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Proceedings of the Marine Fisheries Subcommittee Regional Advisory Process Maritimes Region

23-27 March 1998

Miramichi Boardroom Gulf Fisheries Centre

G. Chouinard, Chairman

Department of Fisheries and Oceans
Science Branch, Maritimes Region
Gulf Fisheries Centre
P.O. Box 5030, Moncton
New Brunswick

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ABSTRACT

The Marine Fisheries Subcommittee of the Maritimes Regional Advisory Process (RAP) met in Moncton, N.B. during 23-27 March 1998 to review the status of 4T, 4VWX and 5Z herring, as well as SA 3-6 porbeagle shark. A number of management issues, decision rules in the 4Vn winter herring fishery, shift in groundfish fishing effort in 4X and the impact of the 4TVW haddock closed area were also examined. Stock Status Reports were produced for the fish stocks, except Georges Bank (5Z) herring, while Fisheries Status Reports were produced for the management issues.

RÉSUMÉ

Une réunion du Sous-comité des poissons de mer dans le cadre du processus consultatif régional (PCR) s'est tenue à Moncton, du 23 au 27 mars 1998 afin d'examiner l'état des stocks de hareng du 4T, 4VWX et 5Z ainsi que celui de la maraiche des sous-zones 3 à 6. Certaines questions de gestion telles les règles décisionnelles pour la pêche d'hiver au hareng dans le 4Vn, le déplacement de l'effort de pêche pour le poisson de fond dans le 4X, et l'impact de la zone interdite pour l'aiglefin du 4TVW ont aussi été à l'étude. Des rapports sur l'état des stocks ont été établis pour les stocks de poissons, sauf pour le hareng du Banc Georges (5Z). Des rapport sur l'état des pêches ont été préparés pour les questions de gestion.

INTRODUCTION

The chair, G. Chouinard, welcomed the participants (Appendix 1) and reviewed the Terms of Reference or Remit (Appendix 2) of the meeting. Stock assessments and Stock Status Reports were required for 4T and 4VWX herring, as well as SA 3-6 Porbeagle shark. Information for input into the US 5Z herring was also sought. Discussion on decision rules for the 4Vn herring winter fishery was required and a Fishery Stock Status Report was developed. An examination of the shift in groundfish fishing effort in NAFO Division 4X was conducted and a Fisheries Status Report was produced. As well, a review of the effects of the 4TVW haddock closed area was presented and a Fisheries Status Report produced for this issue as well.

The meeting schedule is given in Appendix 3, the list of documents tabled in Appendix 4 and Appendix 5 contains a review of the working paper on the 4TVW closed area submitted by A. Sinclair.

4T HERRING (ASSESSMENT)

Working Paper: Claytor, R. 1998. Assessment of the NAFO Division 4T Atlantic herring stock. RAP Working Paper 98/132.

Rapporteur: Mike Power

Remit:

- Conduct an assessment of spring and fall spawners, using previous methods: catch rate analysis and VPA. Prepare a Stock Status Report.

- Evaluation of decision rules concerning the area to be fished by Gulf based purse seiners in the 4Vn winter fishery. Prepare a Fisheries Status Report on the issue.

- Address methods for deriving local area assessments.

Fall Spawners

The Fishery

- Are changes in mesh size usually upward? Yes, usually due to regulations.

- What are the differences in age structure between zones? This is shown in the other Working Paper.

- Why are known areas of fish on the west side of Cape Breton in the fall not covered by the acoustic survey? This has been considered and is planned when survey time is available but it is considered more important to cover the same areas between years with the limited survey time available.

- How does the acoustic data collected by the seiners Ocean Leader and Gemini fit into the assessment? This will be shown in a separate Working Paper, but will show particular areas and times rather than an overall view.

- Is the tendency to underestimate age 4 related to changes (ie. increase) in mesh size? This is possible and there is a program of experimental gillnets that may help resolve this problem.

Resource Status

- How are the biological samples collected from the acoustic surveys and are there any problems with selectivity? Two vessels are used for the operations; the Creed does the acoustic survey and Calanus is called upon to do midwater trawl tows where areas of fish are encountered. It is believed that the midwater trawl catches younger ages (up to age 7) without bias but there appears to be an underestimate with older ages.

- Can the egg survey method used for mackerel be applied to herring? There are various reasons relating to the biology differences between herring and mackerel that make this method difficult. Herring eggs are demersal.

- What is the impact of the relationship between number of eggs and recruitment and whether the type of fishery (on spawning fish or not) makes a difference? This is not considered in the assessment but is accounted for in the individual fishery components.

- Due to the different management measures that have been imposed, should there not be research on the impact of one type of fishery over another? This is an important question but we have no data at present at this meeting. The use of target F is considered sufficient. However, science must provide to fisheries management the tools to manage with the different types of fisheries taking place.

- What is the real issue here? The mobile fleet feels it has been targeted with management decisions that have restrained them detrimentally.

- The question is ‘are differences in target F’s taken into account for on spawning fisheries and feeding fish for different fleets?’ There is no distinction made between different gear types in F’s within the current assessment but this could be a recommendation for the future.

- Are otoliths used to identify stocks, especially local stocks like those in 4Vn? No, this would be more important in mixing areas. Acoustic estimates of stock size is better done in areas of spawning concentration rather than in mixing areas.

- Older fish tend to be unavailable to midwater trawl gear and older fish tend to concentrate in hard bottom in 4Vn which is untrawlable.

- The Chair noted that we need to undertake an evaluation of the impact of spawning fisheries (for male and female) but now the group must concentrate on what has been presented related to the assessment.

- What is known about the decreasing weights at age trends? It decreased in the 1990s but now seems to have slowed or even increased from the previous year. The weights at age could be presented as a percent increase for a cohort in order to see the patterns in the matrix (for example take the 1987 year-class: in 1988 it grew by x % etc.)

- The CPUE is up but the catch is down compared to previous years, is this reasonable? Explained by the quota limitation and low price in previous years. F/effort plot supports the relationship.

- What is the distribution of spring and fall spawners in the bottom trawl survey (September). Only a few years have been analysed. This survey may or may not be indicating abundance of each component due to the high yearly variability and also the lack of inshore tows in shallow depths where there was an active fishery known to occur.

- Does the acoustic survey start in 4Vn with fish still spread throughout the Gulf and comparison of fish distributions found in bottom trawl and acoustic surveys? The migration has already started by mid Oct. and the survey starts in the north (near Gaspé coast) and works south to 4Vn, getting there by late Oct./early Nov. when much of the migration has taken place. Also by the time the acoustic survey gets to the PEI, Cape Breton area it is one month later. The overlap in time is only a few days but starts in the north.

- Noted that the acoustic sampling in 4Vn was limited and compromises survey in a critical area. Agrees with this but the sampling vessel had to leave at this time and thus were unable to get samples.

- This is a wide area to cover in a limited time with changing areas/strata covered. Are there key areas that need to be emphasized? The Tracadie (N.B.) strata has already been mentioned.

- Acoustic surveys in the northwest Atlantic have failed over the long term when using fixed strata. They have found you need to be more adaptive to try to survey areas where you expect to find fish.

- How do you determine the real biomass? It is hard to determine but there has been a real increase. The acoustic survey is not used as an absolute estimate but rather as an index of abundance.

- Presentation of stock assessment model used: a) CPUE only b) CPUE and acoustic combined. Analysis A is similar to last year but noted anomalous trends in age 4 & 6 residuals. Could rerun the analysis with age 4 removed.

- We should look at the next run and decide if any new analysis is needed. It could be noted in the SSR that this analysis may be optimistic for younger ages and the managers should be made aware of it.

- Indices are not calibrated and some residuals are all negative.

- If the 1990 data point is throwing the analysis off and messing up the overall view, then redo it with 1990 removed. Not uniform for all ages over years and the interaction of the calibration and convergence of the VPA back to 1990 should be considered. The analysis is requested and we should wait for results before going further at this point.

- Concerned about changes in area effecting validity of acoustic survey. Used essentially the same areas between years but in some years, areas (like 4Vn) were missed.

- Did you think about using abundance instead of abundance per unit area for the acoustic survey? It would obviously increase with area covered.

- Do not think it will affect stock status and suggest taking 1st run. Use combined analysis for future work and standardized area for acoustic survey should be used.

- There are a lot of fish now. This analysis corresponds very well to what is seen while fishing and there has been an increase overall this year.

- When asked to explain ‘concern’ see pg 99 age by age analysis. Age 4 plot shows the catch rates are higher than expected in early years and much higher in recent years. Recent trend of increasing mesh size may be a contributing factor but R. Claytor noted this is not the whole fishery. Concern is that the model may be overestimating age 4s which is used to project forward and could produce ‘paper fish’.

Outlook

- Suggestion to partition the Adapt run. Then left with initial analysis. Aim of assessment seems to be $F_{0.1}$ and wonders about precautionary approach especially for herring with their variable age structure from year to year. Need to document or examine it in SSR or Research Document.

- There are various regulations in the Gulf which are different from those used in the Scotia-Fundy area that protect spawning groups with time and area closures.

- It was described that the projection analysis for fall spawner data as well as the 'risk' plots and Chair then asked for comments on the method. $F_{0.1}$ is what has been used and this analysis shows there is a good chance the biomass will be lower than in previous years.

- Management measures in recent years and things like dockside monitoring have improved our picture each year and how are improvements taken into account? R. Claytor: accepts the data as it is and under-reported catches in the past have not been revised as there is no quantitative estimate of the under-reporting.

Spring Spawners

The Fishery

- Fishery information has already been presented and will now describe the catch rate data series. Another index was calculated this year due to lack of response to the phone survey. Fishery coordinator data for 1990-96 and DMP data for 1997 from a slightly different program. Catch rate model has area, time period and year. Retrospective effect is mainly in older ages which are not a major part of the fishery. Overall declining biomass trend with only an average year-class coming in. F's are close to $F_{0.1}$. Analysis also combined the catch rate index with acoustic survey for 1990-97.

- Question about roe on kelp: and lack of age 3's in catch. This is not used to calibrate and so not shown in the analysis here and will show the full range of ages the next time this is shown. It may be there are lots of 2's and 3's but they don't always show up in the catch.

- No mention of index fishermen. A program has started and is now ongoing.

- Is a tagging program useful for the spring fishery? There are fisher groups that would help. Good idea but can be expensive. Emphasis on determining spawning stock biomass.

Resource Status

- Abundance index: same info as collected for index gillnetters. Are there plans for maintaining the spring index in the future? There was an increase in 1997 TAC from 96-97, while you had predicted a decrease in previous assessment. Explained the uncertainty of predictions and use of most recent data for the current year as a last minute update.

- Are there different age groups in different areas? No.

- Should also look at interaction terms in catch rate standardization and the residuals as well. Would accept the spring index.

- F/effort plots to be consistent, should use 0 intercept model.

- Is catch rate data from Magdalen Islands used and are samples collected from there? No, need a good dockside monitoring program. A phone survey and samples are collected.

- Noted higher CVs and estimates not significantly different from zero. Further look with more data next year is recommended. Analysis may stand as is but same problem with age 4's and comment of changing mesh size effecting results. Not sure and will check but if appropriate for the fall spawners then should do it also for spring.

- Would a change in size at age also be reflected with a change in mesh size and would this help explain these years? Big drop in weights at age around 1990 etc. and can be looked at as a research recommendation.

Outlook

- Proceed or propose a different hypothesis? We know the fleet gear has changed and should be looked at but should leave the change in weights at age analysis for another time.

- It is 'riskier' or more uncertain than the fall risk plots. Don't know what management is going to do and we will have to look exactly what the risk represents. This is where the precautionary approach can have an effect. Final SSR report should and will show this difference in uncertainty. If you include the acoustic index in the analysis will it change the risk curve?

- Interested in looking at commonality between spring & fall recruitment year-classes and has a concern the 1991 year-class was very strong in spring yet very low in the previous fall.

4T HERRING (ACOUSTICS)

Working Papers: Clay, A., and R. Claytor. 1998. Hydroacoustic calibration techniques used for southern Gulf of St. Lawrence herring fishing vessels – 1997. RAP Working Paper 98/133.

Claytor, R., A. Clay, and C. LeBlanc. 1998. Area assessment methods for 4T fall spawning herring. RAP Working Paper 98/134.

Rapporteur: Gary Melvin

- Ross Claytor began the presentation with a summary of the fall fishery and the fishing surveys. Specific points discussed included; the sharing formula, common appearance of dominant year-classes, differences in abundance between areas and the correlation Escuminac/West PEI and Fisherman's Bank/ Pictou.

- Allan Clay then presented a summary of the calibration procedure and the TVG/Ball results from several vessels.

- Is target strength determined from the end of the transmit pulse for echo integration? Yes, but the ball echo is not integrated. For most systems filtering, peak occurs at the end of the pulse duration.

- Norm Cochrane expressed concern about the temperature dependence of calibrations. It is possible to get a 2 - 3 dB difference due to temperature induced conditions. This is likely a factor for both commercial and research vessels. Temperature effects on calibration need to be investigated. It is anticipated that the transmit is variable in one direction and the receive in the other, thus minimizing error.

- Sphere Calibration - is there any problem with the sphere? No, the ball is very accurate.

- What about acclimation time for the transducer. Hull mounted transducer does not require acclimation time as it is always in the water.

- Do you check the systems frequency. No, use the manufactures specifications.

- With respect to calibration to biomass estimate, the calibration creates a correction factor to estimate backscatter. However, the conversion from backscatter to biomass is the literature cited value for herring. This needs to be investigated further. Tennis balls target strength (TS) are typically not reproducible. The backscatter (Sa) value represents size distribution and weight is calculated from the length/weight relationship. The equation for TS = 20Log(len)2 - 71.9 Distribution is not a problem. Another problem identified was depth vs TS as swim bladder return is strongest. Possibility of large TS near surface and small on bottom due to pressure change. Ranking of error is for aspect ratio first and ripeness, second. Further work in this

area is required. Despite all variables there is a relatively good correlation with industry estimates. One source of error could be fouling of transducer for hull mounted systems. This has not been investigated.

- Ross Claytor then presented a review of the surveys and discussed the difference between using the mean or geostatistics to estimate distribution or polygon area. The biomass estimates using the mean was usually less than for geostatistics. Proposed use of biomass estimate and catch for determining F on fishing grounds and possibly adjusting F to area. Vessel comparisons in same range. For Fisherman's Bank no relationship was found for egg deposition and abundance.

- Do the fishermen's observations make sense re gillnet vs seiner? Cannot compare the gear types as they fish different groups of fish. Gillnets target spawners and seiners feeding aggregations. Best to use abundance and CPUE as an index. Question on how to extrapolate beyond data. Variogram can be used to fill in gaps. For the recent work 100m square boxes were used with the average if two or more samples from a single box occurred. Geostatistics can account for clumping in some cases. Further review of the technique is recommended. Is the mean appropriate for 100m square, there maybe some autocorrelation due to grouping.

4VWX HERRING

Working Papers: Stephenson, R., and M. Power 1998. An assessment of 4VWX Herring. RAP Working Paper 98/138.

Paul, S. 1998. Fleet activity in the 1997 4WX herring fishery. RAP Working Paper 98/139.

Melvin, G. 1998. Quantitative acoustic surveys of 4WX herring in 1997. RAP Working Paper 98/140.

Clark, K and R. Stephenson 1998. The status of the herring in the Bras D'Or Lakes. RAP Working Paper 98/141.

Rapporteur: Claude Leblanc

Remit:

- Review and evaluate biological and fishery information, and prepare a Stock Status Report for 4VWX herring, including:
    - an analytical assessment of the SW Nova Scotia spawning component

    - a review of the coastal Nova Scotia spawning component with emphasis on fisheries in the Bras d'Or Lakes and east of Halifax and including to the extent possible a description of local stocks in the area (distribution, stock identity, spawning locations/seasons and fisheries)
    - a review of the offshore Scotian Shelf spawning component; and SW New Brunswick migrant juveniles.
- Major issues include:
    - progress in acoustic surveys
    - progress in documenting offshore Scotian Shelf, and coastal spawning components
    - plans for new data gathering under the Pelagic Research Council projects.

- The main paper was presented by R. Stephenson with other sections by G. Melvin, K. Clark and S. Paul. Following the main presentation, the reviewer for this paper, G. Evans, presented his comments, followed by comments from other participants.

- Some comments were made on the format of the document: more basic information on the stock and the fishery (spawning of feeding aggregations; components; map of fleet activity) are required for the reader to understand; need to address more clearly the status of the stock, the reasons for that conclusion and the level of catches that it can support.

- Many questions are addressed qualitatively, should try to describe quantitatively wherever possible. This is particularly important when addressing the precautionary approach or when identifying targets (e.g. what is considered a broad age distribution, what is a long spawning season).

- The type of analysis conducted assumes random mixing. It is noted that if it is not the case, small separate components could be over-exploited.

- There needs to be a stock status description over the last several years for comparison in order to provide some perspective.

- It was noted that there had been some difficulty in getting thorough information from the fleet in 1997.

- The reasons for recommending an increase in TAC given the low amount of information need to be more detailed.

- Pelagic Research Council (PRC) paper appears to be mandate to increase TAC rather than to gather scientific information

Quantitative Acoustic Surveys in 4WX

- The methodology used to arrive at the estimates needs to be better described.

- There were some concerns that the surveys conducted on Oct. 3 and 9th could have counted the same fish twice. As well, on Oct. 9th two transects overlap. It was suggested that this could be examined by looking at the length frequency distribution by maturity stage to determine if same fish were present on Oct. 3 and 9th, or at the GSI indices.

- There was also some concern that the commercial fishery may impact on the surveys by dispersing the fish aggregations. This would have the effect of producing lower estimates. Different fish behaviour between feeding and spawning aggregations may affect the estimates.

- The surveys only covered a small part of German Bank. It was suggested that the survey could be done on the entire bank with a two-phase approach.

- There were concerns expressed that the methodology is somewhat different from year-to-year and whether the surveys produce reliable estimates of SSB that are comparable from year to year.

- Recommendation to look at the appropriate time laps between spawning wave succession on the spawning grounds now estimated at 6-10 days.

Southwest Nova/Bay of Fundy Spawning Component

- Sampling is currently adequate and has improved in recent years. Industry conducts some of the sampling in their own plants. Catch-at-age should be split by area and time periods.

- The SPA does not have age-structured abundance index. There were concerns about the differences in result when one year is added.

- It was noted that the results were presented in an aggregate form. There is a need to have various tables disaggregated by age (e.g. table of biomass-at-age plus total biomass).

- Natural mortality is set at 0.2, no work done in recent years to see whether M has changed.

- It was suggested that a table of weight-at-age in percentage increase by age would be a good method to show whether growth is improving. A recommendation was made that a comprehensive analysis of condition factor in the population be undertaken.

- It was noted that there is little correlation between the larval survey index to VPA biomass. It was suggested that the 1996 larval survey map be included for comparison to 1997. There were also concerns about the impact of the change to the *Alfred Needler* in 1995. The usefulness of the larval index is limited; it tends to increase the uncertainties.

- The SPA was considered not to be reliable. An estimate of the SSB of about 568,000t was arrived by combining individual estimates from the acoustic surveys. Given the uncertainties with the estimates, it was considered that the catch in 1998 should not exceed 1000, 000 t.

- A recommendation was made to investigate surplus production model as an alternative assessment method.

Offshore Scotian Shelf Spawning Component

- A presentation was made by Christian Reiss (Dalhousie University) It was noted that there has been a range extension of larvae in recent years.

- Groundfish survey in July indicating general increase in the 90's, but in recent years seeing a decline. This decline tends to correspond with the re-opening of the fishery.

- It was noted that the age structure is not very broad but 1997 fishery more widespread.

- Several uncertainties were noted: how many components are there, are they mixing, what is the population structure, what are the migrating routes (it was suggested that tagging be conducted); rules need to be established for adjusting TAC up or down.

- In order that the risk of over-exploitation be minimized, it was noted that it may be better to recommend fish be taken only on large aggregations and in small amounts.

- No context of historical references, i.e. catches. It was noted that there was little information to arrive at a TAC.

- It was suggested that age composition and length frequencies from the bottom-trawl survey could be useful in understanding the dynamics.

Coastal Nova Scotia Spawning Component

- The fishery is of local interest to local communities. Spawning has been documented in recent years. There are large un-recorded catches which hamper the development of an historical perspective. It was noted that the coastal stocks have more older fish in the age distributions. Establish distribution of lobster fishers using herring as bait.

- One way of examining where the catches may originate is to look at the distribrution of bait licenses. SW Nova would be main area of fishing for bait.

- Spawning variable along the coast, no evidence of spawning in northern 4Vn.

- Some form of dockside monitoring should be instigated on the coastal components.

- Recommendation was made to estimate the bait fishery removals.

Herring in the Bras D'Or Lakes

- The fishery in 1997 was similar to 1996. The fishery in the Barra Strait is usually good, however there were very low catches in 1997. There appears to have been some effort shift. Fishers are heavily targeting last few spawning areas. Effort appears to have increased.

- Larval survey results (not in the working paper) indicate that there were very few larvae found. It is important to compare with previous years but it appears that there has been a large decline.

- It was noted that stringent measures were being discussed for the Bras D'Or Lakes including the closure of six spawning areas, logbooks and a limit of 3 nets per fisher for bait.

- Need to establish migration patterns of Bras d'Or lake herring.

- Based on status of stock, a complete closure would be cautious.

5Z HERRING

Working Papers: Melvin, G. 1998. Georges Bank Herring. RAP Working Paper 98/142.

Rapporteur: Ghislain Chouinard

Remit:

– Review any new information pertaining to the status of Georges Bank (5Z) herring, and discuss proposed input to the upcoming US Gulf of Maine assessment.

- The document was presented by Gary Melvin. There were large landings over 300,000 t in 1968 –69 then the stock collapsed and catches remained low until 1995. Catches have started to increase since. It was first noted that there might now be a great deal of interest in the fishery and that the U.S. were to conduct a stock review in 2 months.

- There are several sources of information (Canadian and US surveys) and they are suggesting an increase in the population abundance in recent years.

- It was noted that despite several years with little fishery and that fish have been seen since 1983, the age distribution of the population has not recovered. It would be informative to examine what kind of age distribution that would be expected. There are differences in size distribution between the Canadian and US surveys that should be investigated.

- There appear to be three spawning concentrations in the area. The issue of the relationship between the various concentrations should be examined. A comparison of the growth characteristic with herring south of Cape Cod might be helpful in determining the link between these components.

- It was concluded that the herring population from Georges Bank is in recovery. It was noted that given the previous collapse, exploitation should be cautious and the risk to the resource should be investigated.

SA 3- 6 PORBEAGLE SHARK

Working Paper: O'Boyle, R.N., G.M. Fowler, P.C.F. Hurley, and M.A. Showell. 1998. Update on the status of NAFO SA 3-6 porbeagle shark (Lamna nasus). RAP Working Paper 98/54.

Rapporteur: Claude Leblanc

Remit:

– Review catch, effort and size information from the 1997 and historical fishery to provide guidance for the establishment of 1998 harvest levels. Prepare a Stock Status Report.

- Tagging studies suggest no migration from east to west Atlantic.

- Age interpretation is not clear cut and no validation of data on aging available.

- Reported catches from the Norwegian fleet appear to be legitimate.

- 1997 catches exceeded TAC by 26%, not sure if steps have been taken to remedy this problem in 1998.

- Logbook data were not directly compared to observer data, observer data spotty.

- Recommended to look at changes in size composition over the years. Regenerate the ZIFF data file using lat and long positions and provide for date of catch for larger vessels that could be used in catch rate data set.

- 200 cm maturity of females, a lot of catches less than 200 cm, less so in 1997 compared to 1995.

- Catch rates analysis show that interaction between vessels was not a problem when change occurred between Faroes and Canadian vessels.

- Recommendation to redo catch rate analysis using raw data rather than mean catch by set.

DECISION RULES FOR THE 4Vn OVERWINTERING HERRING FISHERY

Working Paper: Claytor, R., and C. LeBlanc. 1998. Decision rules for 4Vn overwintering herring fishery. RAP Working Paper 98/135.

Rapporteur: Kirstin Clark

Summary

- Chair introduced the paper emphasizing that the focus of the paper is on the scientific information on which the rules are based. Two objectives for this meeting: 1) To provide additional information on areas of concentration so as to develop rules on where to fish, and 2) To determine how "where to fish" might affect the amount to fish.

- Discussed the problems with mixed fisheries. Presented the principles which were in last year's SSR.

- **The issue of where to fish/where local stocks are:** Discussed the issue of where 4T migrating fish are during the fishery. Survey results (from research vessel acoustic surveys, bottom trawl surveys, purse seiner surveys), the distribution of the fishery, tagging information from the 1970s and 1980s and the distribution of lobster licenses were presented.

- **What amount of fish should be caught:** fishing levels since 1983 have not been detrimental to northern local spawning components. The effect that a difference in the size of local and migrating populations would have was presented as a series of simulations.

- **Conclusions:** Local spawners and Bras d'Or herring are present in the south below the Cape Dauphin Line, but 4T fish still dominate the catch in this area. In the north, the ratio of 4T fish to local fish is very high.

The Data

- There was almost a break in the percent composition of fall spawners in the early 1990s. Was this when the methodology for determining spring vs. fall spawners changed? There was no change in methodology. The change was that there was not much sampling information for some years, so information was extracted from the acoustics.

- Which survey series most clearly reflects the fishery? The acoustic survey.

- Elaborate on the importance of the lobster license information. Concern was expressed by bait fishers that herring were less abundant and the amount of herring taken for bait seemed high - needed to document what was happening. If you want to look at the effects on local fisheries, you need to know what those fisheries are.

- What would be the biomass from surveys? About 120,000t.What would be the population size of local stocks? This is not well known. There is some information from the September survey in 4Vn (1995-1996) and fall, roe fishery off Glace Bay. There is a substantial fall spawning stock south of the Cape Dauphin Line. There is a small stock in the area north of Neils Harbour.

- Is it a problem with method that you can't assess local populations? When doing a survey, you survey all the fish in the area, but short of finding fish in spawning condition, you can't determine local populations. Would be more comfortable with a survey in September than October to find local populations. Do you need a separate September survey for this area? It might be a good idea, then there would be a more precise idea of the exploitation rate.

- Is there a need to survey 4Vn in October? Could commercial vessels collect more information? Would keep the research vessel acoustic survey from the Gulf the same.

- If a research vessel was not available, could fishing vessels be used to do a survey specifically in 4Vn? Yes.

- Have you detailed samples from the test fishing associated with the acoustic survey? Yes. Very few fish in the samples were in spawning condition (see Figure 5). Based on sampling done last year, there is local spawning around Neils Harbour.

- Would they have distinct characteristics to distinguish local stocks from 4T. Do not know.

- Are there any fives and sixes in the winter catch? Usually none.

- A stage six in that catch is not the hypothesized stock and would definitely be a flag, even within season.

- A large part of the stock are migrating at the beginning of the fishing season (Nov 1). Is there any value in concentrating an acoustic survey in mid-November or later to have more precise information on the importance of the 4T stock? Can take a night of fishing from acoustics on a fishing vessel and analyse it.

- Lobster bait isn't involved in the landings so if it was included, it might double 3500t landings. Is there any trend over time? There is no evidence of a trend.

- In Table 7, the biomass from the acoustic survey should match the sum of the numbers in Figure 5, but they are enticingly different - why? The difference should be investigated. It could be due to rounding.

- When doing surveys, there is lots of mobility in other species. How certain are you that this biomass is herring. Fairly certain because it matches the purse seine catches. Cod would be later. The one confounding species might be mackerel, but we do have samples to confirm that it is herring. We don't have samples from some years, but in those years we use the purse seine catches.

- Does the acoustic gear pick up mackerel? Yes. The influence of mackerel might be there, but be minimal.

- Conduct a retrospective on the maturity data from the bottom trawl and acoustic surveys.

- Was there any adjustment for effort in the tagging information in Table 9? No. The only point is that there are Bras d'Or Lake herring in the area.

- Given the fishery in the Bras d'Or Lakes, is this a high tag return? Can't say. Didn't pursue it much further.

- What percentage of tags would you expect back? 1 to 3%. Herring tag returns are usually low, but I have little experience with this.

- Is the Cape Dauphin Line the one presently used for management purposes? The Line dividing areas 17 and 18 was moved to Cape Dauphin to protect the mouth of the Bras d'Or Lakes. As of last year, the line was drawn at Cape Smokey.

The Analysis

- The catch of spring spawners was high in 1996 and also in 1992. Given that, is the Cape Smokey line in an appropriate position? You would want to stay away from areas where there is mixing that is not random and the area south of the Cape Smokey line would be such an area.

- The coefficient of variation for exploitation rates in the graphs of local stocks in Figure 23 (graphs 1.1 and 1.2) has not changed, despite the larger population to sample from. The catch remains the same. The same catch is being taken regardless of population size.

- If you are assuming 40t per school there is no variability in that. The variability is in the number of local vs migratory fish.

- What do the biomass estimates from acoustics reflect? The biomass that we measured. This is in the area of mixing.

- Do the biomass estimates from acoustics show trends in abundance? The acoustic surveys in the 1980s were done later. So the series is not a standard series and doesn't reflect a trend in abundance because of a difference in timing.

- In the 4T assessment document the age 4+ biomass is 250,000t. When I asked what percentage could migrate, you said that they all could but we know that some migrate along the edge of the channel in 4T between the Magdalen Islands and Cape Breton so they can't all migrate. Is it reasonable to say at least half would migrate into 4Vn during the time of the fishery? The migration along the channel takes place in January, not November/December but yes, about half would be a conservative estimate.

- If you accept the analysis, looking at catch rates, the simulation which is appropriate to focus on is the one that uses 120,000t as the 4T proportion of the 4Vn population. I hesitate to say yes, because migration would be well underway by November 1st, but it is ongoing; the fish arrive before that date and throughout the month. The 120,000t would be appropriate to focus on since it is the most accurate depiction of what is occurring there at that moment.

- Not many fish are caught south of Smokey in 1996/97 so this is no big deal with industry. Up to 1990, most fish were caught south of Ingonish Bay and Smokey and then this changed. Now it is OK to fish up north because most of the fish are there, but if it changes, what is available to industry if the fish are somewhere else? The rules are set before the fishery starts and that is how it proceeds that year. The rules

are evaluated each year. If you are talking about in-season changes then that is a whole other topic - what criteria would you use? How would you apply them? This needs further consideration.

- More research is needed in this area. If all the fish moved out of Aspy Bay, we should survey and see where they are.

- What evidence is there for half of the 4T biomass being in 4Vn in November? This is inferred from where the fishery takes place. In the juvenile survey in December we don't get an appreciable number of adults. There are aggregations in 4Vn in the north but we don't know how big. Fish are leaving the Gulf but we don't know where they are. The acoustic surveys show less than we are assuming migrate in the next two weeks, and the bottom trawls show a concentration elsewhere. Is it logical for 150,000t to go in over a two week period and then go offshore? Is there evidence of schools in 4Vn of 150,000t size in winter? There is no direct evidence. By November 1st., the migration is well underway but fish continue to come in throughout the month. They may move off into deep water.

- The concentration of sets from this fishery is very tight. 150,000t should occupy a substantial area. You should document this with the fleet in the area. The data needs to be analysed. The figures on page 32 are the extremes. The first simulation is the ideal situation since 20,000t would be a small proportion of the 4T stock. Any decision needs to bear in mind not only the worst, but also the best that could happen.

- The area surveyed on German Bank was small but it had 200,000t of fish in it.

- Is there evidence of a relation between school size and stock size? Don't know.

- The size of the local northern 4Vn stock is less than the Bras d'Or Lakes which at its highest is about 500t. Why is the model leading with the unlikely number of 2500t? It is being general.

- The catches in the Lakes may be 500t but the stock is much larger. We can look at what the worst, best and most likely scenarios are.

- We expect the 4T stock to move into Aspy Bay, move south and then offshore. Would we expect the local fish to follow the same pattern? It might happen.

- Would it affect your calculations? Do not think so, 4T fish just stay in Aspy Bay.

- All manner of mixing is possible but Ross Claytor has presented a reasonable hypothesis about 40t per school. Perhaps the scenario should be extended up and to the left to see what would happen with small amounts of migrating fish, like in the first week of November, for defining a worst case scenario. It might not be a long lasting scenario. But in a short lived fishery it could be relevant.

- Are there no local fish in the catches from Aspy Bay? Fish from Neils Harbour could move into Aspy Bay. The worst case scenario would seem unlikely. If there are no local stocks to protect in Aspy Bay, what would be the impact of catching more than 4200t in Aspy Bay? The problem is bracketed by two extremes. In the figure on page 32, in the best scenario, there is no impact. In the worst case, there is none. What other fisheries there are on this stock elsewhere are not taken into account by the model.

- Do you think that fish from Chedabucto Bay are coming north into 4Vn? Also, in the Bay of Fundy, the fishery is closed down if it is thought that it is having an effect on local stock.

- Was it concluded that it was likely that the Chedabucto Bay fish were there? The Chedabucto Bay fish are most likely offshore in 4W. The age composition of Chedabucto Bay is different from Aspy Bay, as is the age composition from 4T.

- 4Vn and Chedabucto Bay fish are bought by our plant. 4Vn fish are bigger than Chedabucto Bay and equal to Chaleur Bay. We don't usually buy from Chedabucto Bay because the fish are too small.

- Fish from the northern portion of 4Vn are very like 4T fish and not like 4WX - for example, you don't get any spring spawners in Chedabucto Bay. The analysis of the length frequencies of 4WX vs 4T fish was done in 1993, and they were very different.

Conclusions

- There is a lot of speculation on the movement of fish. The tagging at St. Anns Bay shows movement. The Smokey line is a means of protecting spring spawning stocks. Putting the line at Smokey is what was recommended.

- Are you comfortable about the placement of the line for protecting the Bras d'Or Lakes stock? The only places where catches have occurred with a higher percentage of spring spawners is further south. Average catches taken north of Smokey would have a minimal impact on local stocks.

- If the Bras d'Or stock is so low that we are recommending closure, any exploitation at any level on that stock would be unacceptable. If the fishery is in the St. Anns Bay/Bird Island area then it would be more likely to affect Bras d'Or Lakes fish than further north.

- The further north you go, the lower the risk of taking spring spawners and Bras d'Or Lakes spawners. The risk gets very small, but it is never eliminated. The fishery in the northern part with the decision rules should be quite acceptable.

- It is a biological fact that it is still possible that spring spawners from the Bras d'Or are being taken in fisheries in 4Vn. This approach would minimise but not eliminate the effect.

SHIFTS IN FISHING EFFORT, COMMERCIAL LANDINGS AND RESOURCE DISTRIBUTION FOR COD, HADDOCK, POLLOCK AND WHITE HAKE IN NAFO DIV. 4X

Working Paper: Clark, D., et al. 1998. Shifts in fishing effort, commercial landings and resource distribution for cod, haddock, pollock and white hake in NAFO Division 4X. RAP Working Paper 98/137.

Rapporteur: Tom Hurlbut

Remit:

– Document any changes in the distribution of landings and effort directed towards haddock, cod, pollock and white hake in NAFO Division 4X. Determine whether such changes reflect changes in resource distribution, and if so, what (if any) management measures should be considered to ensure adequate resource conservation. Prepare a Fisheries Status Report.

Introduction

- The reviewer questioned the extent to which the perceived shifts constitute an issue of importance.

- A participant asked when the perceived shifts began, to which J. Nielson responded 1989. This prompted the same individual to question the current importance of this issue.

- The reviewer recommended that the manuscript and presentation would have benefited from a comprehensive description of the management regime (past and present) in NAFO 4X.

- The reviewer reported difficulty in judging the relative importance/weight of the anecdotal evidence (from industry) for and against the perceived shifts.

Landings

- The reviewer recommended that the analyses of landings and effort would have been improved by further disaggregation of the data (i.e., using positional data where available).

- It was noted that there are some problems with the catch/effort data used in the analyses (i.e., white hake entered as “shack”, etc.).

- It was asked whether the landings reported in Fig. 4 include those reported in Fig. 2. D. Clark indicated that the Fig. 4 landings do not include those from Fig. 2.

Fishing Effort

- The recommendation for a historical description of management measures (including effort restrictions) in NAFO 4X was reiterated.

- Several questions were raised regarding the interpretation of fishing effort in absolute and proportional terms. It was suggested that the observed shift may not be as striking in absolute terms. D. Clark indicated that total effort has declined for all gears in NAFO 4X since 1991 and noted that the greatest changes in the distribution of fishing effort involved declines in the amount of gillnet and otter trawl effort in eastern areas of the management unit.

- A participant asked about the magnitude of the changes in fishing effort (See Fig. 4). It was noted that there has been an overall decline in fishing effort throughout NAFO 4X, and that the distribution of effort has shifted from approximately 50:50 to about 2/3:1/3 (west:east).

- It was recommended that the analyses be extended to include vessels of all tonnage classes to provide more information on the impact of the Temporary Vessel Replacement Program (TVRP).

- Skepticism was expressed as to whether there has actually been a shift in fishing effort, directed at white hake, into the Bay of Fundy. It was suggested that the perceived shift may really reflect a general increase in white hake directed effort throughout NAFO 4X.

- An industry representative concurred that there has been a westward shift in the distribution of fishing effort in NAFO 4X and suggested that the shift in cod directed effort occurred because of changes in quota allocations. Several of the industry representatives agreed that the shifts in effort to the Bay of Fundy are largely due to the availability of a good mix of species in this area.

- It was suggested that the species mix in an area needs to be considered when quotas are being set. The same individual also recommended a systematic documentation of

fishermen's views and opinions concerning changes in the distribution of fish, effort and landings.

- The reviewer suggested that the observed shifts may be due entirely to changes in management measures. This suggestion was countered by a fishery manager who contended that the only management measures that may have contributed to the observed shifts were reduced TACs and the extension of the closure of Brown's Bank in winter. An industry representative disagreed, and recommended a month-by-month examination of the areas of NAFO 4X that were closed to fishing groundfish (he contended that some of the best pollock fishing areas have been closed). Other management measures were cited that may have contributed to the shifts in effort (i.e. changes in sharing arrangements, small fish closures, TVRP, etc.).

- An industry representative disagreed with the suggestion that small fish closures on Baccaro and Roseway banks contributed to the shifts in effort. He also noted that this year, for the first time in many years, there is much more effort being directed at haddock in the eastern part of NAFO 4X, because of the availability of haddock and changes in management measures.

- It was noted that the changes in the distribution of fishing effort that have occurred, have not resulted in the concentration of effort in one area.

- It was suggested that technical gear interactions have resulted in a significant displacement of fishing effort in NAFO 4X (specifically the expansion of lobster and crab fishing grounds - See CSAS Res. Doc. by Doug Pezzack).

Groundfish Survey Data

- The reviewer recommended that the analyses of survey data should have focused on the fishable portions of the resources (i.e., commercial age/size groups).

- Noting that the survey information is not used as an index of abundance for white hake or pollock, the utility of the same information to measure shifts in resource distribution was questioned. Given the "spikey" nature of the survey data for some of the species (i.e., white hake and pollock) how do you separate the signal from the noise?

- It was recommended that the ITQ survey dataset should be examined for additional information relevant to this issue (it was noted that the ITQ survey does not cover inshore areas and is only 3 years old).

- It was asked if analyses of the survey data could be restricted to areas of commercial fishing activity to determine whether there has been a shift of resources to these areas. J. Neilson and D. Clark responded that there are problems with the survey data that constrain the utility of the survey data to address this issue (i.e. the survey doesn't cover some areas of the distribution of some of the stocks (inshore areas)).

- There was considerable discussion as to whether the survey data indicates shifts in resource distribution in NAFO 4X. There was consensus that there is no survey evidence supporting shifts in the distribution of cod and pollock, and it was felt that the evidence for shifts in the distribution of haddock and white hake, into the Bay of Fundy, was weak at best (there may be other explanations for the apparent shift in these two species). D. Clark recommended that the survey data does not indicate that a shift in resource distribution has not occurred. He stressed that industry has repeatedly described shifts in the distribution of cod and pollock into the Bay of Fundy (these views were not expressed by the industry members present). It was suggested that the observed changes in the distribution of haddock may be indicative of a resurgence of the population, commencing in the Bay of Fundy (similar to the resurgence that occurred in the late 1970s).

- It was recommended that foraging theory be applied to describe changes in the distribution of resources in NAFO 4X? (See paper by Darren Gillis).

- An industry representative suggested that seals may be responsible for some of the shifts in the distribution of groundfish in eastern 4X. Noting that the Bay of Fundy is an extremely productive and dynamic system, another representative speculated that shifts in the distribution of resources to this area may have occurred because of greater food availability.

Conclusions

- It was noted that bottom temperatures have recently been colder in the eastern portion of NAFO 4X and that this may have contributed to some of the observed shifts (i.e., occurrence of smaller fish in some areas). It was recommended that bottom temperatures be included in future analyses of the distribution of resources in NAFO 4X.

- Regarding the problem of selective fishing on discrete spawning areas/concentrations, it was recommended that fishing be prohibited during spawning seasons.

- It was recommended that stock assessments take into consideration, as much as possible, shifts in effort, landings and the distribution of groundfish resources.

- There seemed to be agreement with the author's conclusion that it would not be appropriate to consider management measures to spread fishing effort throughout NAFO 4X, because of the likelihood that this would result in depletions of local spawning concentrations.

4TVW HADDOCK CLOSED AREAS

Working Paper: Frank, K., and J. Simon. 1998. An Evaluation of the Emerald/Western Bank Juvenile Haddock Closed Area. RAP Working Paper 98/136.

Rapporteur: Ghislain Chouinard

Remit:

- Conduct a review of the Western Bank juvenile haddock closed area 10 years after its establishment. In particular, examine the impacts of the closure on the 4TVW haddock stock and examine whether positive or negative effects can be detected for other species. Prepare a Fisheries Status Report on the issue.

- The presentation was made by Ken Frank. This was followed by a review of the comments on the Working paper made by A. Sinclair (see Appendix 5).

- There was some discussion of the terms of reference for this item. It was noted that the area was closed in 1987, a preliminary evaluation had been done by K. Zwanenburg.

- Most assessments of closed areas (or marine reserves) are modelled rather than evaluated as is the case with the present work. The Emerald/Western Bank closed area for juvenile haddock is for most, but not all, gears. In particular, fixed gear were allowed and scallop fishing has been prosecuted in the area but was reduced after 1995.

- Comparisons of juvenile mortality were made between the closed area and adjacent areas. Results indicated no discernible difference. Some discussion took place on the amount of contrast needed for differences to be detected. It was concluded that based on the available statistical information, the expected effect should have been detected.

- The year-classes that were present when the closure was imposed appear to have a higher survivorship than adjacent areas.

- It was noted that a sentinel fishery is on-going in the area and there were questions regarding the co-occurrence of pollock and haddock in the area. As well, there may be some relationship between 4X and 4W haddock which could tend to mask any impact that the closure may have.

- A member of industry indicated that fixed gear may catch juvenile haddock from time to time.

- It was noted that further analysis which would take into account all sources of potential mortality including the effect of seal predation may be desirable in the future.

- The apparent benefits for American plaice were noted. A participant asked whether there had been benefits for halibut. It was remarked that halibut seem to be more abundant in fishery catches. The species is infrequently caught in surveys.

Appendix 1: List of Participants

NAME	Address	Tel.	FAX	e-mail
Alan Sinclair	DFO, Moncton	(506) 851-2721	(506) 851-2620	Sinclaira@mar.dfo-mpo.gc.ca
Alfred Babineau	UPM, Loc. 2, Président Pêcheur Cap Lumière	(418) 523-7498	(418) 523-7498	
Allen Clay	Femta Electronics, Halifax	(902) 865-8565	(902) 865-8558	aclay@fox.nstn.ca
Bob Crawford	NS Fisheries and Aquaculture	(902) 863-2521	(902) 424-4671	rhcraw@atcon.com
Brian Giroux	33 Chestnut St. Yarmouth, N.S.	(902) 747-6732	(902) 747-6732	sfmobile@fox.nstn.ca
Camilien Haché	Shippagan, N.B.	((506) 336-8473		
Christian Reiss	Dalhousie University	(902) 494-2830		
Christin Lanteigne	DFA - N-B. Caraquet	(506) 726-2400		
Clarence Bourque	DFO, Moncton	(506) 851-6232	(506) 851-2620	Bourquec@mar.dfo-mpo.gc.ca
Claude d'Entremont	MiddleWest Pubnico, Yarmouth County, N. S.	(902) 762-2522	(902) 762-3464	Inshore@atcon.com
Claude LeBlanc	DFO, Moncton	(506) 861-3870	(506) 851-2620	Leblancc@mar.dfo-mpo.gc.ca
D. Coon	CCNB	(506) 766-7083	(506) 766-2971	
David Bollivar	Seafreeze Foods Inc.	(902) 469-5004	(902)461-9689	
Delma Doucette	Herring Co-op	(506) 461-3353		
Dick Stewart	Atlantic Herring Co-op	(902) 742-9101	(902) 742-1287	
Don Aldous	Pelagics Research Council	(902) 757-3915	(902) 757-3979	daldous@fox.nstn.ca
Don Cunningham	West Nova Fisherman's Coalition	(902) 742-8691	(902) 742-3574	johncore@fox.nstn.ca
Donald Clark	Biological Station, St. Andrews, N.B.	(506) 529-5908	(506) 539-5862	clarkd@mar.dfo-mop.gc.ca
Donna Larkin	Southwest Seiners, Pubnico, N.S.	(902) 762-2672	(902) 762-3427	
Donny Hart	5 Merry Road, Sambro, N.S.	(902) 868-2140	(902) 868-2596	

NAME	Address	Tel.	FAX	e-mail
	B3V 1E9			
Edmund Drysdal	U.P.M. Shediac	(506) 532-9162		
Elmer Wade	DFO, Moncton	(506) 851-6210	(506) 851-6210	wadee@mar.dfo-mpo.gc.ca
Fernand Friolet	Caraquet, N.B.	(506) 727-7336	(506) 727-1118	
Gary Melvin	SABS/DFO/MFD	(506) 529-8884	(506) 529-8862	melving@mar.dfo-mpo.gc.ca
Geoff Evans	DFO, St. John's, Nfld.	(709) 772-2090	(709) 772-3207	evans@mrspock.nwafc-nf.ca
Ghislain Chouinard	MPO, Moncton	(506) 851-6220	(506) 851-2620	Chouinardg@mar.dfo-mpo.gc.ca
Greg Egilson	Gulf NS. Herring Federation	(902) 485-4415	(902) 495-1729	egilsson@north.nsis.com
Greg Glennie	Connors Bros. Limited	(902) 456-3391	(902) 456-1568	
Havien Surette	South West Seiners	(902) 762-3272	(902) 762-3427	
J.F. Martel	Regroupement Gaspé Sud	(418) 385-2073	(418) 385-3782	
Jay Lugar				
Jean Saint Cyr	278 Avenue des Pêcheurs, Shippagan, N.B., E0B 2P0	(506) 336-1414	(506) 336-1415	frapp@nbnet.nb.ca
Jerry Coreham	Southwest Seiners	(902) 762-2672		
Jim Fennell	Box 1085, Sydney, N.S.	(902) 564-7878	(506) 564-7398	
Jim Simon	MFD/BIO, Dartmouth	(902) 426-4890	(902) 426-2506	simonj@mar. dfo-mpo.gc.ca
John Neilson	MFD, St. Andrews	(506) 529-5913	(506) 529-5862	neilsonj@ mar.dfo-mpo.gc.ca
Joy Fry	Herring Co-op	(902) 742-9101	(902) 742-1287	
Ken Frank	MFD/BIO, Dartmouth	(902) 426-4890	(902) 426-1506	Frankk@mar.dfo-mpo.gc.ca
Ken Rodman	DFO, P.O. Box 530, Halifax, N.S.	(902) 426-6074	(902) 426-1484	rodmank@mar.dfo-mpo.gc.ca
	B3J LS7			
Kirsten Clark	MFD, St. Andrews	(506) 529-8854	(506) 529-5862	Clarkk@mar.dfo-mpo.gc.ca
Klaus Sonnenberg		(506) 662-8481	(506) 662-8336	

NAME	Address	Tel.	FAX	e-mail
Laurent Paulin	MPO, Moncton	(506) 851-7792	(506) 851-2607	Laurentp@mar.dfo-mpo.gc.ca
Léonard Arseneault	Blue Cove Group	(506) 782-2200	(506) 732-1020	
Maria Recchia	DFA, St. George, N.B.	(506) 755-4285	(506) 755-4001	mariar@gov.nb.ca
Mario Cormier	UPM	(506) 532-4783	(506) 532-2487	
Mark Fowler	MFD/BIO	(902) 426-3529	(902) 426-1506	Fowlerm@mar.dfo-mpo.gc.ca
Maxime Cormier	Blue Cove Group	(506) 732-2200	(506) 732-2020	
Michael O'Connor	National Sea Products	(902) 634-8811	(902) 634-4926	oconnor@natsea.co
Michael Power	DFO, St. Andrews	(506) 529-3065	(506) 529-5862	Powerm@mar.dfo-mpo.gc.ca
Mike Pittman				
Moril Gallant	Leslie Leger & Sons Ltd.	(506) 577-4730	(506) 577-4960	
Norman Cochrane	OSD/DFO BIO	(902) 426-5172	(902) 426-2256	cochranen@mar-dfo-mpo.gc.ca
Olin Gregan	Seafreeze Foods	(506) 627-6016	(506) 773-4750	
Paul Emile Michon	187, rue Blanchard, Caraquet, N.B. E1W 1A5	(506) 727-2341		
Peter Dyzart	N.B. Fish Packers Association	(506) 857-3056	(506) 857-3059	
Peter Hurley	MFD/BIO	(902) 426-3520	(902) 426-1506	hurleyp@mar.dfo-mpo.gc.ca
Réginald Comeau	UPM	(506) 395-6306	(506) 395-1898	
Rob Stephenson	DFO, Biological Stn, St. Andrews, N.B.	(506) 529-8854	(506) 529-5862	Stephensonr@mar.dfo-mpo.gc.ca
Robert Haché	A.S.G. Inc. Site, 28, Boîte 19, Allardville, N.B. E0B 1A0	(506) 725-2282		robhach@nb.synpatico.ca
Robert O'Boyle	RAP, BIO, Dartmouth, N.S.	(902) 426-3526	(902) 426-1506	oboyler@mar.dfo-mpo.gc.ca
Rodney Ingalls	Grand Manan, N.B.	(506) 662-3720	(506) 662-8523	
Roger Cormier	Cap Pelé	(506) 577-4133		

NAME	Address	Tel.	FAX	e-mail
Roger Stirling	P.O. Box 350, Dartmouth, N.S. B2Y 3Z6	(902) 463-7790	(902) 469-8294	spans@fox.nstn.ca
Ron Cronk	North Head, Grand Manan, N.B. B0G 2M0	(506) 662-7026	(506) 662-7030	
Ross Claytor	DFO, Moncton	(506) 851-6249	(506) 851-2620	claytorr@mar.dfo-mpo.gc.ca
Roy Calder	Campbellton, N.B.	(506) 752-2058		
Sherman d'Eon	ISPANS	(902) 768-2550	(902) 768-2418	
Stacey Paul	Pelagics Research Council St. Andrews	(506) 529-5973	(506) 529-5862	pauls@mar.dfo-mpo.gc.ca
Steve Campana	MFD/BIO, Dartmouth	(902) 426-4890	(902) 426-1506	Campanas@mar.dfo-mpo.gc.ca
Tim Kaiser	Scotia Garden Seafood Inc.	(902) 742-2411	(902) 742-1595	scotia@fox.nstn.ca
Tom Hurlbut	DFO, Moncton	(506) 851-6216	(506) 851-2620	hurlbutt@mar.dfo-mpo.gc.ca
Tony Hooper	Connors	(902) 456-3391		
Warren Joyce				

Appendix 2: Remit

4T Herring (Assessment)

- Conduct an assessment of spring and fall spawners, using previous methods: catch rate analysis and VPA. Prepare a Stock Status Report.

- Evaluation of decision rules concerning the area to be fished by Gulf based purse seiners in the 4Vn winter fishery. Prepare a Fisheries Status Report on the issue.

- Address methods for deriving local area assessments.

4VWX Herring

- Review and evaluate biological and fishery information, and prepare a Stock Status Report for 4VWX herring, including:
  - an analytical assessment of the SW Nova Scotia spawning component
  - a review of the coastal Nova Scotia spawning component with emphasis on fisheries in the Bras d'Or Lakes and east of Halifax and including to the extent possible a description of local stocks in the area (distribution, stock identity, spawning locations/seasons and fisheries)
  - a review of the offshore Scotian Shelf spawning component; and SW New Brunswick migrant juveniles.

- Major issues include:
  -progress in acoustic surveys
  -progress in documenting offshore Scotian Shelf, and coastal spawning components
  -plans for new data gathering under the Pelagic Research Council projects.

5Z Herring

- Review any new information pertaining to the status of Georges Bank (5Z) herring, and discuss proposed input to the upcoming US Gulf of Maine assessment.

SA 3-6 Porbeagle Shark

- Review catch, effort and size information from the 1997 and historical fishery to provide guidance for the establishment of 1998 harvest levels. Prepare a Stock Status Report.

Shift in Effort for 4X Groundfish

- Document any changes in the distribution of landings and effort directed towards haddock, cod, pollock and white hake in NAFO Division 4X. Determine whether such changes reflect changes in resource distribution, and if so, what (if any)

management measures should be considered to ensure adequate resource conservation. Prepare a Fisheries Status Report.

4TVW Haddock Closed Area

- Conduct a review of the Western Bank juvenile haddock closed area 10 years after its establishment. In particular, examine the impacts of the closure on the 4TVW haddock stock and examine whether positive or negative effects can be detected for other species. Prepare a Fisheries Status Report on the issue.

Appendix 3. Schedule

Time	Monday 23-Mar	Tuesday 24-Mar	Wednesday 25-Mar	Thursday 26-Mar	Friday 27-Mar
8:30		4VWX herring	Decision rules for winter – 4Vn	4X groundfish effort	Reruns and SSR's
9:00	Travel	4VWX herring	Decision rules for winter – 4Vn	4X groundfish effort	Reruns and SSR's
9:30		4VWX herring	Decision rules for winter – 4Vn	4X groundfish effort	Reruns and SSR's
10:00	Intro	4VWX herring	Decision rules for winter – 4Vn	4TVW Haddock Closed area	Reruns and SSR's
10:30	4T herring	4VWX herring	Reruns and SSR's	4TVW Haddock Closed area	Reruns and SSR's
11:00	4T herring	4VWX herring	Reruns and SSR's	4TVW Haddock Closed area	Reruns and SSR's
11:30	4T herring	4VWX herring	Reruns and SSR's	4TVW Haddock Closed area	Reruns and SSR's
12:00	Lunch	Lunch	Lunch	Lunch	Lunch
12:30	Lunch	Lunch	Lunch	Lunch	Lunch
13:00	4T herring	4VWX herring	Porbeagle	4TVW Haddock Closed area	Reruns and SSR's
13:30	4T herring	4VWX herring	Porbeagle	4TVW Haddock Closed area	Reruns and SSR's
14:00	4T herring	4VWX herring	Porbeagle	Reruns and SSR's	Reruns and SSR's
14:30	4T herring	4VWX herring	Porbeagle	Reruns and SSR's	Reruns and SSR's
15:00	4T herring	4VWX herring	Porbeagle	Reruns and SSR's	Reruns and SSR's
15:30	4T herring	4VWX herring	Reruns and SSR's	Reruns and SSR's	Reruns and SSR's
16:00	4T herring	5Z Herring	Reruns and SSR's	Reruns and SSR's	
16:30	4T herring	5Z Herring	Reruns and SSR's	Reruns and SSR's	Travel
17:00	4T herring	5Z Herring	Reruns and SSR's	Reruns and SSR's	

Apendix 4. List of Documents

Clark, D., et al. 1998. Shifts in fishing effort, commercial landings and resource distribution for cod, haddock, pollock and white hake in NAFO Division 4X. RAP Working Paper 98/137.

Clark, K and R. Stephenson 1998. The status of the herring in the Bras D'Or Lakes. RAP Working Paper 98/141.

Clay, A., and R. Claytor. 1998. Hydroacoustic calibration techniques used for southern Gulf of St. Lawrence herring fishing vessels – 1997. RAP Working Paper 98/133.

Claytor, R. 1998. Assessment of the NAFO Division 4T Atlantic herring stock. RAP Working Paper 98/132.

Claytor, R., and C. LeBlanc. 1998. Decision rules for 4Vn overwintering herring fishery. RAP Working Paper 98/135.

Claytor, R., A. Clay, and C. LeBlanc. 1998. Area assessment methods for 4T fall spawning herring. RAP Working Paper 98/134.

Frank, K.T., and J.E. Simon. 1998. An Evaluation of the Emerald/Western Bank Juvenile Haddock Closed Area. RAP Working Paper 98/136.

Melvin, G. 1998. Quantitative acoustic surveys of 4WX herring in 1997. RAP Working Paper 98/140.

Melvin, G. 1998. Georges Bank herring. RAP Working paper 98/142.

O'Boyle, R.N., G.M. Fowler, P.C.F. Hurley, and M.A. Showell. 1998. Update on the status of NAFO SA 3-6 porbeagle shark (Lamna nasus). RAP Working Paper 98/54.

Paul, S. 1998. Fleet activity in the 1997 4WX herring fishery. RAP Working Paper 98/139.

Stephenson, R., and M. Power. 1998. An Assessment of 4VWX Herring. RAP Working Paper 98/138.

Appendix 5. Review of Working Paper of Frank and Simon. 1999. An Evaluation of the Emerald/Western Bank Juvenile Haddock Closed Area by A. Sinclair

This analysis was conducted to examine the impacts of a 10 year closure of a haddock nursery area within the boundaries of the eastern Scotian Shelf haddock stock on the dynamics of that stock and those of other fish stocks in the area. The initial intent of the closure was to protect incoming recruits from fishing to allow the stock to rebuild. The approach taken for haddock was to examine trends in abundance and mortality of different age classes both within the closed area and in adjacent areas. For other species, trends in abundance in the closed area and adjacent areas were compared.

The paper is clearly written and referenced. The main conclusions are that there has been no discernible effect of the closure on juvenile haddock survivorship as a result of the closure. If anything, there has been an increase in adult survivorship. However, it is not clear whether this is a result of the closure or a general reduction of the haddock fishery in the entire management unit. It is not clear whether or not there have been effects on other species. It is important to ask, in such cases where an effect is not evident, what level of effect can be detected with the available data. The juvenile mortality estimates are highly variable and it may take a large effect to be detected. The authors should use, where possible, statistical tests and discuss statistical power. It would have been helpful to have an abstract which summarizes the main conclusions. Such a section should be included in the fishery status report.

It would be useful to have a paragraph describing haddock stock structure on the Scotian Shelf including a justification for the choice of study areas. The closed area is in the western portion of NAFO Div. 4W. Trends in abundance and mortality within the closed area were compared with those from 2 adjacent areas, one in the eastern portion of 4W, the other in the eastern portion of 4X. The latter area is within a different management unit and an explanation of what might be learned by comparison with trends in 4VW is needed. There is no description of any previous work on migration of haddock within the 4VW management unit or between adjacent units. This would be useful for interpreting the trends mentioned above.

Some discussion of the validity of the original closed area designation is warranted. Figure 10 indicates that the centroids of distribution of juvenile haddock (ages 1-3) were at the eastern boundary of the closed area or in the adjacent eastern area. Maps in the original study (Fanning et al. 1987) indicate large catches of juvenile haddock in the eastern part of 4W. There has been little change in that distribution after the closure was implemented. An important question is whether the closed area actually included all of the nursery area. Secondly, given that a portion of the nursery area appears to be outside the closed area, how would this diminish the expected impact of the closure?

It would have been interesting to have a quantitative comparison of the level of fishing activity inside the closed area before the closure and compare these with what was reported after the closure by all gears. This could be trends in both catch and effort. This should not be restricted to just haddock fishing but to other species as well. An important

question not addressed here is what happened to the fishing effort displaced from the closed area, did it end up elsewhere? If so, what was the impact on those fisheries and stocks.

Overall, I am a little surprised that the intended decrease in morality of juvenile haddock did not seem to occur. The closure was implemented at the request of the industry indicating that there must have been a problem of capture and discarding of small fish. Yet, there is no indication that uvenile haddock mortality was in fact high when the closure was implemented, or that it declined as a result of the closure. Alternatively, the mortality rate between the recruiting ages (4-6) and adult ages (7-9) appeared to decline substantially prior to the closure. There has been a slight increase since then. It is doubtful that this trend can be attributed to the closed area, what are other possible explanations of these trends.

As an aside, it is interesting to note the similarity in year-class abundance within and outside the closed area. The table below provides correlations and significance levels for age 1-3 estimates of year-class abundance obtained from multiplicative analyses. All correlations were significant at $p<0.01$, the highest correlation was between the closed area and the eastern 4W reference area.

Table 1. Results of correlation analysis of relative year-class strengths estimates at ages 1-3 for the three study ages, the closed area (closed) the eastern portion of 4W (wea), and the eastern part of 4X (xea).

Variable	By Variable	Correlation	Count	Signif Prob
13 wea	13 closed	0.7901	30	0.0000
13 xea	13 closed	0.6470	30	0.0001
13 xea	13 wea	0.5348	30	0.0023