



Fisheries and Oceans  
Canada

Pêches et Océans  
Canada

Science

Sciences

## **C S A S**

**Canadian Science Advisory Secretariat**

**Proceedings Series 2007/016**

## **S C C S**

**Secrétariat canadien de consultation scientifique**

**Série des comptes rendus 2007/016**

**Proceedings of the Newfoundland and  
Labrador Regional Advisory Process  
for 3Ps Cod**

**October 16-20, 2006  
The Fluvarium, 5 Nagle's Place, St.  
John, NL**

**Meeting Chairperson  
Joanne Morgan**

**Editors  
C. Bishop and N. Wells**

**Compte rendu du processus  
consultatif régional de Terre-Neuve-et-  
Labrador sur la morue dans 3Ps**

**Du 16 au 20 octobre 2006  
The Fluvarium, 5, Nagle's Place,  
St. John's, T.-N.-L.**

**Présidente de la réunion  
Joanne Morgan**

**Éditeurs  
C. Bishop et N. Wells**

Fisheries and Oceans Canada / Pêches et Océans Canada  
Science Branch / Direction des sciences  
PO Box 5667, 80 East White Hills Road  
St. John's, NL, Canada A1C 5X1

**August 2007**

**Août 2007**



---

**Proceedings of the Newfoundland and  
Labrador Regional Advisory Process  
for 3Ps Cod**

**October 16-20, 2006  
The Fluvarium, 5 Nagle's Place, St.  
John, NL**

**Meeting Chairperson  
Joanne Morgan**

**Editors  
C. Bishop and N. Wells**

**Compte rendu du processus  
consultatif régional de Terre-Neuve-et-  
Labrador sur la morue dans 3Ps**

**Du 16 au 20 octobre 2006  
The Fluvarium, 5, Nagle's Place,  
St. John's, T.-N.-L.**

**Présidente de la réunion  
Joanne Morgan**

**Éditeurs  
C. Bishop et N. Wells**

Fisheries and Oceans Canada / Pêches et Océans Canada  
Science Branch / Direction des sciences  
PO Box 5667, 80 East White Hills Road  
St. John's, NL, Canada A1C 5X1

**August 2007**

**Août 2007**

---

---

© Her Majesty the Queen in Right of Canada, 2007  
© Sa Majesté la Reine du Chef du Canada, 2007

ISSN 1701-1272 (Printed / Imprimé)

Published and available free from:  
Une publication gratuite de :

Fisheries and Oceans Canada / Pêches et Océans Canada  
Canadian Science Advisory Secretariat / Secrétariat canadien de consultation scientifique  
200, rue Kent Street  
Ottawa, Ontario  
K1A 0E6

<http://www.dfo-mpo.gc.ca/csas/>

CSAS@DFO-MPO.GC.CA



Printed on recycled paper.  
Imprimé sur papier recyclé.

Correct citation for this publication:

DFO, 2007. Proceedings of the Newfoundland and Labrador Regional Advisory Process for 3Ps Cod; October 16-20, 2006. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2007/016.

---

## TABLE OF CONTENTS / TABLE DES MATIÈRES

SUMMARY .....	v
SOMMAIRE .....	vi
INTRODUCTION .....	1
DOCUMENT OR PRESENTATION SUMMARIES AND RELATED DISCUSSION OR COMMENTS .....	2
Appendix I: Terms of Reference .....	21
Appendix II: Meeting Agenda .....	22
Appendix III: List of Meeting Participants .....	23
Appendix IV: List of Working Papers & Presentations .....	24



## SUMMARY

A Meeting of the Newfoundland Regional Advisory Process (RAP) on 3Ps Cod was held 16-20 October at the Fluvarium, 5 Nagles Place, St. John's Newfoundland. A full assessment of the stock status of St. Pierre Bank (3Ps) cod was reviewed. These Proceedings contain a summary of working papers, presentations and the related discussions. Also included as appendices are the Terms of Reference, the meeting agenda, a list participants at the meeting, and a list of papers and/or power point presentations. Additional information on the resource assessed is available in CSAS research documents and Science Advisory Reports.

### **Summary points for the stock assessment are as follows:**

- Stock status was evaluated from commercial landings (1977 to 31 March 2006) and log-book data (1997-2005) in conjunction with abundance indices from Canadian research vessel (RV) trawl surveys (1972-2005), industry trawl surveys (1997-2005), and sentinel surveys (1995-2005). Exploitation (harvest) rates were estimated from tagging experiments.
- In this assessment a model of the dynamics of the stock using sequential population (SPA) was not accepted and the assessment is based primarily on analyses of survey indices and trends in catch. Therefore, the impacts of fishing at specific TAC levels could not be quantified.
- The RV survey in 2006 was not completed due to unforeseen operational difficulties with the vessels; consequently, there has been no update of the RV index and biological information from this survey.
- All four indices of population size are presently below their average. The two offshore (trawl) indices have been declining, whereas the two inshore fixed gear indices have been stable in recent years.
- Two strong year-classes (1997-1998) are well represented in the catch during 2003-2005. However, these are followed by weaker recruitment (2000-2003 year-classes), and at current catch levels it is anticipated that fishing mortality will increase over the next few years.
- Fish harvesters are of the opinion that the fish stock is healthy and recruitment is good.

## SOMMAIRE

On a tenu une réunion du processus consultatif régional (PCR) de Terre-Neuve sur le poisson de fond du 16 au 20 octobre au Flurarium, 5, Nagle's Place, St. John's, à Terre-Neuve. On y a examiné l'évaluation complète de l'état du stock de morues sur le Banc Saint-Pierre (3Ps). Le présent compte rendu renferme un résumé des documents de travail, des présentations et des discussions tenues. Le cadre de référence, le programme de la réunion, une liste des participants et une liste d'articles ou de présentations en format PowerPoint sont également inclus dans les annexes. Les documents de recherche et les rapports sur l'état des stocks du SCCS contiennent de l'information supplémentaire sur la ressource évaluée.

### ***Voici les points sommaires de l'évaluation du stock***

- On a évalué l'état du stock à partir des débarquements commerciaux (de 1977 au 31 mars 2006) et des données de journaux de bord (de 1997 à 2005), en combinaison avec les indices d'abondance calculés à partir des relevés au chalut par navires scientifiques (NS) canadiens (de 1972 à 2005), des relevés au chalut réalisés par l'industrie (de 1997 à 2005) de même qu'à partir des relevés sentinelles (de 1995 à 2005). On a estimé les taux d'exploitation (récolte) à partir d'expériences de marquage.
- Pour cette évaluation, on n'a pas accepté qu'un modèle de la dynamique du stock utilisant des données séquentielles sur la population soit utilisé, mais on s'est fondé principalement sur des analyses des indices calculés à partir des relevés et des tendances affichées par les prises. Ainsi, on ne pouvait pas quantifier les impacts de la pêche pour certains TAC.
- Le relevé par NS de 2006 n'était pas complet en raison de difficultés opérationnelles imprévues; en conséquence, on ne dispose d'aucune mise à jour relative à l'indice par NS ni d'information biologique issue de ce relevé.
- Les quatre indices relatifs à la taille de la population sont actuellement inférieurs à leur moyenne habituelle. Les deux indices dans les eaux extracôtières (chalut) ont décliné, tandis que les deux indices côtiers (engins fixes) sont demeurés stables au cours des dernières années.
- Deux classes d'âge fortes (1997 et 1998) sont bien représentées dans les prises pour les années allant de 2003 à 2005. Toutefois, elles sont suivies par un recrutement plus faible (classes d'âge de 2000 à 2003) et, aux taux de prises actuels, on prévoit que la mortalité attribuable à la pêche augmentera au cours des prochaines années.
- Les pêcheurs commerciaux sont d'avis que le stock de poissons est sain et que le recrutement est bon.



## INTRODUCTION

A Meeting of the Newfoundland Regional Advisory Process (RAP) on 3Ps Cod was held 16-20 October at the Fluvarium, 5 Nagles Place, St. John's Newfoundland. A full assessment of the stock status of St. Pierre Bank (3Ps) cod was reviewed. The meeting commenced at 0900 on October 16 with introductions by the chairperson. The main reason for conducting the assessment was to provide answers, if the information was available, to the issues raised in the Terms of Reference (Appendix I). Because of the incomplete Research vessel coverage, there was insufficient data to provide an overview of environmental conditions in the stock area during 2006. Information from the other surveys conducted (Sentinel and GEAC) was used to update indices used in previous assessments and to provide additional biological data. Models used in previous assessments were applied again and the results evaluated. The meeting agenda can be found in Appendix II.

Participation at the meeting included both scientific and fisheries management staff from the Fisheries and Oceans Canada (DFO - Newfoundland and Labrador Region and Quebec Region), Nfld. and Labrador Provincial Government representatives, French Research Institute for Exploitation of the Sea (IFREMER), FFAW/UAW members, and fishing industry representatives (Appendix III). A total of 19 presentations were made and the content discussed (Appendix IV). The titles of the presentations and the comments associated with each are presented in some detail in the pages that follow.

## **DOCUMENT OR PRESENTATION SUMMARIES AND RELATED DISCUSSION OR COMMENTS**

### **1. Assessment of the cod (*Gadus morhua*) stock in NAFO Subdivision 3Ps. J Bratley, B.P. Healey, G. Lilly, E.F. Murphy, D. Parsons, J.C. Mahe and N. Cadigan. Power Point Presentation.**

#### Abstract:

Scientific information used to determine the status of the cod stock in NAFO Subdiv. 3Ps off the south coast of Newfoundland was presented. Principal sources of information available for this assessment were: reported landings from commercial fisheries (1959-March 2006), oceanographic data, a time series (1973-2005) of abundance and biomass indices from Canadian winter/spring research vessel (RV) bottom-trawl surveys, an industry offshore bottom-trawl survey (1997-2005), inshore sentinel surveys (1995-2005), science logbooks from vessels < 35ft (1997-2005), industry logbooks for larger (> 35 ft) vessels (1998-2005), and tagging studies (1997 onwards). The fishery was still in progress at the time of the assessment and complete information on catch rates and age compositions from the 13,000 t TAC from 1 April 2006 to 31 March 2007 was not available. In addition, the spring 2006 RV survey was not completed due to operational difficulties with the vessel; consequently, there has been no update of the abundance, biomass, or catch rate indices, or of biological information (growth, maturation rate, and condition) from this survey. All four indices of population size are presently below average; the two offshore (trawl) indices have been declining, whereas the two inshore (fixed gear) indices have been fairly stable. Catches of cod in the 2005 GEAC survey, particularly for the 1997 and 1998 year classes, were much lower than those in preceding years. Sentinel line-trawl catches of the 1997 and 1998 year classes were not markedly different from those of other recent cohorts at the same age. New information on recruitment from the GEAC survey and sentinel linetrawl is consistent with the previous (2005) assessment and indicates that year classes produced during 2000-03 are mostly (3 of 4) below average. Two strong year-classes (1997-98) have been well represented in the catch during 2003-05; however, these are followed by weaker recruitment (2000-03 year classes) and at current catch levels it is anticipated that the stock abundance will decline over the next few years.

#### Comments:

The CV estimates were a useful addition to the catch at age table and indicated that over all sampling of the commercial catch was adequate. However, the offshore LT fishery was sporadic and was not well sampled nor was the OT fishery in the 4<sup>th</sup> quarter.

The age composition of the catch in 2005 had smaller numbers at age 6 than in previous years especially in the otter trawl fishery. This may have been related to the poor sampling of this gear in the 4th quarter.

The LT fishery was picking up smaller cod of the 2000 Y/C that were not being caught by otter trawl. The location of this LT catch was not known but was presumably from west of the Burin peninsula. It would be useful in understanding the differences in age compositions to look at a plot of reported landings by gear type and unit area for a few years. This might help explain where the younger ages in the LT fishery have originated assuming that the distribution by age was consistent across the area for LT and the distribution by age is similar to the catch distribution.

The LT age composition was examined further in presentation 8.

- It was questioned whether the average weights at age were similar to other years but this issue had not been examined. There may not be much difference as the year classes are tracking. However, variability had been observed in the past due to year class effects.

Weight at age in the commercial catch, although variable, especially at older ages, did not indicate any trends.

- The Canadian RV survey in 2006 had operational problems which severely restricted survey coverage to the extent that it was not considered wide enough to give results that could be considered representative of the cod or other fish stocks. Consequently, the results were not comparable with previous years surveys and no analysis was conducted and no tables or figures updated in the document.

## **2. Sentinel Surveys 1995-2006: Catch per Unit Effort in NAFO Subdivision 3Ps. D. Maddock Parsons and R. Stead. Working Paper and Power Point Presentation.**

### Abstract:

Sentinel enterprises continued to collect catch rate and biological information on inshore 3Ps cod resources in 2005 and 2006. Gillnet catch rates (weekly average number of fish per net) in the most recent years remained low compared to 1996-1998 catch rates. Catch rates in small mesh gillnet remained low. Length frequencies of cod caught in small mesh gillnet showed fewer fish at the two size modes (36-44 cm and 52-56 cm) that this gear catches since 2000. Linetrawl catch rates (weekly average number of fish per 1000 hooks) increased from 2000 and showed an increase in the number of fish at the 44-54 cm size range from 2002 to 2004. In 2005, linetrawl catch rates declined, but preliminary results indicate an increase in catch rate in this gear for 2006.

### Comments:

- There was some indication that the length frequency data from the commercial LT fishery showed smaller fish than those from the Sentinel LT survey in 2005. The reasons were not clear but there were some geographical areas where small fish were more abundant in the LT survey catch, particularly in the western part of Fortune bay. There had also been some fishery closures in this area because of catches of small fish. Since the commercial fishery and the Sentinel sites both occur in the same areas it would seem that differences in geographic coverage between the 2 would not explain this.

- Length compositions of the commercial could provide comparisons of gear catches from year to year and aid in comparing with the sentinel fishery.

### **3. Standardized Sentinel Catch Rates. B. Healey. Power Point Presentation.**

#### Summary:

Sentinel fishery catches were age-disaggregated and the catch rates were modeled to produce indices of stock abundance. To estimate standardized catch rates, we applied a generalized linear model (Poisson distribution, log link) with two nested effects: age within year and month within site. Catch rates from gillnet and linetrawl were analyzed separately for both control and experimental sites. The estimated catch rates for gillnets in 2005 were low and were amongst the lowest values at each age across the entire time series. Linetrawl catch rates are also relatively low, and indications of improved recruitment for the cohorts of the early 2000's have not persisted at older ages. Residuals were examined and patterns in residuals were not different from those presented for previous assessments. Results of the standardization were similar to the unstandardized sentinel results.

#### Comments:

Concern was raised about potential bias in the sentinel results if the sentinel fishers were also participating in commercial operations. However it was concluded that the commercial fishery is prosecuted separately enough from the Sentinel fishery that there was no conflict and no opportunity for bias.

### **4. Science Logbooks, < 35' vessels. B. Healey. Power Point Presentation.**

#### Summary:

Commercial logbook data from the small vessel sector were summarized by geographic location and gear type. A time-series of unstandardized catch rates for each area indicated that gillnet catch rates declined in the eastern portion of the stock area, but increased in Fortune Bay and off Burgeo. Current gillnet catch rates in all areas were substantially lower than at the beginning of the time series. Linetrawl catch rates for 2005 from the head of Placentia Bay to the Burgeo peninsula were the highest over the time period, and were relatively high in western 3Ps. The logbook data was modeled using a generalized linear model to produce a time series of standardized catch rates by removing spatial and temporal effects. Current gillnet catch rates are substantially lower than those in 1997 and 1998, whereas the linetrawl catch rates for 2005 were the highest over the 1997-2005 time period.

#### Comments:

The lack of correspondence in trends in sentinel survey catch rates and commercial catch rates could be the result of operational differences.. The Sentinel fishery has certain weeks to fish whereas the commercial fishery can occur when the catch rates were up. - The commercial fishery attempts to maximize catch which maximizes profit. In the Sentinel fishery index sites are fixed. Fishing is done at the same time and location. This may limit comparability between the two data sets. Perhaps a subset of the commercial fishery (in time and area) would be better to compare to the Sentinel results.

- In last year's assessment it was recommended that there be more study at some sites to look at the issue of competition between Sentinel and commercial gears. This has not

been addressed. It is not clear how best to study the issue. It would require examination on a small scale of time and space.

- It was noted that this discrepancy between commercial and Sentinel was not seen in the northern Gulf of St. Lawrence. There were some differences in the way the Sentinel fishery was conducted between the two areas.

**5. Conservation Harvesting Plan, Subdivision 3Ps. D. Tobin. Power Point Presentation.**

No summary available.

**6. 3Ps cod. 1993-2005; Historical Perspective. L. Ryan. Power Point Presentation.**

No summary available.

Comments:

Presentation 5 and 6 were discussed together.

- There had not been much change in the management plan since 2003 with the exception of dockside monitoring.

- There were there no small fish problems noted in 2005 and 2006. However, this contradicts information provided at the meeting by commercial fishers about the LT fishery.

- In the 1980's an F0.1 strategy was used. With a TAC of 15000t, the 2005 assessment would estimate that F's would be higher than F0.1. It could be argued that this was less conservative minded than we were back in the 80's and we were not in step with the rest of the world re management measures. With the precautionary approach F and biomass reference points would be set.

- Since 2003, VMS had been introduced and it was questioned if the data could be used from a scientific perspective, but these data had not been used in the NL. Region and it were not available.

**7. Catch Results 2005: Year Nine of the NAFO Subdivision 3Ps Fall GEAC Surveys. John McClintock. Power Point Presentation and Working Paper.**

Abstract:

To enhance the fisheries research database in NAFO Subdivision 3Ps, the Groundfish Enterprise Allocation Council (GEAC) has funded surveys each fall from 1997 to 2005 directed at groundfish, with specific interest in cod, American plaice, witch flounder, and haddock. In these analysis, catch statistics, length and age distribution, and stratified analysis estimates of biomass, including age distribution estimates, and interpretation of results are presented. These results have also been presented annually during the regular

Regional Stock Assessment Meetings (RAP) in St. John's: in October 2006 the cod catch and analysis results from the survey conducted 6-18 December 2005 were presented.

In 2005, the cod catch weights were about one half those from 2004. There was a continued absence of traditional large catches seen in strata 318 and 319 at the mouth of the Halibut Channel. The survey yielded an abundance estimate of 4.5 million cod and a biomass estimate of 11 ktonnes (compared with the 2004 estimates of 6.6 million cod and 23 ktonnes): the lowest estimates in the nine years of survey.

The numbers of cod for the 1998 and 1997 year classes (ages 7 and 8 in 2005) are estimated at one million, down to 30% of the 2004 estimate of 3.6 million, and down to 7% of the 2003 estimate of 15.4 million of these year classes. A greater proportion of younger fish is contributing to the abundance estimate, with 64% of the total estimate in 2005 being from cod aged 3 to 5 years, compared with 33% in 2004.

Comments:

- The total number of sets was down but most strata had been covered but maybe there were fewer sets per stratum.

- Commercial fishing activity occurring at the time of the survey was similar in 2005 as in other years. The fishery was mostly in statistical areas 3Psh and 3Psf and had been for some years. However, concentrations of cod were not as large as previously seen but catch rates hadn't changed much. The water temperature in 2005 was very warm and the fish were in deeper water. The fishing skippers spent more time in deeper water than in other years. Since tagging had been done in 2005 at depths of 139 - 149 m, there were some fish in shallower water as there had been in previous years.

**8. Plots of Linetrawl catch (2005). E. Murphy. Power Point Presentation.**

No summary available.

Comments:

This work was done to try to examine the discrepancy between commercial catch at age in the LT vs other gears. This might provide information on recruitment.

- In the LT fishery the distribution of ages 4 +5 was different from the previous year (2004) and it didn't result from a shift in location of the fishery. The increase was more prominent in 3Psa and 3Psb and some of 3Psc i.e. throughout the LT area. This may have been related to LT selecting smaller fish. This might not be sufficient to conclude anything about a recruitment signal but monitoring is necessary.

- Commercial fishers indicated that this was not a result of a change in bait size as this has been unchanged for many years.

- In the Gulf of St. Lawrence stock, an increase in small fish in the LT length frequencies was usually associated with better recruitment.

- The research LT had a similar age composition as the commercial LT. The age compositions observed could mean that the age 4 numbers were up but that the other ages were down. The flat appearance of the age composition through ages 4 to 7 could mean a stronger Y/C or that everything else is gone. In terms of catch rate it also doesn't appear to be particularly strong.

- There was no consensus as to what the information meant with regard to a Y/C signal. Although the age 4 abundance in the LT catch was broadly distributed and not the result of a shift in catch, there was not enough information to decide if it was a recruitment signal.

## **9. 2006 Fish Harvester Questionnaire (3Ps Resident Cod License Holders). Harvey Jarvis. Power Point Presentation and Working Paper.**

### Abstract:

Between October 5th and October 12th the FFAW conducted a telephone survey of resident 3Ps licensed cod harvesters. The survey was based on a random selection of license holders. Telephone interviews were conducted based on a standardized introductory script and list of questions. The sample size was calculated to produce a result that would be 95% accurate, plus or minus 5% 19 times out of 20.

Overall when compared to historical levels, current area 10 catch rates are above average while area 11 and St. Pierre Bank catch rates high. In all areas, 2006 catch rates are the same as or better than they were in 2005. Cod are distributed throughout the area and condition is good. In 2006 there was a good mixture of all sizes of cod.

### Comments:

- For similar questionnaires in the Gulf it was reported that there was often a tendency to be positive in the given year. Questions as to what the fisherman thought for previous years might be useful, i.e. ask in 2006 how things were in 2005 as well as in 2006.

- The tag return numbers were lower than those estimated from tagging studies although the number of tags match well. The discrepancy observed in the Placentia Bay area might suggest higher exploitation rates than estimated from tagging studies. The questions on tag returns could be more specific as to the colour of the tag as this could affect the return rate.

- Other suggestions regarding the wording of the questionnaire relative to tagging. These included; it should ask if all tags have been returned, and maybe should be in three parts such as are tags returned always, sometimes or never. The value of the tag was expected to impact on return rates.

## 10. Cohort Signals (or not?) in the 3Ps Cod Data Series. B. Healey. Power Point Presentation.

### Summary:

In previous assessments of 3Ps cod, concern about the quality of the tuning indices have been raised. Year-effects are evident, particularly in the offshore indices, and the ability of the indices to track year-classes has been questioned. An EU study group has recommended that various correlation measures be computed prior to estimating population status using age-disaggregated methods such as virtual population analysis. For context, the experience with these statistics in NAFO and ICES assessments is reviewed. Within and between index correlations are presented for each index data series and for the catch at age matrix. We recommend that the bivariate data plots must be examined in addition to the correlation coefficients, to ensure the correlation results are reliable and not resulting from outlying points. For this data set, we find that the correlations in the catch-at-age matrix are relatively high, and the correlation from research vessel data are generally poor. The GEAC index has high correlation at younger ages only, and the sentinel linetrawl data correlations are high at most age groups. It was noted during discussion that the catch at age correlations may be artificially high as a result of the moratorium. Unusual patterns are found when correlating the index data and the 2005 VPA estimates of population size.

### Comments:

Additional information on this topic is found in Presentation 11 and 12.

- There were general comments concerning what we need in the surveys relative to a VPA. It is thought that surveys should track Y/C's, assuming that the survey measures the population. The survey is a tuning index for the VPA to estimate cohorts that are not finished. There are assumptions (M, F) and commercial catch at age which hopefully mirrors what's actually being caught. In terms of doing the analysis, it was questioned as to what we would need to decide if the survey is good.

- This exercise is an important one. In previous assessments the inputs have been looked at carefully before inclusion in the SPA. In the past, indices have been thrown out because they didn't have sufficient information for inclusion. There is therefore a basis for excluding an index such as the RV data. If a protocol for such is developed the explanation should be explicit and well documented.

- There were no clear answers from the ICES perspective on how to decide which indices to include. Such decisions are difficult and that using correlations alone may not tell the story as they may be spurious. The data needs to be looked at in more detail as well as individual tuning. There exists no cut off for acceptance or rejection of an index.

- Indices excluded from this assessment in the past were the Sentinel GN index and an acoustic index for Placentia Bay. The decision re the Sentinel GN was related to interactions in the computation of the index which depended on what communities were being looked at and this could not be resolved. It was also eliminated because of residual patterns in the VPA. The acoustic index was dropped because after ANOVA no significant Y/C effect was found in the data.



- It was agreed that examining data thoroughly was a good idea but the issue was how we decide what indices to keep and not keep in a VPA.

- The VPA correlation summary showed that the pattern was good at younger ages, dropped off, then rose again. The drop had to do with spatial effects as the surveys don't cover the entire range. Also it was surprising but hard to rationalize that the indices go up again at older ages for GEAC and Canadian RV. The increase in older ages could be explained by the way the VPA estimates these ages

## **11. Information on Y/C strength in the Templeman Index. Peter Shelton and David Miller. Power Point Presentation.**

### Abstract:

Analysis of variance through the application of general linear models in SAS has been considered a useful diagnostic tool for evaluating the information on yearclass strength in survey index and catch data. The general approach is described in Shepherd and Nicholson (1991). The model that is fit has two categorical variables, age and yearclass. The age effect comprises a combination of selectivity at age and cumulative survival to age resulting from natural mortality and fishing mortality. The yearclass effect is expected to relate to the actual strength of the yearclass or cohort in the population. Error is considered to arise from variability in both year effects and age effects. Strong year effects commonly exist in the indices for 3Ps cod. The strength of yearclass effect models is that they average out this source of variability to some extent. Assuming a constant age effect can be problematic because it assumes that mortality and selectivity schedules have been constant over time.

Despite variability in year and age effects, significant yearclass effects are commonly found in indices. For example there is a significant yearclass effect in the RV Templeman survey index used in calibrating the SPA for 3Ps cod. We use simulation to examine whether such effects could be generated spuriously from variability not associated with variability in yearclass strength. Our null model is that there is no yearclass effect. We introduce variability in year and age effects to mimic the overall amount of variability in the Templeman RV index and demonstrate that yearclass effects of the magnitude found in this index could arise spuriously. This does not mean that such effects are spurious, but that they could be.

Next, we examine yearclass effects across a number of survey indices and the catch at age and find that all yearclass effects are significant and that these effects are coherent across indices and the catch at age. Lastly, we ran a combined yearclass model with type (Templeman RV, GEAC, Sentinel linetrawl and commercial catch at age), age and yearclass effects. All effects were significant. The overall yearclass effect shows a downward trend since the mid 1970s with the 1989 yearclass giving a substantial positive deviation from this trend. The uncertainty in relative yearclass strength described by plus or minus two standard errors is large.

Shepherd, J.G., and Nicholson, M.D., 1991, Multiplicative modelling of catch-at-age data and its application to catch forecasts: *J. Cons. Int. Explor. Mer.*, 47, 284-294.

### Comments:

- Only yearclass and age effects were modeled. The year effect can be considered to comprise a combination of measurement and process error. When year effects are introduced into  $F$  or  $M$  in simulated data it produces spurious yearclass effects when the data are analysed using GLM, but not when year effects are introduced on  $q$  in the model. This is because year effects on  $F$  and  $M$  are communicated down the cohort diagonal whereas the variation in  $q$  is just on the index in that year and is not communicated down the cohort.

- There was some concern about the stability of the results, ie. If the simulation was rerun would the results be the same?

- The question is whether Y/C strength can be detected considering the type of variability that exists in the real data. It probably can but the simulation predicted that Y/C strength may be weakly related to the true year class strength.

## **12. Effects of Introduced Year Effects. Joanne Morgan. Power Point Presentation.**

### Summary:

A simple simulation exercise was presented. In this exercise there were 13 years of survey at age information. All cohorts were the same strength except 2, with one being 2 times the strength of the others and the other being half the strength of the others. If 3 year effects are introduced then there are no significant age to age correlations and the average Rsquare was only 0.37. This shows that even with the ability to clearly track year classes, the presence of year effects in the data will result in low age to age correlations. This casts doubt on this as a method of determining the usefulness of indices.

### Comments:

- It would be useful to look at the bivariate plots. In the perfect case you would have everything lining up and when you put in the year effects they move two points off the line. The interpretation of the plot would be that it is not good 'but here is the reason'.

- Every year effect affects two points in an age to age correlation and it doesn't take very many year effects in a survey series to make the correlations non-significant.

- The magnitude of the year effects is important. There could be a case where you would have poor  $r^2$  but good cohort signals and could have reasonable  $r^2$  and poor cohort signals.

## **General Discussion of analyses of year class strength and age to age correlations (Presentations 10, 11 and 12)**

Based on the correlation analyses, the age to age correlations are poor for many of the indices in the VPA and correlation between the observed and predicted index from the VPA was often low. But because of the affect of year effects one also needs to look not only at the correlation but at whether there is a year class strength pattern in the data. One way is to look at the plots. Another is to model with GLM's and it has been shown that while you can

pick out year class effects from noisy data, you can also get spurious ones by varying M and F.

These analyses and discussions were aimed at determining the usefulness of the indices in tuning VPA. However there was no clear direction from these results. It was decided that a single index tuning approach might be useful and this is discussed under Presentations 16 and 17.

### **13. Exploitation of Atlantic Cod (*Gadus morhua*) in Subdivision 3Ps. Estimates from mark-recapture experiments for the October assessment. J. Bratley and Brian Healey. Power Point Presentation.**

#### Abstract:

Updated results from a multi-year tagging study of Atlantic cod (*Gadus morhua*) in NAFO Subdiv. 3Ps, initiated during spring 1997 were presented. Since inception, a total of 66,976 cod have been tagged with single, double, or high-reward t-bar anchor tags and released at various inshore and offshore sites off southern Newfoundland (3Ps) and 13,693 (20.4%) have been reported as recaptured to 1 October 2006. During December 2005, a further 1,490 tagged cod were released an offshore area (3Psh) with the assistance of industry. Estimates of exploitation for cod tagged in each region in each year were computed using methods we reported previously. Estimates of short-term tagging mortality, tag loss, and reporting rate were obtained and are incorporated into the estimation. No tagging has been conducted inshore since 2003, and the cod tagged inshore and captured during 2005 would typically be at least six years old; consequently, the exploitation estimates given here for inshore tagging pertain to year classes produced prior to 1999 (6+ cod) and managers should be aware that these estimates exclude cod newly recruited to the fishery (2000-2001 year classes). Also, this makes differences in exploitation rates across the time-series more difficult to interpret. Among cod tagged in Placentia Bay (3Psc) mean annual estimates of exploitation have declined from 35% in 1999 to 21% in 2005. For cod tagged in Fortune Bay (3Psb) mean annual estimates have been similar (8-12%) during 2000-2005, with tag returns indicating considerable movement of cod between Fortune Bay and Placentia Bay. For cod tagged in 3Psd (Burgeo Bank) the estimate for 2004 was 1.3%, the lowest estimate since 1998, but similar to the 2004 value (range 1.3-9.1%). Mean annual estimates of exploitation for cod tagged in offshore areas (3Psh) are marginally higher for 2005 (5.5%, compared with 1.5-3.2% during 1998-2004) but remain lower than those for inshore areas in spite of offshore landings of >6,000 t. The timing of offshore tagging in 3Psh/g was changed from April to December during 2003-2005 and a total of over 4,200 tagged cod have now been released. However, only 90 of the cod tagged offshore in December have been reported as recaptured. In terms of distribution of recaptures, results were almost identical to those for cod tagged offshore April, with recaptures taken mostly in the local offshore area (3Psh/e) and inshore within Placentia Bay (3Psc).

#### Comments:

- There is still concern about the apparently low exploitation rate in the offshore, Cod were tagged at a range of depths. In the last 3 years in the GEAC surveys tagging was done in relatively shallow water at approximately 140m. Previously it was done at depths to 300m. In some years it was in shallower water, where ever cod could be found. There was not a huge difference in the numbers returned at least at the depth range. Even if 50% of the fish

were dying it would only double the exploitation rate, and that still wouldn't be that high. The mortality would have to be 70 - 80% to produce a significant effect.

- It could be useful to tag in winter in the Halibut Channel to check for potential Northern Gulf fish in the area. However, that area is mainly depth as the fish would be mainly deeper than 300m. Tagged fish from the N. Gulf have not been recovered in the Halibut Channel.

- Winter tagging studies conducted in Fortune Bay in 2001 and 2002 could be repeated.

- The low % return reported from the offshore may be related to a healthy stock but it seems to give an unrealistic figure for stock size. It doesn't fit with other information.

- However harvesters see fish on the Bank from April to November. They are not seeing the same signals as the surveys and they are out there more often. It was suggested that fish can move to deeper water out of the survey range. However, the surveys are conducted to depths of 400 fm.

#### **14. Cod by-catch in the redfish fishery in 3Ps - (2003-2005). A. Frechette. Power Point Presentation.**

##### Abstract:

A series of winter mixing surveys have been conducted over the last decade in order to assess the extent of mixing of Northern Gulf cod (3Pn, 4RS) into 3Ps. The most recent surveys (January 2005 and January 2006) have failed to detect any cod from the southern part of 4R (Bay St. George) into 3Pn and the northern part of 3Ps (3Psa, 3Psd). In order to provide insights on this, an examination of cod by-catch from the Unit 2 redfish stock was done. Over the last few years, the cod by-catch has resulted in some closures due to the high presence of cod. The presence of cod in this fishery was compared to results of the winter mixing surveys.

Over the years, there has been a area of concentration of cod on the south east edge of Burgeo Bank, this has been seen consistently in many winter surveys directed at the cod mixing issue. However these have disappeared in the 2005 and 2006 January mixing surveys. Cod by-catch from the redfish fishery (2003-2005) also concentrates on this area to the south-east part of Burgeo Bank.

A new finding from the cod by-catch in the redfish fishery is the presence of cod in the very deep waters of 3Ps along the 4Vn 4Vs line. This presence of cod did not appear in the winter mixing surveys as the surveys did not reach these more southern areas. This may prove to be of significance if these winter mixing surveys are to continue.

##### Comments:

- Since 2004 midwater trawls have not been used in the Laurentian channel redfish fishery. The current use of bottom trawl might be the reason for increased groundfish by-catch. The fishery has changed. There are also more small boats in the fishery. It is also

hard to understand why fishers would attempt to target cod while fishing for redfish because of quality issues.

**15. Mixing of Northern Gulf cod into 3Ps. The Counting Fence Project. M. Castonguay, J.L. Beaulieu, J. Brattey, J. Spingle, A. Frechet and S. Campana. Power Point Presentation.**

Abstract:

Tracking movements of animals at sea in deep water for long periods has long posed problems. Winter mixing between cod from the northern Gulf of St. Lawrence (Divisions 3Pn4RS) and cod off southern Newfoundland (Division 3Ps) may slow down cod recovery in the Gulf. The purpose of this study was to estimate mixing rate of northern Gulf cod into southern Newfoundland using automated monitoring telemetry methods. We inserted 50 kHz individually-coded transmitters into the abdominal cavity of 262 adult cod. We deployed a total of 80 receivers near bottom every mile that covered the entire distance along management lines separating Divisions 3Pn and 3Ps, and 4R and 3Pn. Two additional shorter receiver lines were also deployed on Burgeo and St. Pierre Banks. Based on two independent measures of receiver detection efficiency (0.76 and 0.83), we estimated the percentage of northern Gulf cod crossing into 3Ps in the fall to be 61%. The main month that Gulf cod entered 3Ps was December while the main month of return to the Gulf was April. This study provides the first firm evidence that the majority of northern Gulf cod mixes with 3Ps cod in winter and that northern Gulf cod are present in 3Ps in April when the research vessel survey is carried out there, which may bias survey results. Current closures in winter in 3Ps to account for mixing appear quite adequate in protecting 3Pn4RS cod. This study was funded by DFO's Fisheries Science Collaboration Program.

Comments:

- The timing of movements would suggest that Gulf fish were in the area during April and in that year a fair portion of the fish had moved out of the Gulf. Some missing information is what proportion of the fish in that area are composed of Gulf fish because there's nothing to say how many fish in the 3Ps survey area are Gulf fish and how many are 3Ps fish. There is no estimate of the population size they have moved into. The contamination could be great or small in April.

- The Y/C's in Burgeo Bank are not the Y/C's in the Gulf but are more associated with 3Ps. This was the reason for combining the RV indices again in the 3Ps assessment. The survey data showed that the 1997 and 1998 Y/C's were strongly represented in the western part of the mixing area but they did not appear in the Gulf.

- The tagging involved 4 experiments- 2 in Codroy and 2 in Burnt Is. Were the differential effects looked at as with conventional tagging? For example, how many of the Codroy tags would have been found in 3Ps? - This aspect needs to be looked at further. Some fish with transmitters were detected on the line (3Ps/3Pn) throughout the year. Suggest that some maybe local fish. Some maybe from the nearshore area and local fish. Need to check to see if these were mainly fish that were tagged in 3Pn. Splitting out the experiments on their own might give more information.

- There is consensus that fish move from the Gulf to 3Ps. It was the reason for moving the survey to April and for fishery closures. The precise estimate of contamination is not clear. Because of the mixing issue it was questioned if the western part of the survey area could be done last during the surveys. However, this may not be practical. In most cases other factors such as vessel problems reduces control over logistics.

- The number of fish that were never heard from again was surprising. There are a number of explanations. If they were resident 3Pn fish they could be wandering around between the lines. Also the detection efficiency on the line was about 75%. So 25% could move through with out being detected.

## **16. Adapt Runs - 3Ps cod. B. Healey. Power Point Presentation.**

### Summary:

A series of ADAPT analyses were presented, using the formulations prescribed by the meeting during discussion following the index correlation presentation. The results and conclusions from the 2004 and 2005 assessments were reviewed. In this presentation, each of the ADAPT analyses discussed use a "flat" partial recruitment assumption. Parameters were estimated using the same index series as in the 2005 assessment: the AT Cameron RV series, the spring Campellen RV series, the GEAC series, and the sentinel linetrawl data. Subsequently, a series of analyses were conducted which included only one index at a time. The results indicated that the spring Campellen RV (only) analysis and the GEAC analysis produce estimates which are most different from the run with all data included. The residuals for all analyses are presented, and the issues raised in previous assessments regarding the ADAPT residuals persist in the current assessment. Further, the parameter estimates continue to have poor precision and large bias. Estimated 2006 biomass from the sentinel linetrawl single-index run is similar to the run using all the data series. When including only the GEAC index, current biomass is estimated to be much lower than that from the all-data run; and much higher than the all-data run if calibrating ADAPT with the spring RV index.

### Comments:

- The residuals look very similar whether used in a single index run or a combined run. The only thing different is that in plots of biomass, GEAC is farthest removed from the others. There is nothing unusual showing up in the residuals. There is lots of noise but not much pattern in the residuals.

- If we look at the results of all and individual runs for GEAC and RV it can be seen that combining changes the trend such that in one case it is going up and the other going down.

## **17. XSA Analysis. J.C. Mahe. Power Point Presentation.**

### Summary:

Several XSA analysis were conducted with different formulations and compared to a formulation similar to the one used in former years with the exception that the analysis was

done with data to the 1st of January 2006. This was done because the DFO research survey index has no data for 2006, due to the non completion of the survey for technical reasons.

Individual runs using only one index for tuning give very different perceptions of the stock status as shown in figure 1 for SSB trends and figure 2 for estimates of stock size at January 1st 2006. The diagnostics show that the estimates are noisy and no strong indication on the best formulation. All the indices seem to indicate different trends in subcomponent of the stocks.

Conclusion is that there is a high uncertainty on the current stock size and recent trend in the biomass and abundance estimates.

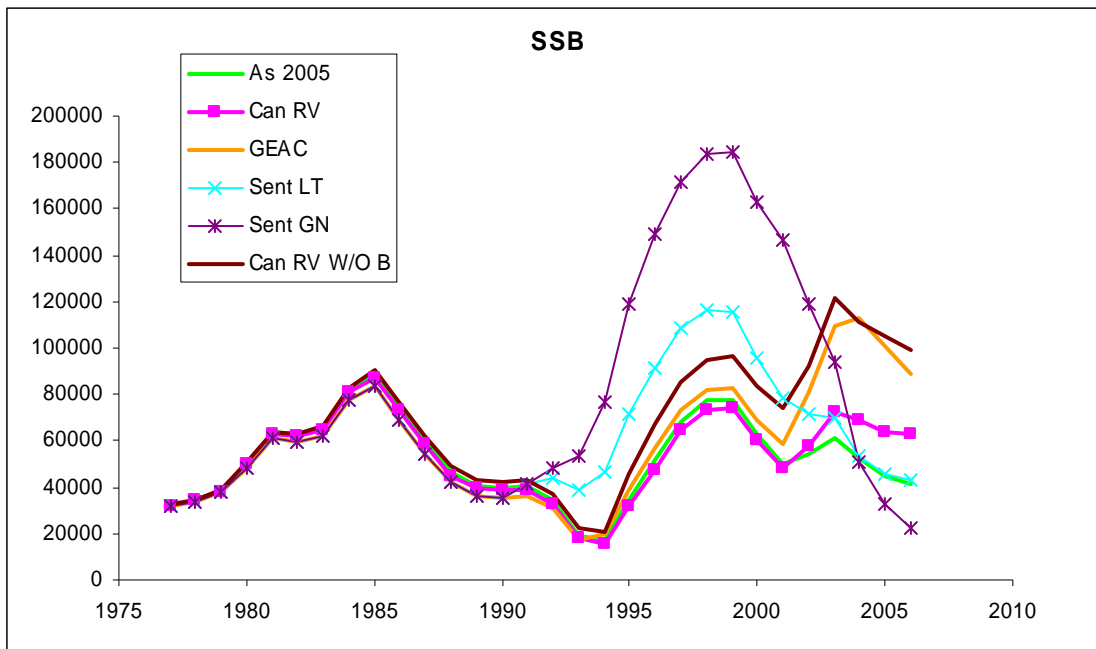


Figure 1 – Comparison of trends in 3Ps cod SSB given by different formulation of the XSA

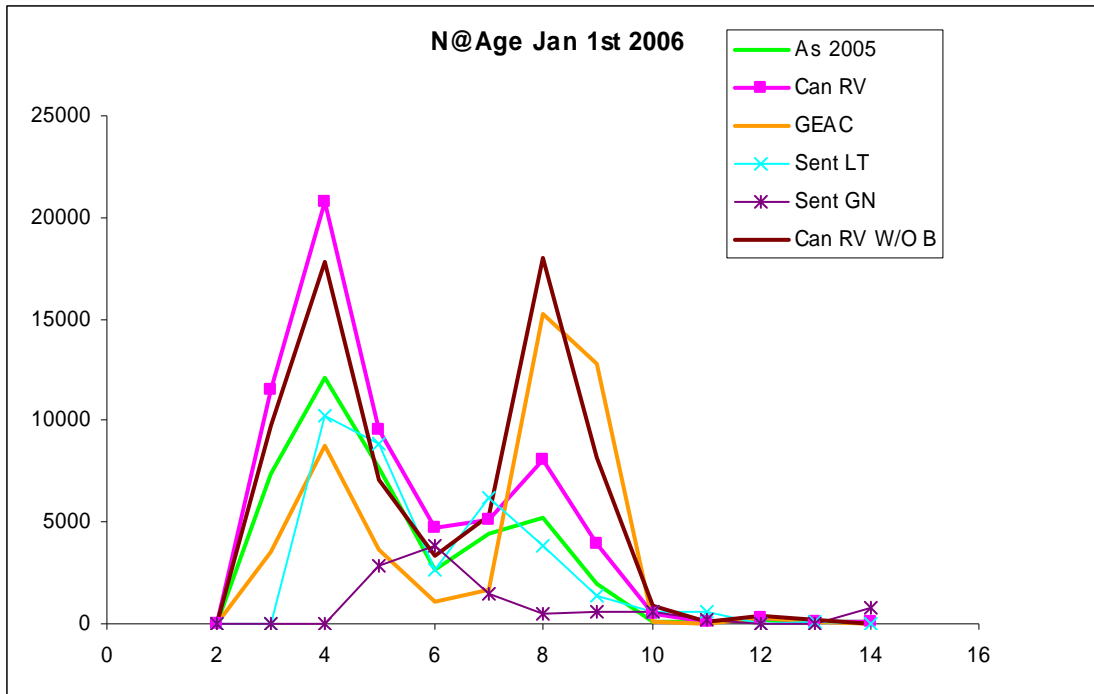


Figure 2 – Comparison of January 1<sup>st</sup> numbers at age of 3Ps cod given by different formulation of the XSA.

Comments:

XSA might work on some of the shorter time series and might let individual index runs move around more than in the constrained ADAPT.

The single runs with GEAC and RV without Burgeo give the highest SSB in recent years and highest in the time series, although the series are declining the recent data is noisy and so more weight is given to earlier estimates of those cohorts which were higher and therefore gives more numbers at age.

**General discussion of single index tuning of SPA**

Comments:

- These were done to determine if any indices should be removed from the VPA and to examine the causes of variability in the VPA

- The single index runs showed that the year over year differences between the GEAC and other indices are causing some problems that the model can't reconcile. They also highlighted the uncertainty in the estimates.



**18. Improved Estimation and Forecasts of Stock Maturities using Generalized Linear Mixed Effects Models. J. Dowden, N. Cadigan, J. Morgan and J. Bratney. Power Point Presentation.**

Abstract:

The mature component of a fish stock is usually referred to as the spawning stock biomass (SSB). It is the product of biomass-at-age and proportion mature-at-age (maturities), summed over all ages in the stock. Good estimates of maturities are required for good estimates of SSB; poor estimates can have deleterious impacts on estimation of potential yield, population growth and health of stocks. In annual sampling programs, age-classes of fish are sampled to count the number mature. A common model used to estimate maturities is logistic regression; however, there are problems with this approach. Data are updated annually for unfinished (eg. recent) cohorts and this can result in substantial changes from year to year in the estimated maturities. Often the annual trends in cohort maturities are fairly smooth. In this presentation, we explore the autocorrelation structure in cohort maturities using a generalized linear model with mixed effects to improve estimates and forecasts of maturities, particularly for unfinished cohorts. We examine two important commercial species in the Northwest Atlantic, Atlantic cod (*Gadus morhua*) and American plaice (*Hippoglossoide platessoides*).

Comments:

- There was no aging error assumed in the model but this could be examined in a simulation exercise.

- Year effects were apparent when the residuals were looked at. There was an occasional year when the maturities were all up or all down for all cohorts. The distribution of sampling should be looked at for each year. Sometimes samples come from specific areas within the survey area. The sampling can be separated into smaller units. When the proportion mature at age drops when going to the next age it is suggesting that there is sampling error. It was **recommended that** the overall sampling within a year be plotted to see if year effects were sampling related.

- In some years it may be due to sampling but year effects may reflect real changes in the population. The factors that affect maturation (F, M, growth temperature, food, and population density) are likely to be broad based phenomena. They change the maturation rate of the whole population and produce a real impact on the maturation rate of more than one cohort simultaneously.

- There have been two periods of fairly rapid change in maturities, namely for the late 80's cohorts and recent years (97, 98 cohorts). They are still there with the mixed effects model with the variability reduced. This may have resulted from variation in spatial distribution of sampling. These cohorts have caused big changes in VPA SSB.

- With regard to the retrospective diagnostics, would it make more sense to make that relative and scale it by the earliest one in your comparison? Is the retrospective worse for age 4 but it is not being measured with the statistic because you took the absolute difference and the proportion there is very small? The magnitude of the retrospective might be worse for the age 4's but the retrospective diagnostic is the absolute difference. At age 4 there is a

very small proportion mature so the absolute difference is going to be substantive even though it looks variable.

- In the Gulf, maturities declined quite a bit especially at the time of the collapse but have picked up again in the last 5-7 years.

- If there were different depletion rates for subcomponents of the stock it might explain discrepancies in maturity rates in the different areas.

### **General Discussion about the use of a SPA in this Assessment:**

Most of the discussion at the meeting revolved around whether or not SPA should form the basis of the advice. Several analyses were presented on this aspect.

Presentations 10, 11 and 12 examined whether or not year classes could be tracked in the indices. The results were equivocal. There is some evidence of yearclass effects in all indices and the catch data. However, some indices, such as the RV index are noisy. Consistency analyses based on age-to-age correlations and GLMs were not easy to interpret without further work. One could get poor age to age correlation due to year effects in the indices, but still get good tracking of yearclasses using GLM. Spurious yearclass effects could be generated in simulated data and detected in the GLM by varying  $M$  and  $F$ , even in the absence of a variation in initial yearclass strength.

Single index tuning with ADAPT (presentations 16 and 17) showed there was not much difference in fit with individual indices or with all. The GEAC was most different in its residuals and results. The flat topped run was highly constrained and might not have allowed the different runs to be much different. Single index XSA runs showed more difference than the single index ADAPT runs.

Overall uncertainty in the VPA was examined. The residuals were large but there was no pattern although there were year effects. The ability to do risk based assessments with such a variable VPA was questioned. It wasn't certain whether flat top or dome shaped PR was appropriate.

Many of these issues had existed in the VPA in the past and it had formed the basis of the advice, with uncertainty communicated in the form of risk analyses. Some in the meeting were of the opinion that not enough was different in the 2006 assessment from the past to warrant retrospectively rejecting the 2005 SPA. However, updating the assessment without the spring 2006 survey would mean a different formulation than had been used in the past, estimating to Jan. 1 rather than to April 1 and was not considered a feasible option. A proposal that the projection from the 2005 assessment should be updated with the new catch and weight data and used as the basis for advice for the 2006/2007 season was debated. Eventually this was rejected on the basis that the 2005 ADAPT was too uncertain to be used for updated projections. Uncertainty in the model was seen as the main argument against projections.

Another issue against the VPA is the persistent reports of the different dynamics of the stock offshore and inshore as reported by fishers and to some extent corroborated by tagging. The VPA is a whole stock model and we don't understand what happens when the whole stock

model is applied to structures which have components doing different things. Also the surveys do not cover the entire stock range.

A deciding factor was also the continued decline in GEAC compared with the inshore which was flat. Both the GEAC and RV had gone down in the last 5 years but the Sentinel was flat. The contrast between inshore and offshore implied that putting them together may not be appropriate.

Based on the uncertainty, and the poor model fit in terms of large residuals, it was felt that the assessment should not proceed with a VPA.

It was **proposed and accepted** that the meeting would not go forward with the SPA because of continued uncertainty in the indices and the loss of the RV survey in 2006. There was consensus opinion that there is a wealth of data for this stock that should be able to be used in an analytical assessment. It was **strongly recommended** that a framework meeting be held as soon as possible to examine the indices and possible different assessment models.

### **Cohort Strength Model**

One of the important determinants of whether a population can sustain a given F is recruitment. Many of the indices contain information on recruitment and it was therefore decided that a recruitment (cohort strength) model should be examined.

Younger ages are usually more amenable to cohort strength models as they have limited exposure to the fishery. This is important as one wants Fs to be consistent over time which is generally not true. Usually analysis is restricted to the younger ages.

There were concerns about the use of the converted portion of the RV time series as the conversions were more uncertain for younger ages however, the converted series allows the estimates of cohort strength to go further back in time which is important when the estimates are only relative.

Most of the sentinel indices do not adequately represent younger year classes. However, using only the offshore indices may miss a portion of the recruitment.

**- It was decided to use a relative cohort strength model using Canadian RV and GEAC for 1996 on, with ages 1-4 for recent years and converted RV ages 3-4 for the earlier years (1995 and earlier) with iterative weighting of variance.**

### **19. Year class Strength of 3Ps Cod from Index Data. B. Healey. Power Point Presentation.**

#### Summary:

Estimates of relative year-class strength are derived using a self-weighted multiplicative model. Several analyses were considered; the final analysis includes ages 3 and 4 from the GEAC index (1998-2005), ages 3 and 4 from the RV data from 1983-1995, and ages 1-4 from the RV data during 1996-2005. Considering only those year-classes with at least two available observations allows the estimation of the relative strength of the 1980-2003 year-

classes. Estimates of relative strength for these year-classes indicate that current recruitment is poor, and that the 1997 and 1998 cohorts were the strongest of the recent period. There are trends in the residuals from the GEAC data, but it receives the minority of the estimation weight.

#### Comments:

- The GEAC survey was more variable than the RV and would get less weight. The indices were saying slightly different things but it was considered best to include both in the analysis. There was no huge pattern in the residual plot and the model fit was considered to be acceptable.

- In general the results indicated: that Y/Cs from 1988-96 were relatively low; the 1997 and 1998 Y/Cs were quite high; the 1999 was not too bad; the 2000 was bad and the 2001-2003 were in the range of those in 1996-98. The strength of Y/Cs after the 1997-98 Y/Cs (2000-2003) were lower than those in 1997-98 and were of the magnitude of those around at the time of the moratorium in 1993. The catch level at current F may not be able to be sustained in coming years with the estimated recruitment levels if these are reflective of Y/C strength throughout the stock area.

#### **Additional fisher perspectives**

- In 2005 fixed gear had to be set in deeper water. In 2006 there were more fish on the Bank. Vessels had steamed through miles of fish on sounders in 2006 on the Bank which was different from 2005. There were more fish on the edge of the bank in 2005 at the same time of the year. Fishers had also reported that observations in 2006 showed the most fish that they had seen on the Bank.

- Fishers in Fortune Bay (Rencontre and Pools Cove) area are seeing increased abundance of cod through out Fortune Bay as well as the increased abundance of haddock.

- In Placentia Bay fishers are reporting similar observations. Small fish have been observed in the catch by baited hooks but are not big enough to be caught by 51/2 inch GN. It's hard to believe that there is no recruitment when lots of small fish are being observed in the fishery. Something seems to be seriously wrong between what Science and the fishery is seeing. Most fishers think that the TAC should be higher.

- Fishers also report a lot of fish on the Bank using sounders and they believe, based on experience, that they are small fish. They avoid setting nets in large concentrations and look for sounder marks which are smaller but which usually have larger and consequently higher value cod. Some of the information being provided on log books may not be reflective of the stock situation because it is influenced by efforts to comply with regulations. Fishers don't believe that the stock is in any worse shape than last year and should be able to sustain the quota.

- It is quite clear that fishers think that there are lots of fish in the population and for different reasons think that recruitment is not bad.

## **Appendix I: Terms of Reference**

### **Meeting of the Newfoundland and Labrador Regional Advisory Process (RAP) on 3Ps Cod**

**The Fluvarium,  
5 Nagle's Place, St. John's NL  
October 16-20, 2006**

#### **Chairperson**

Joanne Morgan, Research Scientist, Science Branch, Aquatic Resources Division, DFO, NL Region.

#### **Objectives for the 3Ps Cod Assessment**

- Assess the current status of the stock as a whole. In particular, assess current spawning biomass, total (age 3+) biomass, exploitation rate, natural mortality and biological characteristics (including age composition, size at age, age at maturity, and distribution). Describe these variables in relation to historic observations.
- Further to the previous assessment, analyze the year classes subsequent to the relatively strong year classes of 1997 & 1998 as it relates to the long term growth and sustainability of the stock.
- Assess the implications on the stock by fishing at the 2006 level (13,000 t), and fishing at the 2005 level (15,000 t).
- To the extent possible with available information, provide information on the strengths of year-classes expected to enter the exploitable populations in the next 1-3 years.
- Highlight major sources of uncertainty in the assessment, and where appropriate, consider alternative analytical formulations of the assessment.
- Report on results of tagging and the distribution of this stock in other areas (eg.3L/3Pn).

A science advisory report (SAR), proceedings report, and associated research documents will be produced as a result of this meeting.

#### **Role of Participants**

The Department is endeavouring to ensure all stock assessment meetings are open and transparent peer review process, and provide ample opportunity for knowledgeable individuals to contribute to the process. As such, attendees are expected to participate fully in the discussion and offer objective, informative, and constructive input that will aid in the process while respecting confidentiality requirements. It is not intended that participants come to RAP meetings merely to be informed about conclusions on stock status nor to 'lobby' regarding any issue.

## Appendix II: Meeting Agenda

<b>Monday AM</b>	Opening  Introductions/Work plan  Commercial Catch (Murphy) Catch at age Weight at age  Sentinel (Maddock Parsons/Healey) Overall results Standardized catch rate  Log books (Murphy/Healey/Bratney) <35 ft >35 ft
<b>PM</b>	CHP and fishery review (Tobin)  Questionnaire (Jarvis)  GEAC survey (McClintock)
<b>Tuesday AM</b>	Consistency analyses (Healey/Cadigan/Shelton)
<b>PM</b>	Tagging (Bratney)  Mixing Bycatch (Frechet)
<b>Wednesday AM</b>	Mixing Cont'd Counting Fence (Castonguay)  Maturity analyses (Dowden)
<b>PM</b>	SPA
<b>Thursday AM/PM</b>	SPA or SAR
<b>Friday AM/PM</b>	SPA or SAR

### Appendix III: List of Meeting Participants

<b>Name</b>	<b>Affiliation</b>	<b>E-mail</b>	<b>Phone</b>
Bishop, Claude	Consultant (Rapporteur)	<a href="mailto:Claude.bishop@nf.sympatico.ca">Claude.bishop@nf.sympatico.ca</a>	(709) 726-4205
Bowles, William	3Ps fish harvester	<a href="mailto:ewbowles@gmail.com">ewbowles@gmail.com</a>	(709) 886-2718
Bratley, John	DFO Science, NL Region	<a href="mailto:bratleyj@dfo-mpo.gc.ca">bratleyj@dfo-mpo.gc.ca</a>	(709) 772-2891
Brodie, Bill	DFO Science, NL Region	<a href="mailto:brodieb@dfo-mpo.gc.ca">brodieb@dfo-mpo.gc.ca</a>	(709) 772-3288
Cadigan, Noel	DFO Science, NL Region	<a href="mailto:cadigann@dfo-mpo.gc.ca">cadigann@dfo-mpo.gc.ca</a>	(709) 772-5028
Cahill, Paul	DFO FAM, NL Region	<a href="mailto:cahillp@dfo-mpo.gc.ca">cahillp@dfo-mpo.gc.ca</a>	(709) 772-3732
Castonguay, Martin	DFO Science, Quebec Region	<a href="mailto:castonguaym@dfo-mpo.gc.ca">castonguaym@dfo-mpo.gc.ca</a>	(418) 775-0634
Coffin, David	Dept. Fisheries & Aquaculture, NL	<a href="mailto:djcoffin@gov.nl.ca">djcoffin@gov.nl.ca</a>	(709) 729-1532
Dooley, Tom	Dept. Fisheries & Aquaculture, NL	<a href="mailto:tdooley@gov.nl.ca">tdooley@gov.nl.ca</a>	(709) 729-0335
Dowden, Jeff	DFO Science, NL Region (MUN)	<a href="mailto:dowdenj@dfo-mpo.gc.ca">dowdenj@dfo-mpo.gc.ca</a>	(709) 754-1008
Fréchet, Alain	DFO Science, Quebec Region	<a href="mailto:frecheta@dfo-mpo.gc.ca">frecheta@dfo-mpo.gc.ca</a>	(418) 775-0628
Healey, Brian	DFO Science, NL Region	<a href="mailto:healeyb@dfo-mpo.gc.ca">healeyb@dfo-mpo.gc.ca</a>	(709) 772-8674
Jarvis, Harvey	FFAW/CAW	<a href="mailto:hjarvis@ffaw.nfld.net">hjarvis@ffaw.nfld.net</a>	(709) 576-7276
Lilly, George	DFO Science, NL Region	<a href="mailto:lillyg@dfo-mpo.gc.ca">lillyg@dfo-mpo.gc.ca</a>	(709) 772-0568
Maddock Parsons, Dawn	DFO Science, NL Region	<a href="mailto:parsonsdad@dfo-mpo.gc.ca">parsonsdad@dfo-mpo.gc.ca</a>	(709) 772-7703
Mahe, Jean Claude	IFREMER Station de Lorient France	<a href="mailto:jcmahe@ifremer.fr">jcmahe@ifremer.fr</a>	+33297873818
McClintock, John	AMEC Earth & Environmental	<a href="mailto:John.mcclintock@amec.com">John.mcclintock@amec.com</a>	(709) 722-7023
Miller, David	DFO Science, NL Region	<a href="mailto:millerdcm@dfo-mpo.gc.ca">millerdcm@dfo-mpo.gc.ca</a>	(709) 772-0573
Morgan, Joanne	DFO Science, NL Region	<a href="mailto:morganj@dfo-mpo.gc.ca">morganj@dfo-mpo.gc.ca</a>	(709) 772-2261
Murphy, Eugene	DFO Science, NL Region	<a href="mailto:murphye@dfo-mpo.gc.ca">murphye@dfo-mpo.gc.ca</a>	(709) 772-5479
O'Connor, Michael	Icewater Harvesting	<a href="mailto:mcoconnor@eastlink.ca">mcoconnor@eastlink.ca</a>	(709) 482-7747
Power, Don	DFO Science, NL Region	<a href="mailto:powerd@dfo-mpo.gc.ca">powerd@dfo-mpo.gc.ca</a>	(709) 772-4935
Ryan, Lou	DFO FAM, NL Region	<a href="mailto:ryanl@dfo-mpo.gc.ca">ryanl@dfo-mpo.gc.ca</a>	(709) 832-3014
Ryan, Ralph	3Ps fish harvester		(709) 463-8765
Shelton, Peter	DFO Science, NL Region	<a href="mailto:sheltonp@dfo-mpo.gc.ca">sheltonp@dfo-mpo.gc.ca</a>	(709) 772-2341
Skinner, Mildred	3Ps fish harvester	<a href="mailto:mskinner@hotmail.ca">mskinner@hotmail.ca</a>	(709) 885-2567
Spingle, Jason	FFAW/CAW	<a href="mailto:jspingle@nfld.net">jspingle@nfld.net</a>	(709) 634-0277
Stead, Rick	DFO Science, NL Region	<a href="mailto:steadr@dfo-mpo.gc.ca">steadr@dfo-mpo.gc.ca</a>	(709) 772-0561
Strong, Patrick	3Ps fish harvester		(709) 873-2509
Tobin, Derek	DFO FAM, NL Region	<a href="mailto:tobind@dfo-mpo.gc.ca">tobind@dfo-mpo.gc.ca</a>	(709) 772-2914
Wells, Nadine	DFO Science, NL Region	<a href="mailto:wellsn@dfo-mpo.gc.ca">wellsn@dfo-mpo.gc.ca</a>	(709) 772-8892

#### Appendix IV: List of Working Papers & Presentations

**(Note: These are listed in order of presentation at the Meeting. All were power point presentations. Only those designated as Working Papers had provided documentation as well)**

1. Bratney, J., B.P. Healey, G. Lilly, E.F. Murphy, D. Parsons, J-C Mahe and N. Cadigan. Assessment of the cod (*Gadus morhua*) Stock in NAFO Subdivision 3Ps in October 2006.
2. Maddock Parsons, D. and R. Stead. Sentinel Surveys 1995-2006: Catch Per Unit Effort in NAFO Subdivision 3Ps. Working Paper.
3. Healey, B. Standardized Sentinel Catch Rates.
4. Healey, B. Science Logbooks, <35' Vessels.
5. Tobin, D. Conservation Harvesting Plan, Subdivision 3Ps.
6. Ryan, L. 3Ps Cod. 1993- 2005; Historical Perspective.
7. McClintock, John. Catch Results 2005: Year Nine of the NAFO Subdivision 3Ps Fall GEAC Surveys. Working Paper.
8. Murphy. E. Plots of Linetrawl catch (2005).
9. Jarvis, H., Lilly Rideout, Janette Penell, Diane Power, Angela Tucker, Patricia Pomroy, Janice Ryan, Keith Sullivan, Jamie Coady and Sherry Glynn. 2006 Fish Harvester Questionnaire (3Ps resident Cod License Holders). Working Paper.
10. Healey, B. Cohort Signals (or Not?) in the 3Ps Cod Data Series.
11. Shelton, Peter and David Miller. Information on Year Class Strength in the Templeman Index.
12. Morgan, Joanne. Effects of Introduced Year Effects.
13. Bratney, John and Brian Healey. Exploitation of Atlantic Cod (*Gadus Morhua*) in Subdivision 3Ps. Estimates from Mark-recapture. Experiments for the October Assessment.
14. Frechet, A. Cod By-catch in the Redfish Fishery in 3Ps - (2003-2005).
15. Castonguay, M., J.-L Beaulieu, J. Bratney, J. Spingle, A Frechet and S. Campana. Mixing of Northern Gulf cod into 3Ps: The Counting Fence project.
16. Healey, B. ADAPT Runs - 3Ps Cod.
17. Mahe, J.C. XSA Analysis.
18. Dowden, J., N. Cadigan, J. Morgan, and J. Bratney. Improved Estimation and Forecasts of Stock Maturities using Generalized Linear Mixed Effects Models.
19. Healey, B. Year-class Strength of 3Ps Cod from Index Data.