for recovery. An evaluation framework, consisting of three phases (species status, scope for human – induced harm and mitigation) has been established by DFO to allow determination of whether or not SARA incidental harm permits can be issued. To inform decisions relating to listing of Atlantic Porbeagle and its recovery planning, the meeting will review analyses prepared to meet the objectives stated below.

Objectives

Phase I: Species Status

1. Evaluate present species trajectory
2. Evaluate present species status
3. Evaluate expected order of magnitude / target for recovery
4. Evaluate expected general time frame for recovery to the target

Phase II: Scope for Human – Induced Mortality

5. Evaluate maximum human-induced mortality which the species can sustain and not jeopardize survival or recovery of the species
6. Document major potential sources of mortality/harm
7. For those factors NOT dismissed, quantify to the extent possible the amount of mortality or harm caused by each activity.
8. Aggregate total mortality / harm attributable to all human causes and contrast with that determined in task 5

Phase III: Mitigation and Alternatives

To the extent possible,

9. Develop an inventory of all reasonable alternatives to the activities in task 7, but with potential for less impact. (e.g. different gear, different mode of shipping)
10. Develop an inventory of all feasible measures to minimize the impacts of activities in task 7

11. Document the expected harm after implementing mitigation measures as described and determine whether survival or recovery is in jeopardy after considering cumulative sources of impacts

Products

- Status Report on all objectives
- Proceedings of meeting
- Research Document

Participation

- NHQ and Zonal DFO Science
- NHQ and Zonal DFO Fisheries Management
- Provinces NS, NB and NFLD
- NS, NB and NFLD Fishing Industry
- NGOs (WWW and EAC)
- External Reviewers

Appendix 4. Agendas

22 March 2005

09:00 – 09:15	Introduction / O'Boyle
09:15 – 10:00	Working paper on Phases I and II / Campana and Gibson
10:00 – 10:15	Break
10:15 – 11:00	Working paper on Phases I and II (cont'd) / Campana and Gibson
11:00 – 12:00	Discussion on Mitigation and Alternatives to Impacting Activities / Weber
12:00 – 13:00	Lunch
13:00 – 15:00	Discussion and Finalization of Status Report
15:00 – 15:15	Break
15:15 – 17:00	Discussion and Finalization of Status Report

28 June 2005

09:00 – 09:15	Introduction / O'Boyle
09:15 – 10:00	Overview of Analysis Raised at 22 March 2005 RAP Meeting / O'Boyle
10:00 – 10:15	Break
10:15 – 12:00	Working paper on Phases I and II / Gibson and Campana
12:00 – 13:00	Lunch
13:00 – 15:00	Discussion and Finalization of Status Reports
15:00 – 15:15	Break
15:15 – 17:00	Discussion and Finalization of Status Reports

Appendix 5. Comments of S. Harley on Working Paper

Introduction

For the purpose of this review I have focused on the scientific aspects of the analysis and provided my comments under the 11 objectives as described in the remit for the meeting. I have combined some sections together, and the majority of my comments, which are related to the population model, are discussed under objectives 1 and 2. The comments have subheadings referring to the section in the report where they occur. Due to the very short time frame available, I may have missed some parts of the report and some issues raised in this review may not be appropriate.

Overall

- The analysis is based upon considerable fishery and biological data.
- There is little doubt that the stock is at levels lower that those that will produce MSY
- There are concerns that the model is not fitting abundance data (CPUE) at all well. It is possible that biomass trajectories are being driven by catches and stock productivity (alpha) and efforts should be made to investigate this lack of fit.
- The methods used in the PVA are adequate for long term projections.
- The analysis represents a thorough scientific evaluation and its conclusions relating to the objectives in the remit appear to be reasonable, though there is scope for more work on mitigation.

Phase I: Species Status

1. Evaluate present species trajectory
2. Evaluate present species status

- Life history: add details of the assumed biological stock and how this might differ from the stock assumed for management/modelling purposes.
- Life history: add details of the frequency of spawning
- Commercial landings: include a statement indicating if there are any other catches that may not be included in the catch statistics.
- Commercial landings: include details of the rational for splitting the target fishery into three components. Some of this is provided later in the document.
- Commercial landings: Table 3 indicates some dramatic changes in the split of catches across the three regions. Include some details for this (e.g. is it related to the dramatic decrease in target catch?) and how it might affect the population, e.g. differences in selectivity among areas.
- CPUE: define “CFV”.
- CPUE: there is insufficient details to determine if the CPUE series are adequate. It would be useful to include details of the amount of variance/deviance explained by the model and which variables were found to be most important.
- CPUE: of particular concern is the very poor fit to the CPUE data by the population model. The model does not fit the last 2-3 observations of immature CPUE. These

observations are consistent across areas and all well above the predicted line. The poor fit is likely related to the combination of low productivity and low recruitment variation that does not allow for spikes in recruitment necessary to fit these data. Of perhaps greater concern is the poor fit of the early observations of mature CPUE. Here the model overestimates the early abundance quite dramatically (e.g. Shelf edge). Simply, the declines in spawner biomass since the resumption of fishing are not well supported by the CPUE data. These results require further examination.

- Catch-at-length data: there is considerable data available for this fishery. It might be useful to indicate what proportion of the catch was measured.
- Commercial fishery selectivity: it was noted that the selectivity curves for all areas have strong descending right-hand limbs. This suggests that, with the exception of the NFGulf, spawners are “cryptic”, i.e. they are not seen in the [fishery] data, but are assumed to be out there spawning. If there are biological reasons or fisher behavior that lead to this, then these should be described. If there is no sensible basis for this, then the model should be run, forcing selectivity to be monotonically increasing at least fot the NFGulf fishery.
- Tagged population: provide details of the assumed sex ratio of the tagged fish. Also, the equations in this section should be modified with respect to natural mortality assumed for tagged fish, i.e. the subscripts.
- Tagged population: provide details as to why reporting rates are assumed to have declined so drastically in recent years.
- Tagged population: it is possible that the poor fit to the CPUE data may in part be driven by the CPUE data. I recommend another model raised (based around either model 2 or 3) in which the tagging data is excluded from the model fit. Also, it would be better to replace Figure 12 with one showing the fit to the data rather than the residuals. This may require considerable space (e.g. like the fits to the length data), but it would be important to determine if the model is fitting the tagging data at the expense of the CPUE data.
- Likelihood equations: it is noted that all CPUE series have the same assumed CPUE. It would be useful to compare the standard deviation of the standardised residuals to see if this is justified.
- Likelihood equations: it would be good to include a model run where all length frequency sample sizes are divided by 10 (including maximum allowed). This would indicate in the fit to the length data is leading to the poor fit to the CPUE data
- Likelihood equations: Provide details of the bounds used in estimation or any “informed penalties” used to improve parameter estimates. Of particular interest are any constraints relating to the alpha parameter which appears to be very well defined in the model (high precision in estimates – Table 6).
- Population dynamics: it would be useful to provide some estimates of the current levels of recruitment and how that compares to the levels expected in the 1990’s and the unfished stock. I assume that it is possible to take these estimates directly from the model – this information would be important for the summary relating to historical and current stock status. Also, the symbol for alpha appears to have been replaced with a sigma. This continues throughout the document.
- Summary for objective 1: The report states that “the declines have continued since the quota reductions in 2002”. Given the lack of fit to the immature CPUE data I have some

reservations about this comment. It should be clearly stated whether this is based on observations (e.g. data) or model predictions. If this is based on the later, then any lack of fit to recent data should be highlighted.

3. What is expected order of magnitude / target for recovery

- Summary for objective 3: I note that recovery targets have not been established for this stock, however, it is not clear why recovery would be reported against $SSN_{20\%}$. In particular this level appears to be much lower than the biomass required to support the maximum sustainable yield. Furthermore this 20% level is generally (at least in New Zealand) treated as a limit reference point, i.e., a place that we want to have low probability of going below rather than a target.

4. Evaluate expected general time frame for recovery to the target.

- Population viability analysis: The approach undertaken here to evaluate the recovery times is generally a good one. It would be preferable that uncertainty in current stock status being included in any projections of the stock, though including variability in recruitment and natural mortality somewhat overcomes these concerns particularly as the projections are long term rather than short term.

- Population viability analysis: a critical assumption of the analysis is that by-catch will increase (in absolute terms) as abundance increases. This should be clearly outlined in the text as it implies that the by-catch fisheries will stifle recovery of the population in the absence of targeted fishing.

Phase II: Scope for human induced mortality

5. What is the maximum human induced mortality ……

- Summary for objective 5: Notwithstanding my concerns about reporting recovery in terms of $SSN_{20\%}$, the conclusions appear robust though it would be useful to include the estimates in terms (roughly) of numbers of fish and biomass in addition to an exploitation rate.

6. What are the major potential sources of mortality/harm?

7. For those factors not dismissed, quantify …

8. Aggregate total mortality/harm …….

- Summary for objective 7: It would be useful to summarise here the findings in Table 2. In particular the proportion of the by-catch taken in trawl versus longline and the target groundfish fisheries.

9. Develop an inventory of all reasonable alternatives …..

10. Develop an inventory of all feasible measures to minimize …..

- Summary for objectives 9 and 10: It may be beyond the scope of the report, but I feel that there is room for more work in these sections. Particularly as the levels of by-catch mortality greatly increase rebuild times. There is no mention of possible restrictions that do not allow porbeagle to be retained in the by-catch fisheries. New Zealand observer data indicates that 52% of all porbeagle are alive when landed on surface longlines. Given that over 50% of the by-catch comes from the swordfish and tuna longline fisheries, any restriction on landing porbeagle shark could alone reduce by-catch by 25%.

Observer data should be used (if available) to estimate the proportion of porbeagle shark that are alive when landed on trawls and longlines and simulations undertaken to look at the potential benefits of prohibiting landing porbeagle shark. Also, it could be possible to find time/area strata where by-catch rates are high. Such strata could be considered for closures. Note, it is not uncommon for fisheries to be restricted due to by-catch problems.

Appendix 6. Issues Raised in RAP Meeting of 22 March 2005

1. Commercial Landings, Sampling and Effort
    a. Need to characterize the size composition of by-catch in the large pelagic and groundfish fisheries
    b. Need to confirm that all foreign catch is included in the assessment
    c. Need to illustrate spatial and temporal changes in fishing effort

2. Catch Rate Analysis
    a. Need to better understand why lack of fit of model to mature sharks in 1980s and immature sharks in last 2 – 3 years
    b. Need to reconsider CPUE analysis, particularly influence of interaction terms & fleet changes
    c. General concern that CPUE is being influenced by immigration & emigration; could temperature be used as covariate?
    d. Desire to see more diagnostics on model fits
    e. Suggestion to investigate different weighting of the CPUE data in an effort to understand what is driving the model.
    f. Communication needed with industry in linking their at-sea observations with results of the CPUE analysis

3. Tagging
    a. Concern that mortality rates from tagging results are based on too many unknowns e.g, tag loss, tag mortality
    b. Concern that exploitation rates from tagging are averaged over all areas when recaps were actually from only 2 areas – basin and shelf edge
    c. Desire to see analysis separately from model

4. Model
    a. Current model produces very low survival through first year of life. There is a need for external info (e.g. observations on mortality in first year of life) to guide choice of alpha parameters used in model
    b. Weighting on CPUE, tagging & length composition
        i. impact of different weighting
        ii. Rationale for weighting
        iii. Different years of data included in analysis
        iv. Different algorithm to calculate Z
    c. Partition of CPUE size composition into more bins than immature & mature
        i. 0-50, 50-100, 100-150, 200+ cm
    d. Desire for more diagnostics on model fit
        i. Y vs X plots (to check for hyperstability in CPUE vs Numbers)
        ii. Residuals vs expected and time

5. Results
    a. Need to compare current view of resource with that in 2003

6. Reference points
    a. No specific items

7. Projections

Appendix 7. Comments of J. Baum

Introduction

Given the very short time frame provided, in this review I have made general comments pertaining to the June 28th & July 14th meetings, and the Stock Assessment and Recovery Assessment Reports. I have not reviewed the technical aspects of the assessment model as other reviewers have considered these. Instead, I focus on what I believe are the remaining major issues that need to be addressed.

General

An enormous amount of effort has been invested in developing a state-of-the-art forward projecting age- and sex-structured assessment model for this porbeagle stock, and in exploring variations of the model e.g. through different input parameters and data. All evidence indicates that the porbeagle stock is currently at low levels of abundance and that it will take many decades for the stock to rebuild. There remain, however, considerable uncertainties in the assessment (e.g. lack of fit in the models to the recent high CPUE), because of the lack of a fishery independent time series for this stock, uncertainty about the magnitude of catches outside Canadian waters (i.e. Japanese offshore catches), and difficulties in standardizing catch-per-unit-effort time series for a fishery which has changed drastically over time. This uncertainty should be explicitly explained in the assessment and accompanying documents. Moreover, it should be noted that according to SARA, "if there are threats of serious or irreversible damage to a wildlife species, cost-effective measures to prevent the reduction or loss of the species should not be postponed for lack of scientific certainty."

Clarification of points discussed at June 28th meeting

COSEWIC's designation of porbeagle as Endangered was based on criteria A2bd, the declining trend as indicated by the index of abundance for mature females, and the actual or potential levels of exploitation. Although there was some discussion at the meeting about the absolute numbers of mature females and/or total matures, this did not play a role in the COSEWIC assessment or designation.

Porbeagle Catches

By-catch

There was discussion at both meetings about the substantial increase in porbeagle by-catch that occurred in both the swordfish (doubling of by-catch from ~9.6t – 18.9t) and tuna (increase from 0.6t – 18.4t) Scotia-Fundy fisheries in 2002, the year the directed porbeagle quota was reduced (Table 1, Recovery Assessment Report). A change in porbeagle abundance cannot account for this change, as it is biologically impossible for the stock to have increased to anywhere near this extent within a year. The pelagic longline industry and industry representatives have stated that they do not target porbeagle because of their much lower monetary value compared to their target species. The most plausible explanation for this increase is highgrading or "selective harvesting" by the industry.

Foreign Catches

Catches of porbeagle outside the Canadian EEZ, particularly by Japanese longliners represent a substantial source of uncertainty in this assessment. Although the Japanese

observer program on these vessels is very limited, data are available from ICCAT for several cruises made in the Grand Banks area between mid-2001 and the beginning of 2003. Please note that although the ICCAT documents report on the Japanese longline observer program in all of the Atlantic, data specific to an area referred to as the Grand Banks (delineated by ~45-69°W and 39-50°N (Figure 1 Matsumoto et al. 2003)) are available within the tables of these documents (Matsumoto & Miyabe 2002; Matsumoto et al. 2003, Matsumoto et al. 2004). Although the stock structure of porbeagle is uncertain it is currently thought that there is a population within our region of the Northwest Atlantic and a separate population near Iceland. If this is the case, then these Japanese catches would belong to the "Canadian" porbeagle population. As an example, the following porbeagle catches were recorded in Japanese observer program in the area off the Grand Bank:

Dates of cruises on the Grand Banks	Number of Porbeagle	Reference
May – July 2001	185	Matsumoto & Miyabe 2002
September – November 2001; December 2001-January 2002	90	Matsumoto et al. 2003
September 2002-January 2003	6	Matsumoto et al. 2004

If extrapolated based on the ratio of porbeagle:Japanese tuna catches, these could represent a substantial proportion of known total annual catches of porbeagle within or near Canadian waters, which to date have not been considered in the assessment.

Model

Stock delineation

The porbeagle population has been defined as those individuals within Canadian waters, based on the reasoning that most catches occur within the Canadian EEZ. While U.S. porbeagle catches have been quite low, there is some evidence (see above) that Japanese catches outside the Canadian EEZ may be substantial, and may now comprise a considerable proportion of total catches of this population. Currently, there is insufficient information available from the Japanese observer program to assess what effect this would have on the stock status.

Alpha

The alphas set for the three models (2.0, 2.5, 3.2) appear to be in the upper end of what might be realistic for porbeagle sharks, rather than encompassing lower, medium, and higher values, based on the following pieces of information:

(i) alpha estimates from the models presented at the March 2005 meeting ranged from 0.862 to 3.097, with the preferred Model 2 alpha = 1.596;

(ii) these alpha estimates were based on based on the Beverton-Holt stock-recruit function, which, if anything, is biased towards overestimating alpha;

Variability in alpha is due to survivorship to age, as stated in the RAP Working 2005/10 document prepared for this meeting.

(iii) the two studies that have estimated survival through the first year of life for sharks yield mean estimates of 0.48 (Heupel and Simpfendorfer 2002) and 0.57 (Gruber et al. 2001), which equate to alpha estimates of 1.872 and 2.223 respectively;

It appears that alpha = 1.76 and r = 0.034 from the March assessment were perceived to be too low. This section of RAP Working 2005/10 states that "according to Model 3 of the RAP

meeting, porbeagle is the most unproductive shark species in the world". What is the basis for this comment? An *r* of 0.034 certainly would not place this shark species as the least productive. Cortes (2002) which ranks porbeagle as the 28th most productive shark species out of 41 species estimated porbeagle sharks to have annual growth rates of 1.022, equating to an intrinsic growth rate, *r* = 0.02. Smith & Au (1998) estimated *r*'s ranging from 0.017 to 0.136, and Beerkircher *et al.* 2003 estimated *r* = 0.048 for silky shark, a species with similar age at maturity as porbeagle shark.

There is obviously a fair amount of uncertainty about alpha and *r* for porbeagle. Given this uncertainty, it would be more appropriate to use a wider range of alpha values, which encompass the values from the above estimates (e.g. 1, 1.5 or 1.6, and 3). In the current model formulation (integrated cpue), an alpha=1 does not allow for population growth. Does the model work with alpha=1.5? It is quite possible that these alpha values are better biological estimates for porbeagle, and that the model would show population increases for these lower alpha values if the component of the population outside of the EEZ could be included in the model. The lack of detailed information on porbeagle outside of the EEZ (i.e. that indicated by the Japanese catches) is a large source of uncertainty in the understanding of this population.

Reference Points (Recovery Targets)

In the absence of defined recovery targets for porbeagle, the fishery reference points $SSN_{20\%}$ and SSN_{msy} have been used to gauge porbeagle recovery. It should be emphasized that $SSN_{20\%}$ is not a recovery target but rather a limit reference point i.e. there should be a low probability that the porbeagle population falls below this level. As the models indicate that the porbeagle population is already currently below this level, this reference point is useful only as the first step in rebuilding the population.

It should also be made explicit in the Recovery Assessment Report that at fishing mortality levels above that of ~4% the porbeagle population is predicted to never recover to SSN_{msy}.

Review Process

In order to ensure a thorough and objective external review, independent reviewers should be provided with the relevant background documents at least one week prior to meetings. The amount of time provided prior to the Recovery Potential Assessment meetings in this process (<1 – 2 days) was inadequate, and led to one reviewer withdrawing from the process as a consequence.

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Appendix 8. Submissions from Fishing Industry and Ecology Action Centre

Fishing Industry

The following text was prepared by the Nova Scotia Swordfishermen's Association, the Atlantic Shark Association, the Nova Scotia Fixed Gear Association (45' – 65'), the Halifax West Commercial Fishermen's Association, the Eastern Nova Scotia 4X Community Management Board and the Eastern Nova Scotia 4VsW Community Management Board

It is industries belief that the models used for this analysis present a much more conservative or less optimistic picture than that seen by both those who conduct the directed porbeagle fishery and those that encounter porbeagle as by-catch while directing for other species.

Since the implementation of the porbeagle recovery plan in 2002, catch rates (CPUE) in the directed fishery have steadily increased each year to the point that in 2005, catch rates match or exceed those encountered at the beginning of the Canadian fishery. This supports the idea that abundance has increased beyond the projections made by the models used in this analysis.

This increase in abundance is also supported by a drastic increase in the porbeagle catch rates in several fisheries that have taken porbeagle while directing for other species. This is clearly seen in the groundfish fixed gear 45' to 65' fleet (by-catch tripled from 2001 to 2004), groundfish fixed gear <45' fleet (by-catch doubled from 2001 to 2004), swordfish longline (by-catch doubled 2001 to 2004), tuna longline (by-catch more than quadrupled 2001-2004).

As further support for industries observations, it is also stated in the CSAS Science Advisory Report, under the heading of Sources of Uncertainty, that "two lines of evidence exist that indicate that present abundance is being underestimated by the models: the tagging data and recent high CPUE".

The directed porbeagle fishery has also observed an increase in the average size of the individual fish caught since the recover plan was put in place in 2002. This point was not picked up by the models used in the analysis and indicates that the resource has recovered beyond the projections of the model.

Based on the current analysis, it is industries position that porbeagle does not fit the COSEWIC criteria for listing as endangered. It is clear that the current adult population is greater than 10,000 animals, one of the thresholds used by COSEWIC to establish an endangered designation. Under the higher productivity scenario, with annual removals of 2% of the vulnerable biomass, the total population is predicted to be above the threshold of 30% of the initial population in 1961 by 2015 (the time period from 1961 to 2015 represents the three generation time period used in the COSEWIC designation). Keeping this in mind, it is possible to continue the fishery at some level and still not meet the COSEWIC criteria requiring an endangered designation.

Ecology Action Centre

It is the Ecology Action Centre's (EAC) position that, according to the best available information, the Atlantic Canadian porbeagle population qualifies as an Endangered species under SARA. The EAC is aware that the porbeagle fishing industry has taken several measures to protect porbeagles, including drastic quota reductions, area closures, and

participating in scientific research. Regardless of these efforts, it is clear that the porbeagle stock is severely depleted (female spawners are at 12-15% of virgin population abundance).

While further destruction of the porbeagle stock must be prevented, the EAC would like to remind the DFO that the Species at Risk Act should be the management tool of last resort. Placing more marine species on the SAR list merely signals the failure of the DFO to heed science, adopt a precautionary approach, and manage our fisheries wisely. The ecosystem effects of fishing, such as the destruction of fish habitat, impacts on slow reproducing species, and altering of marine food webs must become part of fisheries management rather than an obligatory part of SAR Recovery Plans. This is the only way to prevent more marine species from being deemed Endangered, and to prevent future betrayal of fishermen who have, for the most part, participated in DFO's flawed management schemes in good faith, and sometimes at great costs to themselves.

The EAC hopes that necessary actions will now be taken to ensure the recovery of the porbeagle populations and a faster return to a viable fishery, including:

1) Recovery to SSN_{MSY} be adopted as a *minimum* recovery target for this species. The recovery to $SSN_{20\%}$ is a watch post for recovery, however this point is not an acceptable recovery target for a fish with an extremely low reproductive capacity such as porbeagle.

2) To achieve SSN_{MSY}, an incidental harm rate of 1% (~45t) is recommended as being precautionary in the Recovery Assessment Report. At a higher incidental harm rate (i.e. 4%), 30% of the modeled populations did not recover within 100 years. At a rate of 7% incidental harm, even the most productive model shows the population will *never* recover to $SSN_{20\%}$, much less reach SSN_{MSY} (Figure 2, Recovery Assessment Report). [*N.B.*:- The model is biased so that recovery times are underestimated and the possible effect of decreased juvenile survival at low population sizes are not incorporated, so that recovery of the porbeagle population may be *even slower* than predicted.]

3) Given that recovery will take decades, allowing the porbeagle fishery to continue until 2007 seems the only fair to the industry which has participated in good faith for several years. Also, data gathered from this fishery will hopefully clarify some of the uncertainty regarding this population. Advice on the most efficient and effective means of gathering such data must be sought and utilized.

4) By-catch of porbeagles tripled (swordfish and groundfish) and quadrupled (tuna) after severe quota reductions were adopted by the directed porbeagle fishery. If such increases continue, by-catch rates would exceed levels that would permit the recovery of the porbeagle population, and must therefore be closely monitored. Catches by foreign fleets (US, Japanese) and all regions of Atlantic Canada must also be incorporated.