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Proceedings of the Maritimes Region Science Advisory Process on the Assessment Framework for 3NOPs4VWX+5Zc Atlantic Halibut

30 – 31 October 2007[1]
8 – 9 January 2008[1]
16 – 17 June 2009[2]

[1]Bedford Institute of Oceanography
[2]Dartmouth Sportsplex

Dartmouth, Nova Scotia

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October 2009

Compte rendu des réunions du Processus consultatif scientifique de la Région des Maritimes au sujet du cadre d'évaluation du flétan de l'Atlantique de 3NOPs4VWX+5Zc

Les 30 et 31 octobre 2007[1]
Les 8 et 9 janvier 2008[1]
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[1]Institut océanographique de Bedford
[2]Dartmouth Sportsplex

Dartmouth (Nouvelle-Écosse)

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Octobre 2009

Canada

Foreword

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

Avant-propos

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

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SUMMARY

The Maritimes Region Science Advisory Process (SAP) review of the assessment framework for 3NOPs4VWX+5Zc Atlantic halibut was undertaken in three meetings: review of management unit, fishery data inputs and indices of abundance: Part I (30–31 October 2007), review of management unit, fishery data inputs and indices of abundance: Part II (8–9 January 2008), and review of model(s) to assess stock status and productivity (16–17 June 2009). Participation in these meetings included Fisheries and Oceans Canada (DFO) and non-DFO scientists, members of the halibut industry, DFO managers, provincial representatives, aboriginal communities and non-governmental organizations (NGOs). The results of these meetings will be used to conduct future assessments of the status of 3NOPs4VWX+5Zc Atlantic halibut.

SOMMAIRE

Dans le cadre du Processus de consultation scientifique (PCS) de la Région des Maritimes, un examen du cadre d'évaluation du flétan de l'Atlantique de 3NOPs4VWX+5Zc a été effectué lors de trois réunions ayant porté sur les aspects suivants : examen de l'unité de gestion, présentation des données sur la pêche et indices d'abondance – Partie I (30 et 31 octobre 2007); examen de l'unité de gestion, présentation des données sur la pêche et indices d'abondance – Partie II (8 et 9 janvier 2008) et examen du ou des modèles d'évaluation de l'état et de la productivité du stock (16 et 17 juin 2009). Participaient à ces réunions des scientifiques de Pêches et Océans Canada (le MPO) et de l'industrie du flétan, des gestionnaires du MPO, ainsi que des représentants des provinces, des communautés autochtones et d'organisations non gouvernementales (ONG). Les résultats de ces réunions seront utilisés dans les futures évaluations de l'état du stock de flétan de l'Atlantique de 3NOPs4VWX+5Zc.

INTRODUCTION

Prior to the late 1990s, Fisheries and Oceans Canada (DFO) science assessment of the status of the 3NOPs4VWX+5Zc Atlantic halibut stock was hampered by the lack of a reliable survey time series of relative abundance. In 1998, a new survey was initiated with the cooperation of the halibut industry in an effort to develop a way of producing estimates of absolute abundance and fishing mortality and to aid in the determination of Total Allowable Catch (TAC). At the fall 2003 review of this survey (DFO 2003), it was concluded that while the new survey had the capacity to monitor the relative abundance of the halibut population, there was still a need for an assessment framework to guide resource management decisions. It was recognized at this time that additional elements would be helpful, such as the initiation of a tagging study and the development of an assessment model. Research recommendations were developed at a workshop in August 2004 (DFO 2004), and science activities to contribute towards the development of an assessment framework have been underway since this time.

An assessment framework for Atlantic halibut (Terms of Reference provided in Appendix 1), which represents the culmination of work to date, is now being developed and reviewed through series of science advisory meetings:

- Review of Management Unit, Fishery Data Inputs and Indices of Abundance: Part I (30–31 October 2007)

- Review of Management Unit, Fishery Data Inputs and Indices of Abundance: Part II (8–9 January 2008)

- Review of Model(s) to Assess Stock Status and Productivity (16-17 June 2009)

It is expected that this framework will be used in future stock assessments until such time as a new assessment framework is developed.

These proceedings attempt to summarize the discussion of the framework meetings, and each section is to be adopted by correspondence after each meeting.

REVIEW OF MANAGEMENT UNIT, FISHERY DATA INPUTS, AND INDICES OF ABUNDANCE: PART I (30–31 October 2007)

After welcoming participants (Appendix 2) and doing a round of introductions, the chair (T. Worcester) provided a brief introduction to the meeting. She noted that this was a science advisory meeting, which means that it would be focussed on the development of science advice rather than on the management implications of that advice. While everyone was invited to participate fully in the discussion and contribute knowledge to the process, the intent was to deliver a scientifically defensible product. The external peer reviewers were introduced, including Åge Høines, from the Institute of Marine Research in Norway, Kohl Kanwit, from the Maine Department of Marine Resources, Bruce Leaman, from the International Pacific Halibut Commission (IPHC), and Daniel Ruzzante, from Dalhousie University. It was noted that this meeting was part of a series of meetings to develop an assessment framework for Atlantic halibut, an evaluation of the state of the resource this year would not be reviewed (as in an traditional Assessment meeting). Rather, it would be a discussion on how DFO Science would be evaluating the state of the resource in subsequent years. Finally, it was noted that halibut is currently being assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and information developed through this meeting would likely contribute towards their review.

The Terms of Reference for the meeting were reviewed (Appendix 1), including the objectives of this meeting, which were to:

1. Review information (e.g., tagging, distribution, morphometrics, meristics, growth) on the biological basis of the management unit in support of subsequent decisions on the management unit definition by Fisheries and Aquaculture Management (FAM) and industry, including interrelations of halibut with populations to the north and south of the management unit.

2. Review fishery data inputs, including sampling (commercial and survey catch, distribution, size and age composition), biology (growth, age, life history, sex, fecundity, natural mortality, spawning location and timing, recruitment) and ecosystem information (bycatch, trophic information, temperature).

3. Review indices of abundance, including fixed station and commercial index and all relevant research vessel surveys (southern Gulf northern, Gulf, Newfoundland, and US).

The Agenda (Appendix 3) was reviewed, and nothing further was added.

Biological Basis for the Management Unit

Presentation:	Tagging Studies
Working Paper:	C.J. Schwartz. 2007. Estimating Survival and Exploitation Rates from a Tagging Study on Juvenile Atlantic Halibut in 3NOPs4VWX Conducted Between 1995 and 2007. CSA Working Paper 2007/26B.
Presenters:	K. Trzcinski and S. Armsworthy
Rapporteur:	H. Stone

Presentation Highlights

K. Trzcinski presented results from the working paper by Carl Schwartz, which uses Atlantic halibut tag and release data to estimate population parameters.

A more recent mark recapture project using all sizes of halibut (legal and sublegal) was described by S. Armsworthy. This study was designed to obtain estimates of population size, exploitation and movement and used the fixed station halibut survey as a tagging platform from May through July. All fish were double-tagged and most recaptures to date have occurred during months of peak fishing, with some returns indicating an eastward movement pattern. The Peterson exploitation rate estimated from this tagging data was 15.7% yielding a fishing mortality (F) of 0.17.

Although there has been a long history of fishing halibut on the Scotian Shelf and Grand Banks, it is still not known exactly when spawning occurs. There is clearly a need for more research on when and where they spawn. If this was known, then it may be possible to design a tagging study on spawning fish which would give a better picture of movement and stock structure. The BIO halibut assessment team is not yet ready to target survey effort outside of the current fishing season (May-July) to overlap with the perceived time of spawning.

Discussion

It was noted that there were many problems with the halibut tagging data and several observations had missing information (i.e., of 8700 records available, only 1700 were usable). Also, many of the assumptions for the tag recovery models were difficult to satisfy (i.e., 100% tag retention, 100% tag reporting, no permanent emigration).

Halibut tagged in this study may have different catchabilities related to size (i.e., legal versus sub legal) which could affect estimates of F, survival and recovery rates. For example, it is difficult to calculate F on sublegal animals even though they are still being caught and released. While the vast majority of tag recoveries occur in the directed halibut fishery, some have also occurred in the halibut longline survey. It was suggested that differences in tag returns between these two sources could be used to help determine reporting rates.

The estimate of natural mortality (M) from this study is very low compared to other species and stocks; however, it was pointed out that this estimate was just a lower bound for M. Results from halibut holding studies (i.e., Neilson et al. 1989) based on bottom trawl survey and longline capture methods may provide further information on survival after capture.

It was suggested that data storage tags could be used to collect data on halibut movements and water temperature to determine which water masses they are associated with. Such information may be useful in describing movement patterns in and out of the tagging area.

Information from the earlier tagging program clearly had limitations since it was not designed to estimate exploitation rates, but rather distribution and movement. However, it was still considered worthy of detailed examination to determine if any useful information could be obtained.

It was suggested that halibut tagged in the Gulf of St. Lawrence may be recaptured on the Scotian Shelf and visa versa. The BIO halibut assessment team is not currently working with Quebec Region Science but will contact Dianne Archambault to obtain the Gulf of St. Lawrence tagging data in time for the next framework meeting. If Scotian Shelf halibut are exploited outside of the 3NOPs4VWX+5Zc management unit, then this may influence our interpretation of F. Further questions about mixing with the Gulf stock prompted a call by S. Campana to the DFO lab in Mt. Joli for clarification on their halibut tag recaptures. Up to 2005, there were no Gulf-tagged fish reported from the Scotian Shelf, which supports the notion of separate stock in

the Gulf and on the Scotian Shelf. However, it appears that there may be a small amount of mixing/immigration along the western boundary of the management unit with halibut from US waters in the Gulf of Maine moving westward onto the Scotian Shelf. Preliminary results indicate that up to 20% of US tagged fish move into Canadian waters; however, no reciprocal movement patterns of Canadian tagged fish to the Gulf of Maine are apparent. It is possible that there may also be a small amount of movement outside the 3NOPs4VWX+5Zc management unit to the Northwest Atlantic Fisheries Organization (NAFO) divisions 3LMN on the eastern boundary, but the amount is unclear.

It was concluded that there is no strong indication that the current 3NOPs4VWX+5Zc management unit should be changed even though there appears to be movements of fish from west to east through the management unit along with a progressive increase in size composition in the same direction (i.e., from west to east). A population model that accounts for immigration and emigration through the management area may be appropriate to capture the dynamics of this stock.

Review of Fishery Data Inputs

Presentation: Commercial Landings
Working Paper: Atlantic Halibut Assessment and Research Team. 2007 Working Document for Atlantic Halibut Framework Assessment Meeting #1: Data Inputs. CSA Working Paper 2007/26A.
Presenter: S. Wilson
Rapporteur: H. Stone

Presentation Highlights

S. Wilson presented commercial landings data for halibut from the NAFO statistics (1960-present) by province, NAFO division, country and gear type. Landings from Newfoundland for 1947 (63,000t) 1948 (59,000t) were very high and may include Greenland halibut (turbot).

Discussion

It was suggested that it would be useful to have effort data (i.e., # of hooks, hours fished) along with the catch information. However, this data would have to come from other sources and would require details on changes in management practices in order to interpret effort trends. For some nations, reported landings included in the NAFO Statistics may also include halibut bycatch. It was recommended that only the Canadian longline data be used for analytical purposes since it is considered to be the most reliable. Landings from the Gulf of St. Lawrence (4RST) have averaged over 300 t since 2000. Given the high proportion of landings from this region, there is a requirement to know more about possible movements of halibut from the Gulf of St. Lawrence to the Scotian Shelf and visa versa.

Presentation: Catch Composition
Working Paper: Atlantic Halibut Assessment and Research Team. 2007. Working Document for Atlantic Halibut Framework Assessment Meeting #1: Data Inputs. CSA Working Paper 2007/26A.
Presenter: K. Trzcinski
Rapporteur: T. Davignon-Burton

Presentation Highlights

K. Trzcinski presented length frequencies that had been compiled from observed trips. Patterns for length frequency could be seen on a year by year basis, potentially representing recruitment. Preliminary analysis indicated that size composition of this fishery has changed over time. For males, the size distribution seems to be flat, but for females appeared to be increasing slightly. Distinctive pattern of length frequency were seen in unit 3N, and this was to be investigated further. Box plots also indicated larger fish in units 3M and 3N.

Discussion

Questions were raised about whether or not there were observers on longliners in the years presented, and further uncertainties were raised about the scope of the data being analyzed. It was noted that observers had only been present on Scotia-Fundy longline trips since 1988; however, it was also noted that there were several large longliners in Newfoundland waters that may have had observers. It was unclear whether Newfoundland data and/or trawl data had been included in the data extraction.

It was suggested that length frequencies be broken down by decade. It was also suggested that data could be compared prior to 1995 and post 1995, as well as analyzed after eliminating data for halibut less than 81cm data. It may also be useful to look at the data year by year, as you could get a similar pattern with a pulse of recruitment going through.

It was asked whether the literature supported the idea that females were living longer and growing to be larger. Literature that had been compiled to date on this did seem to support this observation.

Industry noted that they would expect to see more smaller animals in 4X than in 4W.

While it was noted that 3N has a gillnet fishery, it was agreed that the analysis should not be affected by this.

Presentation:	Ageing Studies
Working Paper:	Atlantic Halibut Assessment and Research Team. 2007. Working Document for Atlantic Halibut Framework Assessment Meeting #1: Data Inputs. CSA Working Paper 2007/26A.
Presenter:	S. Armsworthy and K. Trzcinski
Rapporteur:	T. Davignon-Burton

Presentation Highlights

S. Armsworthy described the methodology used for the ageing study, and K. Trzcinski presented the results to date. Results are dependant on sample size, which is low but likely to be adequate. A catch at age matrix will be developed for use in modelling.

Discussion

It was suggested that the assessment team stay with status quo and use the blind side of the otolith for analysis. IPHC prefers blind side otoliths, and studies show no big difference between these approaches.

There was some discussion about the section technique versus the break and burn technique for ageing. It was recommended that break and burn might be appropriate if there is a workload bottleneck, i.e., limited time available for sample processing. In general, sections are preferred because they are more permanent; otoliths that are processed using the break and burn approach tend to fade over time. The break and burn approach is faster.

A question was raised as to how otoliths are treated prior to preparation. In the Maritimes, otoliths are generally left dry, with a very few older otoliths in glycerin. It was suggested that otoliths may be easier to read when they are frozen, as they do not dry out this way. In Norway, otoliths are frozen, then photographed and then read whole.

It was noted that the quality of the length at age matrix can be affected by the numbers of fish aged, and some concern was raised about dealing with years where length information was available but not ageing results.

In the Pacific, 2000 otoliths are used from the commercial index and 2000 otoliths are used from the survey within each area for each year. These are divided by sex also. The number used in the Maritimes Region is much less than this - less than 1000 for each sex over the entire area over the entire study period (1970-2007). It is possible that the Maritimes may not have enough ages for each year for the sex-specific length at age model.

It was recommended that the assessment team follow the International Commission for the Conservation of Atlantic Tunas (ICCAT) approach for the next meeting, i.e., use a growth model to do cohort splicing as a first cut. Note that there are several assumptions that must be made in doing this, e.g., it must be assumed that growth does not change over time. This approach would be problematic if growth has changed over time.

Presentation:	Life-History Information
Working Paper:	Atlantic Halibut Assessment and Research Team. 2007. Working Document for Atlantic Halibut Framework Assessment Meeting #1: Data Inputs. CSA Working Paper 2007/26A.
Presenter:	S. Lusseau and K. Trzcinski
Rapporteur:	T. Davignon-Burton

Presentation Highlights

S. Lusseau presented trends in average length and weight from both the fixed station survey and the commercial index survey. Preliminary results indicated that condition increased from 1995 to 1997, decreased to 2005 and has recently risen again. The average length of legal fish has increased, but this has not been matched by an increase in weight. It was uncertain whether this may be a result of a gap in recruitment or from better survival to larger sizes. It was noted that if size is changing over time, than the total biomass (kg) landed is not being accurately reflected.

K. Trzcinski presented preliminary results on length at age that indicate that there may have been an change in growth rate over time, although he did note that the model used for males may not be a good fit. He also presented preliminary results on the length, weight and age of maturity of Atlantic halibut based on the 4VsWX research vessel (RV) survey from 1970-1997.

Discussion

Hypothesis for the apparent change in average length without a corresponding change in average weight over time was examined, including the possibility that there has been a change in sex ratio in the population and the possibility that there has been a change in the relative proportions of males versus females being caught/sampled. It was recommended that this trend be explored further, including comparison with condition and length data from the Gulf, as well as analysis of results for fish under 81cm to determine whether this is happening at all sizes or just in the commercial size range. However, it was noted that a 12 hook is not very good at catching small fish and could be more likely to catch the fastest growing fish.

It was unclear why, based on the analysis presented, larger fish seem to be getting larger while smaller fish seem to be getting smaller. It would be interesting to see the same analysis presented for the 4RST halibut stock.

It was suggested that other measures of condition be explored. For example, it was suggested that condition of fish collected during the RV survey be examined. Relatively few halibut have been caught in the RV survey; however, sampling did go back to the 1970s.

The hypothesis that there has been a change in growth rate was also examined, including a discussion of an alternative hypothesis that perhaps gear selectivity has changed over time or that changes in gear may be influencing results.

It was noted that all trawl residuals are negative in Figure 26 of the working paper. It was suggested that this could be resolved by ageing all fish from the first ten years of RV survey and comparing these to fish aged from the last ten years of the RV survey. It was questioned whether there would have been enough fish collected in the early years to make this analysis possible, and how easy they would be to access. It was suggested that if there was a desire for halibut from the RV survey, this request should be submitted and added to the RV sampling protocol for next year.

Someone asked whether there had been any correlation with temperature. The assessment team indicated that it was hard to pull out this signal. Analysis in the Pacific did find a significant relationship with the Pacific Decadal Oscillation (PDO). It would be interesting to determine if there was any relationship with the North Atlantic Oscillation (NAO).

It was noted that Scotian Shelf and Grand Banks data had not been separated in this analysis. This would be important if halibut are growing differently in these two areas. Depending on the sample size of the different areas, it might be possible to look at this further.

Total mortality rate (Z) was determined to be 0.2; therefore, it may be better to use an M of 0.1 rather than 0.2 in determinations of exploitation. The IPHC is current using an M of 0.11. Honeg's formula gives the same result.

The possibility of a sexually dimorphic M was raised. While IPHC does use a common M, there may be data to the contrary. It was suggested that it would be trivial to repeat this calculation for both sexes. The calculation was done over the break, and it appeared to be consistent.

It was suggested that an allometric length-weight power function could be tried to get tighter fit of the data.

There was some confusion about the maturity stages that were included in the analysis (e.g., 3s and 4s?). It was recognized that the maturity data may not be particularly good since it was all collected in a three month block in a post spawning time frame. In the Pacific, it takes a year for R2s to mature. It was recommended that the data be reanalyzed for just the higher maturities. Ideally, the halibut program would try to collect better maturity information.

It was noted that a flatfish maturity guide was developed in the Gulf, and they have someone who is dedicated to the determination of maturities for consistency.

It was noted that the maturity results presented were inconsistent with Maine data. Maine uses the IPHC method.

Informal summaries of maturity data from other regions were presented by participants:

Table 1. Average halibut length or age at 50% maturity from different locations.

	females	males
Maine, USA	102 cm (40 inches)	97 cm (38 inches)
Norway	age 8	age 7
Gulf Region, Canada	115cm	75cm

It was recommended that current information from the Maritimes may not offer an accurate picture, and it may be useful to consult the literature until further sampling and analysis has been conducted.

The Gulf Region has done some maturity work over the last two years that may be useful to review. J. Neilson's work could also be considered.

Some questions were asked about halibut spawning, including spawning frequency, spawning duration, spawning location, whether every fish spawns every year, and about spawning behaviour. There was some uncertainty about the spawning of Atlantic halibut. The suggestion that there may not be annual spawning for some fish was based on tagging of two fish that did not participate in the spawning migration. Results from the Scotian Shelf Ichthyoplankton Program (SSIP) indicated no spawning on shelf (only three halibut eggs recorded). However, there are some historical records of halibut spawning in shallow water. It was noted that Pacific halibut spawning behaviour appears to involve movement up and down in the water column, i.e., the spawning dance, with hydration of eggs in batches. This is based on tagging results. Similar behaviour is observed in Dover sole. There is limited information on spawning from Norway. However, there appears to be winter spawning (Jan-Feb) and some migration from shallow to deep in the fiords.

Presentation: Ecosystem Information
Working Paper: Atlantic Halibut Assessment and Research Team. 2007. Working Document for Atlantic Halibut Framework Assessment Meeting #1: Data Inputs. CSA Working Paper 2007/26A.
Presenter: S. Lusseau and K. Trzcinski
Rapporteur: T. Davignon-Burton

Presentation Highlights

S. Lusseau presented preliminary results of the bycatch analysis. From the fixed station surveys, which do not reflect commercial fishing practices, the main bycatch species were found to be spiny dogfish, cod, and thorny skate. In the commercial index, which better reflects

commercial fishing practice but with different timing, the main bycatch species caught were cusk and white hake. A few basking shark got tangled in the longline gear.

K. Trzcinski reported on the results of stomach contents analysis, which included samples taken from the Halibut survey from 1999-2001. The results indicated that Atlantic halibut ate a lot of redfish and little bit of everything else. He stressed the importance of thinking about halibut in the context of the broader fish community.

Discussion

It was unclear to some participants how the bycatch analysis would be used for decision-making, if at all, and how a halibut trip was being defined.

Numerous suggestions were made as to how the analysis could be done differently, including separation of the commercial index into different areas (3Ps, 3NO, 4VW, and 4X+5) since these different areas were expected to have different species compositions. It was also suggested that "index boats" could be used, e.g., larger vessels for the open directed fishery.

It was noted that observers sometimes get basking sharks and Greenland sharks mixed up.

Given that there is some observer coverage of the commercial fishery (20% at one time), some bycatch information may be available. A comparison of commercial fishery observed trips versus commercial index trips in the same timeframe might be useful. It was noted that most observer coverage was in 3NOP.

It was agreed that a breakdown of the bycatch results from the commercial index by area should be presented in the working paper for the next meeting. These could be discussed at the next meeting, if there was time.

It was noted that the bycatch results represent a snapshot in time and are not able to indicate changes in diet over time. For example, we are not able to determine if something happen with redfish in 1995 when conditions improved. Halibut may have been eating something else before this time. Also, there are three different redfish stocks that are not separated out in this analysis.

Clarification was requested on the stomach collection methodology. Most were collected by fishermen in surveys, but the analysis also included some samples from the RV surveys. It was not clear what proportion of the samples these represented. It was noted that many halibut evert their stomachs, which makes it difficult to collect useful stomach data. It was surprising that so few crabs were found, since they are often found in halibut stomachs collected in Maine waters.

It was suggested that while bycatch and stomach content information were nice, there may be other ecosystem information that would be useful, including temperate data. It was noted that temperate data could be collected from the fixed stations.

Review of Indices of Abundance

Presentation:	Research Vessel (RV) Survey Index
Working Paper:	Atlantic Halibut Assessment and Research Team. 2007. Working Document for Atlantic Halibut Framework Assessment Meeting #1: Data Inputs. CSA Working Paper 2007/26A.
Presenter:	K. Trzcinski
Rapporteur:	D. Clark

Presentation Highlights

K. Trzcinski presented results for only the Maritimes Region at this meeting. Results from other areas would be presented at the next meeting and trends for all areas would be presented for other areas in the final Research Document.

Discussion

RV survey data may be useful as an index of recruitment, but the numbers caught annually are quite low. There appears to be little difference in catch between the *CCGS Alfred Needler* and *CCGS Teleost*, so catches for all years can be included in the same series. Trends in abundance and area occupied are shown in the survey review document (Clark and Perley 2006), and trends in condition will be included in the survey document for 2007 (Clark and Emberley 2008). Area occupied is currently the highest in the survey series. Condition is generally lower since 1996 than in years prior to 1989.

Halibut otoliths were collected on the survey in 2007. Collections in future years could be frozen, rather than stored dry, to see if this improves readability.

The use of maturity stages from the RV survey was discussed. It is not clear that staging during July will be reliable. This will be reviewed, and a decision on whether to continue to record stages, and which protocols to follow, will be made by July 2008.

Presentation:	Fixed Station Survey Index
Working Paper:	Atlantic Halibut Assessment and Research Team. 2007. Working Document for Atlantic Halibut Framework Assessment Meeting #1: Data Inputs. CSA Working Paper 2007/26A.
Presenter:	S. Armsworthy
Rapporteur:	D. Clark

Presentation Highlights

S. Armsworthy presented the design of the fixed station survey. New stations have been added, and efforts are underway to determine the sensitivity of the index to these new stations. The new stations have also now been assigned to strata. At present, there is 84% reproducibility with the original strata. The new stations have not been included in abundance estimates as of yet, but it would be possible to show how these stations affect the estimate of abundance. Re-stratification is seen as a long-term project. The Generalized Linear Model (GLM), which was used to standardize the data, appears to have the lowest variance. It also shows an increase over time.

K. Trzcinski presented current information on the catch composition of the fixed station survey, which indicated some differences compared to previous results. For example, there appear to be different mortality rates and growth rates between males and females. There may be differences in mortality rates across areas as well. The intent is to check these results using a survivorship curve to see how much variation is explained by this.

Discussion

The stratification used is based on average halibut catch, with high, medium and low catch strata. It was recommended that an analysis be undertaken to determine whether the stratification improves the precision of the survey indices compared to using unstratified data.

Bait size and species influences catch rate for pacific halibut. There is no standardization in this survey and recording bait used is not a consistent practice. There were strong concerns stated regarding the precision of the survey if bait is not standardized. Standardization for future surveys is possible, but would need discussion among participants and may not be practical to undertake. It is not clear how this would be related to past surveys where bait was not standardized.

A proposal was made to use the raw catch data at length to produce survey indices at length and age. Selecting how these data are used to produce indices can be done based on modelling once the data are put together. The best method of incorporating the stratification and stations occupied can be done based on model fit.

Bimodality in the length frequencies for females in the fixed station survey was noted. The length-frequencies are aggregated over time, and this may reflect differences in length composition in time stanzas, or a recruitment event. This will be explored further to determine what this pattern reflects.

Presentation:	Commercial Survey Index
Working Paper:	Atlantic Halibut Assessment and Research Team. 2007. Working Document for Atlantic Halibut Framework Assessment Meeting #1: Data Inputs. CSA Working Paper 2007/26A.
Presenter:	S. Lusseau
Rapporteur:	D. Clark

Presentation Highlights

S. Lusseau presented preliminary results of an analysis of the commercial survey index. Data was filtered data, and sets with low effort or unknown effort were not used (i.e., <500 hooks, <5 hrs, etc.). Most effort was in 4VWX, with no data from 3P and only from 3N since 2004. 3NOP was the most patchy. There did not appear to be a linear relationship with soak time. The analysis suggested that it may be inappropriate to use linear correction for standarizing; however, more work is required.

Discussion

For the commercial catch rate analysis, sets are excluded if fewer than 500 hooks are set. 34% of sets in 4X in 2006 had fewer than 500 hooks. This seemed unexpected to survey participants and will be investigated further. Whether or not these sets should be included despite the low number of hooks was discussed. These data were investigated to determine if the catch/1000 hooks is markedly different from sets with more hooks, and it was recommended that only those sets with <200 hooks be excluded.

Catch per set increases with time and number of hooks, but not in a linear fashion. Standardization of sets for duration or number of hooks will be done using a non-linear relationship.

Spacing of gangions on the line does seem to be a factor which influences catch rate of Pacific halibut. It has been measured for Atlantic halibut and will be examined in the future.

The inclusion of null sets in the calculation of survey indices using GLM was discussed. The number of null sets will be reported. The model does not account for a high proportion of the variability; the treatment of null sets may contribute to this, but the inability to look at interaction effects or bait due to lack of information is clearly a difficulty in modelling the data. It was suggested that it might be useful to include line spacing in the GLM, if that information was available. Analysis conducted in the Pacific corrects for spacing.

Depth is influential in the commercial index catch rate. For those sets where depth is not reported, depth information will be determined from position and included in further analyses. It was suggested that depth could be looked at as a potentially important factor in the analysis of the fixed station data. For future surveys, it will be emphasized to the captains that the depth at the station is required.

The length frequency from 3NO looks different from all other areas. The question was raised of whether there was any mechanical reason for this difference. The consensus was that this is likely a biological effect. The difference between 3NO and other areas is consistent among sampling programs (survey and observer). The lack of small fish suggests that fish move to this area as they age. Tagging information can be re-examined to see if fish move to this area only after they reach a larger size (e.g., 120cm). Perhaps returns after 3 years at large for sub-legal tagged fish could be examined.

Presentation: Commercial Fishery Index
Working Paper: Atlantic Halibut Assessment and Research Team. 2007. Working Document for Atlantic Halibut Framework Assessment Meeting #1: Data Inputs. CSA Working Paper 2007/26A.
Presenter: S. Lusseau
Rapporteur: D. Clark

Presentation Highlights

S. Lusseau presented preliminary analysis of data extracted from the commercial fisheries database, including all sets that caught halibut. Catch rates were analyzed as kilograms landed per set per day and were shown from 2002 to 2007. There appeared to be no trend in catch rate in 4V, 4W, 4X, 3P, and 5Z.

Discussion

Catch-rates from commercial fishing were examined. All sets which caught halibut were examined. It was suggested that index fishermen could be selected to look for trends in catch-rate, and that for 3NOPs this would represent most of the commercial landings. A counter-argument was made that using a model which includes all of the variability (mixed-effects model) is a useful and elegant way to handle the data which simplifies the assumptions.

Catch-rates are difficult to interpret for 4X5 where there are weekly limits of 500 lbs. The data for 4X5 clearly indicate the changes in trip limits in recent years. After 500lbs are caught, the rest of the halibut are released. The release mortality cannot be calculated but it is assumed to be small relative to overall landings. Observer data could potentially be used to estimate this; however, the coverage by observers in the longline fishery is very low, likely too low to provide meaningful conclusions.

4W and 4V have their own trip limit, which is 2-3 times higher. This appears to be reflected in the data. Fishermen in 3NOP don't have trip limits. Management measures are clearly influencing this analysis.

Synopsis of Meeting Conclusions and Recommendations

Biological Basis of Management Unit: Tagging

There is limited understanding of the stock unit; however, there appears to be distinct northeast movement and differences in size composition between areas. There is some evidence of movement between 4Vn and Gulf (presented verbally), but rates may be low. There is evidence of movement northward from the U.S. (28% of tags). There was no agreement on the amount of movement across the current stock unit boundary that would be needed to trigger a re-definition of the unit.

Recommendations for this Framework

- Gulf tagging results (DFO 2005) should be referenced in the Research Document resulting from this meeting.
- A conceptual model of movement or migration matrix may be useful.
- Exploitation rate should be recalculated from all sizes tagging study.
- Natural mortality should be adjusted to a more likely value (0.12?).

Longer Term Recommendations

- Continuation of current tagging program. Ongoing analysis of data.
  - More detailed seasonal analysis.
  - Use in estimation of exploitation rate.
- Use of new tagging technology, where possible.
  - Data storage tags, pop-up tags, PIT tags (reporting issues), etc.
- Consideration of 3Pn.
- Attempt to address implications within assessment framework, using current management unit.

Review of Fisheries Data Inputs: Ageing

There does not appear to be significant bias between readers or between labs. Atlantic halibut otolith were difficult to read compared to many other species. Older Atlantic halibut otoliths were easier to age than younger ones. Pacific halibut otoliths were easier to read than Atlantic.

Recommendations

- Current methodology to be used unless there are timing issues, in which case the "break and burn" method may be faster.
- Freeze samples.

Review of Fishery Data Inputs: Landings

There is a wealth of historical landings information, which it would be useful to document. Without associated effort, landings alone have limited use as an indicator of abundance.

Recommendations for this Framework

- Landings should be presentation in the Research Document by province, sub-area, gear type, and country.

Longer Term Recommendations
- Investigation of effort (low priority), including spatial distribution of effort (e.g., work by D. Kulka). Make use of other projects, where possible.

Review of Fishery Data Inputs: Catch Composition

Females appear to be generally larger than males. Mean length appears to be constant for males (since 1995); females getting a bit longer from 1995-2007. There is high variability in catch composition before 1995 when the size limit was established and observer coverage increased.

Recommendations for this Framework
- Check scope of data (years, areas).
- Check patterns of observer coverage.
- Check port sampling information from the 1970s.

Longer Term Recommendations
- Investigate the apparently different catch composition in 3LMN.

Review of Life-History Information: Length at Age

Recommendations for this Framework
- Further investigation is required.
- Alternate hypothesis should be explored:
  - Growth rate.
  - Gear selectivity.
  - Effects of temperature.

Longer Term Recommendations
- Links to ageing.
- Investigate area effects.

Review of Life-History Information: Maturities

Data from the Maritimes appears to be inconsistent with other studies.

Recommendations for this Framework
- Further investigation of data is required.
- In the meantime, use information from Maine and Gulf.
- Reference to John Neilson, John Kearney, and Ray Bowring's studies.

Review of Life-History Information: Condition

There appears to have been a change in condition over time. Average length of >81cm fish appears to have increased while average weight appears to have decreased.

Recommendations for this Framework
- Further investigation of data is required.
- Alternative hypothesis should be explored (e.g., %males).
- Compare to condition from RV survey.
- Compare to condition of <81cm fish.

- Compare to Newfoundland and Gulf RV data.

Review of Ecosystem Information: Bycatch

Commercial index may be more useful for bycatch analysis (by area) than the fixed station index, but there are timing differences between the commercial index and the commercial fishery that need to be taken into consideration. In general, this is an important area of work and more work is needed. Good estimates of relative bycatch (where and when) can be developed, but care should be taken in doing this to avoid inappropriate extrapolation.

Recommendations for this Framework
- Bycatch analysis should be separated by area to better reflect ecosystem differences (ESS, WSS, 3Ps, 3NO).
  - Also by vessel class.
- Bycatch in the commercial index should to be compared to bycatch in fishery.
- Halibut trip should be more clearly defined.

Review of Ecosystem Information: Stomach Contents

Atlantic halibut appear to be eating primarily redfish. This may be an appropriate analysis for the timeframe studied; however, it may not reflect feeding patterns in the past.

Recommendations for this Framework
- Comparison with changes in redfish (other species) abundance.

Longer Term Recommendations
- Changes in feeding over time.
- Investigation of additional stomach information.
- Talk to Jason Link.

Indices of Abundance: RV Survey Index

Recommendations for this Framework
- Include Teleost and Templeman data.
- Other indicators (in addition to #s) from RV survey include weight, area occupied. Reference in Research Document.
- Try to use in modelling; at least compare with model output to see if it makes sense.
- Evaluate data from other areas.

Indices of Abundance: Fixed Station Index

Recommendations for this Framework
- Investigate sensitivity of this index to new stations.
- Test all three indices in modelling (not just GLM).
- Could look at depth effects.
- Show trends by strata. Put in Research Document.

Longer Term Recommendations
- Test whether stratification improves abundance estimate.
- Bait standardization likely to reduce variance. Reporting of bait recommended at a minimum. Look at what is available.
- Are two 500 hooks close together = 1000 hooks? Look at data to see if it happens.

- Effect of dogfish on catch rates.
- Effect of hook spacing (IPHC study).

Indices of Abundance: Commercial Survey Index

Current standardization and assumption of a linear relationship may be inappropriate. Results indicate some non-linear relationships.

Recommendations for this Framework
- Retrieve depth from remaining sets.
- Add temperature as explanatory variable.
- Consider mixed effects models to account for vessel effects.
- No reason to exclude <500 hooks. Filter down to 200.

Longer Term Recommendations
- Add depth to sheets.
- Encourage people to fill it out once it's added.

Indices of Abundance: Commercial Fishery Index

It is important to review this index, but there may be constraints on its usefulness as an index of abundance.

Recommendations for this Framework
- Investigate whether the commercial fishery index could be used to extend the abundance index timeline prior to implementation of more recent indices (before limits were put in place – before lowering of TAC).
- Compare to other indices, e.g., 4VWX5.
- Generate index back to 1980s for 3NOPs.

Longer Term Recommendations
- Mixed effects model.
- Compare to fixed effects model for 12 "index" boats.

Other Items for Consideration

Data Handling
Data handling is a work in progress. Every time you want to try something different, work is required and it is rarely trivial. Our data handling facilities are more or less state of the art.

Growth Processes
It was suggested that the growth model be fit to the median size at age rather than using a functional relationship. However, there may not be enough ages to do this. To look at changes in growth, fit each year, fit non-parametrically. The important thing is to look at the data every year. A consistent ageing program will be needed if the framework is to be based on an age structured model. We will also need a structured program to collect maturity information, and DFO may have to work with observers to achieve this. Resolution of maturity staging may require training.

Commercial Fishery
CPUE is a work in progress. It might be useful to figure out what landings data from Newfoundland and NAFO mean, since COSEWIC may want this. It may also be useful to

investigate the discard profile: record what is released. If this is being recorded in log books, it should be captured in a database. DFO should also encourage consistent reporting of releases during the commercial index survey. Some form of reporting on management measures would also be useful, since they seem to influence some results. This used to be done every year, but it hasn't been done in many years. Key management measures can be recorded in the background section of the annual Science Advisory reports.

Tagging
At present, it is not possible to estimate absolute abundance from tagging results. Tagging is used for exploitation only. Use of wire tags was recommended for better retention.

Understanding Productivity
There is still a need to develop a limit reference point (or proxy), as well as threshold or cautionary reference points.

Decision Rules
At present, there are general objectives relevant to all groundfish, but these may be too general. Industry would like to encourage further development of objectives for the halibut fishery.

Population Substructure
Better information on spawning and genetics would contribute to a better understanding of Atlantic halibut substructure, and it would be helpful in conducting a recovery potential assessment, if required in the future.

Index of Abundance
An appropriate index of abundance should be resolved before assessment for pre-COSEWIC or recovery potential assessment purposes. We may have to use the RV survey index if nothing else. The ability to simulate long-term dynamics (in absence of fishing, etc.) would also be useful.

Next Steps

Draft proceedings were to be circulated to participants.

The modelling component of the framework was to be held 8-10 January 2008, if possible.

It was noted that the stock assessment for 3NOPs4VWX+5Zc Atlantic halibut was to be held 12-14 February 2008. At the time, it was unclear whether the 2008 assessment would be based on the results of the framework (i.e., model output) or whether it would be based on the trends in abundance indices.

REVIEW OF MANAGEMENT UNIT, FISHERY DATA INPUTS, AND INDICES OF ABUNDANCE: PART II (8 – 9 January 2008)

The meeting commenced with the Chair, T. Worcester, welcoming the participants and sending around the participant sign-in list (Appendix 2). She explained that the modeling component of the framework had been delayed to enable further development and testing, and she noted that this meeting was intended to take advantage of this delay by providing updates of work done to address a number of suggestions provided at the previous framework meeting in October on the management unit, fishery data inputs and indices of abundance. In addition, since this framework would not be completed in time to contribute towards the 2008 halibut stock assessment, this meeting would also be used to discuss the content of that assessment. The Chair introduced the two scientific reviewers: Diane Archambauld from DFO in the Quebec Region and Bill Brodie from DFO in the Newfoundland and Labrador Region. The Agenda for this meeting was reviewed (Appendix 3).

Historical Context

Presentation: Assessment History for 3NOPs4VWX+5Zc Atlantic Halibut
Presenter: T. Worcester
Rapporteur: T. Worcester

Presenter: T. Worcester

Presentation Highlights

After the last meeting, several people had suggested that the next framework meeting should include some mention of the history of 3NOPs4VWX+5Zc Atlantic halibut assessment. Atlantic halibut was assessed every year from 1988 to 1993 by the Canadian Fisheries Scientific Advisory Committee (CAFSAC). In these meetings, a precautionary TAC was set at 3200 mt based primarily on previous catch levels. In 1994, the Atlantic halibut assessment was conducted through the new Regional Advisory Process (RAP) and the TAC was reduced to 1500 mt. Halibut was assessed through the RAP every year from 1994 to 2001, with advice being provided as a Stock Status Report. No assessment was conducted in 2002. In 2003, an overview of the industry / DFO longline survey and results to 2003 were provided as a Fisheries Status Report (DFO 2003). In 2004, a meeting was held to discuss Atlantic halibut research and a proceedings of this meeting was produced (DFO 2004). The next and last formal assessment of Atlantic halibut was in 2006 (DFO 2006). The structure and content of these previous assessments were compared, and the changes over time were noted. Some parts, such as the habitat description, had not changed significantly through time, while other parts, such as the assessment indices, had changed quite significantly since 1994.

Discussion

In reference to the TAC reduction, it was noted that when cod stocks collapsed the Fisheries Resource Conservation Council (FRCC) was looking for places to be risk averse. The TAC increased again in small (150 mt) increments to test the reaction of the stock. At the same time, catch rates were going down since much of fishery was incidental and other groundfish fisheries were being reduced. It was also noted that in 1988 the average landings were 2000 mt but the TAC was 3200 mt, which was larger than the long-term average.

Updates on the Biological Basis for the Management Unit

Presentation: Tagging Updates
Working Paper: Assessment Framework for Atlantic Halibut Scotian Shelf and Southern Grand Banks (Div. 3NOPs4VWX+5Zc) Maritimes Region Science Advisory Process Data Inputs: Part II
Presenters: K. Trzcinski and D. Ricard

Presentation Highlights

K. Trzcinski and D. Broughton spent some time trying to pursue development of tag reporting rates, but they ran into problems. The tag reporting rate can't be provided given the current structure of the data. When a tag comes back, it is known when and where it was caught but not if it was caught in the survey. If tagged halibut were caught with an observer on board, it would be helpful. Tags are more likely to be returned when an observer is on board.

New graphs were presented on the current understanding of the seasonal movements of Atlantic halibut based on tagging results.

In order to explore the distance and direction of release, halibut were separated into sub-legal (Tables 1-3) and legal fish (Tables 4-6). Based on where an individual had been tagged and then recaptured, the direction (in radians) and the distance traveled were determined. Results presented in Table 1 were then converted into "transition probabilities". This analysis indicated that most of the halibut that are tagged from a given area tend to be recaptured in the same area. There also doesn't appear to be much north-easterly movement.

D. Ricard presented the results of a geospatial analysis of the tagging results. He suggested that the directionality of the Shelf (generally running east/west) could be influencing the movement of halibut and also suggested that this type of analysis was able to provide a more accurate indication of halibut movement than the tables. However, there are some challenges in presenting the results graphically, as it can require overlaying many arrows on a single map.

Movement of halibut across boundaries was also investigated. K. Trzcinski reported the percentages of juveniles and adults that had been captured inside and outside of stock boundaries. Only 1.69% of juveniles tagged in the stock area were caught outside the stock unit. Only 2.82% of adults tagged in the stock area were caught outside the stock unit. 1.27% of juveniles and 2.82% of adults tagged in the stock unit were caught in 4RST.

Discussion

Suggestions were provided on additional ways to try to determine reporting rates. For example, if the number of the trip was recorded in the Zonal Interchange Format (ZIF) database, one could perhaps determine if a halibut was caught on a survey. Someone asked why it would be useful to know whether or not tags were recovered during the survey. It was agreed that this could help to determine tag reporting rate. However, it was unclear whether this could be determined retroactively. It was suggested that if the date was known, one could probably figure out who was doing the survey. Only 60 tags were recovered over two years, so it wouldn't be a large task to try to address this.

The assumption that the recaptured rate in the survey is reflective of the fishery as a whole was questioned. It was suggested that recaptures within a certain time period after release would

have to be excluded before you make that assumption. There was some discussion of what the differences might be between the fishery compared to the survey in terms of tag returns.

Concerns were expressed about the reporting rates in the older tagging study. It was strongly suggested that a reporting rate of 100% should not be assumed. Rather, efforts should be made to try to estimate it. It was noted that there is a new method using scanned tags being used in the Pacific. Scanned tags can help to improve issues with reporting.

There was some discussion about whether the tagging information might be able to provide an indication of spawning times or locations, as well as some indication of the distances travelled between release and recapture. It was suggested that it is hard to answer this kind of question with the kind of data that is currently available (i.e., primarily just the position and sometimes date of release and recapture). While the number of months the halibut was in the water can be determined, this does not necessarily reflect the distance travelled. Short of putting telemetry instruments on the halibut, it is unclear how the tags used would provide the desired information. It was noted that for yellowtail flounder, movements of a batch of fish that were all tagged at the same time in one area were investigated to determine where they went. It would be possible to use year of release as the batch number. It was agreed that, while the tagging information available would not be able to answer all questions, there was some additional analysis that could be done to extract more information than had been provided to date. For example, one could plot distance from tagging site for a single area, with months from release (days at large), truncated for a year (minimum 1 year at large). One could then aggregate many years of data, overlay years, or do the analysis by season (Julian calendar). It was suggested that the first 1-2 years after tagging should be separated from the other years.

Someone asked whether seasonal patterns in movement had been investigated. There appears to be seasonal movement on and off shelf based on catch rates in the RV surveys by depth and temperature. Halibut are rarely caught below 6 degrees. Some seasonal changes in the abundance of halibut in different areas were indicated by the surveys. It was suggested that tagged halibut could be separated into those that were caught in the summer and those that were caught in the winter. Movements of these two groups could then be compared to determine whether there were differences. It was also suggested that the returns from 1995 (600 juveniles tagged) be investigated independently.

It was suggested that Tables 5 and 6 be reviewed as the may have had some errors.

To date, it was suggested that there has been no definitive answer about the site fidelity of Atlantic halibut. However, there does appear to be a high proportion of recaptures close to the site of release.

Issues regarding the likelihood of tag reporting from the northern portions of Atlantic halibut distribution were discussed briefly. It was noted that the relative fishing activity is quite low in the north (e.g., 3KL). In the last three years, it is less than 5% of previous activity – both in terms of effort and landings. The TACs have declined also. In addition, the depth range is different than halibut would normally be found. NAFO Units 3L and M still had some effort.

Tag reporting from the Gulf of St. Lawrence was also discussed. When D. Archambault (Quebec Region) gets tags from our area, she sends them back; however, very few tags are submitted and most have been from the south-eastern part of Gulf. No tags were returned from 4RS. It was noted that 1 tag from 4R was sent directly to the Maritimes Region.

There was general agreement that the current management unit was sufficiently large to capture most of the movements of Atlantic halibut. However, this was not meant to imply that the current management unit represented the biological unit, and there could be significant structure within the unit. Additional work was required to further characterize movements across the management boundary. For example, US results indicate significant movement of small fish north across the Canada/US boundary. It was suggested that a reciprocal tagging program with the US should be developed.

The implications of movement across the management unit boundary were also discussed to some degree, particularly in terms of management implications. It was suggested that developing an assessment model based on the current boundary would likely be sufficient for providing management advice within the boundary. Management of halibut outside this boundary would be more problematic, however.

Presentation: Issues Raised by Bruce Leaman (reviewer from previous meeting)
Presenter: K. Trzcinski

Presentation Highlights

K. Trzcinski reported on progress that had been made to address issues raised by B. Leaman at the previous framework meeting. These included tagging allocation via potential mapping and Delauney triangulation. It appeared that potential mapping resulted in 4X and 3N being underestimated. Instead, Delaunay triangulation was used. As a result, 45 tags were taken from 3P and put into 3N. Participants were asked to tag in 3NO combined, which resulted in 100% coverage. Not enough halibut were tagged in 3Ps in 2006, but the numbers were made up in 2007.

Discussion

It was noted that these results had not yet been sent to B. Leaman for his review.

Implications of adding additional tags in one year if not enough had been tagged the previous year were discussed. Adding additional tags to an area to catch up from a previous year is problematic if there is an intent to analyze the data for the whole area by year. Some tags (possibly 100) may have to be dropped in order to conduct this type of analysis. For example, they would have to be dropped to determine the overall exploitation rate for whole area. It was agreed that tagging should always be done in proportion to abundance. If there are tags left over in a particular year, it was suggested that these should be distributed over all areas proportionally. Proportions are more important than numbers per area (~700). It was noted that putting additional tags in one area might not be as problematic for analysis at a smaller scale (e.g., exploitation in 3Ps) or for a different purpose. An alternative to dropping tags from an area (i.e., in 2006) would be to bump up the tags from other areas. It was suggested that bumping up would be better than dropping tags, though it places a lot of dependency on the accuracy of triangulation.

Difficulties in reaching the proportional targets were also discussed. In Year 1, the target was not reached. In year 2, there was financial help to reach the target. The only reason why it was achieved was because money was available. It is harder to achieve targets in areas that are further away. If things are the same as in 2007, it should be possible to reach the targets in 2008. The only twist is that if the targets are achieved before the end of survey, where the final tags should go has to be determined in the middle of the survey. This is hard to do but not impossible. Difficulties with doing tagging in 3Ps were due to gear conflicts.

Presentation: Estimating Exploitation from Tagging
Working Paper: Assessment Framework for Atlantic Halibut Scotian Shelf and Southern Grand Banks (Div. 3NOPs4VWX+5Zc) Maritimes Region Science Advisory Process Data Inputs: Part II
Presenter: K. Trzcinski

Presentation Highlights

An analysis of the tagging results to estimate exploitation looked at adults of all sizes tagged from May 2006 and caught in the 9 month period before the next survey started up. The Peterson equation was applied. Release mortality was based on a holding study (25% release mortality). The reporting rate was assumed to be 99%. Natural mortality was assumed to be 0.11 based on that used by the IPHC. All fish in this study were double tagged to estimate tag loss rate. A 16% exploitation rate was estimated for legal fish and a 4% exploitation rate was estimated for sublegal fish. Note: After correcting an error in the Peterson equation, the exploitation rate for adults was estimated to be 10%.

Discussion

The correct release mortality from the study was identified to be 23% rather than 25%. The sensitivity of the results to this change was expected to be low. It was also noted that L (tag loss rate) should have been squared, because fish were double tagged. This change resulted in an exploitation rate of 10%.

It was suggested that rather than picking a single value for some of the assumed rates (e.g., release mortality, tag shedding rates, etc.), it would be possible to determine a probable range. The lowest and highest reasonable rates could be estimated, and the variance in the results could be determined. For example, reporting rates might be in the range of 80-100%. It was also suggested that all data should be used to determine tag shedding rate, which results in 60 samples rather than 30 samples.

Questions were asked about whether the tag recaptures were reflective of the fishery. Since it takes about 3 months to conduct the tagging, the return period was likely closer to 9 months than to a full year. The assumption of the analysis, however, is that it is a pulsed tagging event with returns over the full year. It was suggested that this might mean that part of the fishing season is not covered, which would suggest exploitation rates could be higher. It was suggested that the older juvenile tagging had been done throughout the year, though it would have been concentrated in the summer.

It was clarified that exploitation rates could not be determined by area as there had been only 30 recaptures. Another 5-10 years of tagging would be required to get a good estimate by area. Also, the program had been designed to look at an exploitation rate for the whole management unit, not by subarea. A different design would be required to investigate the differences in fishing mortality between the difference areas within the management unit.

The accuracy of the fishing mortality estimates was discussed. With very few recoveries, variance is quite high, but each year the estimates are expected to get better. An annual rate like this will improve with the length of the study, since variance goes down as recaptures come in. Need to first calculate variance to see how quickly it goes down with more tagging versus time. It was suggested that the variance may never decrease sufficiently and that tagging is

notorious for having broad estimates of mortality. It was agreed that variance would be calculated and the sensitivity of this estimate to tag allocation would be determined.

Fishing mortality (F) reference points were briefly discussed. F of 0.2 was suggested as a possible reference point. Further discussion would be required, however, before reference points were determined. Their selection would depend on the results of the model meeting.

Other possible approaches were also discussed. While there are numerous abundance indices available, there appears to be little change in these indices despite large changes in TACs. It is unclear whether the index is not sensitive to these changes or whether the population is not responding to the changes. At present, it is hard to get reliable estimates of biomass. Until there is a working assessment model, it was suggested that this opportunity should be used to try an adaptive model to see whether changes in indices are possible. While fishing a population until you see a response in the abundance index was not suggested, it was mentioned as one option. However, if the halibut index is accurate and is showing the desirable property of stability, it would not be advisable to push it until you get instability, which is not desirable. It was noted that the management objective was not necessarily to maintain stability at the current fishing level, but it may be to determine whether stability is possible at a higher TAC. When the model is working, its output can be compared against the abundance indices and can also be used to make predictions and evaluate different management scenarios.

Updates on the Fishery Data Inputs

Presentation:	Observer Coverage
Working Paper:	Assessment Framework for Atlantic Halibut Scotian Shelf and Southern Grand Banks (Div. 3NOPs4VWX+5Zc) Maritimes Region Science Advisory Process Data Inputs: Part II
Presenter:	K. Trzcinski

Presentation Highlights

Last meeting, some concern was expressed that the data had been lumped too much. It has now been separated by gear, year and month. Also, participants wanted to know what length-frequencies are based on. They are based on otter trawl samples mostly from 1986-1994, longline observer records since 1987/88, includes observed trips from the halibut survey. The database contains observed trips from all months. If there was a condition index in spring, summer, and fall, then seasonal changes could be investigated. However, there is not enough data to calculate condition per year by season. This will be investigated a bit more, but the data probably isn't sufficient to address this. There are some problems with the observer coverage, as it is missing some important times.

Discussion

There was a request to determine the percentage of trips that had been observed, including the percentage observed during the survey as compared to other times. It was suggested that the percentage of trips observed outside of the survey was quite low (<5%).

It was clarified that for this analysis, any trip in which halibut had been caught was considered. However, it was acknowledged that non-directed trips would have different selectivities. It was suggested that trips using halibut gear should be separated out from trips that did not. It would also be useful to have the length-frequencies from the longline fishery to compare to the otter trawl fishery.

For observed data, determination of a halibut trip was based on what the captain said it was and not on the main species caught. For observed trips, hook size would also have been recorded. It was noted that a directed trip is defined differently in the ZIF and the Maritimes Fisheries Information System (MARFIS) databases.

Some interest was expressed in the history of hook use and the implications for catch rates and size frequencies. Circle hooks were introduced at some point. They were selling size 16 hooks in the 1980s, but most are using size 14 hooks now. It was suggested that there would not be much difference in catch rates between 14 and 16 sized hooks. If a halibut bites and you hook it, you're going to catch it since most are caught around the jaw. From 32 inches and up, it doesn't make much of a difference. For smaller fish, it might make a difference. It was suggested that small fish had been caught by the survey in areas where they had never been caught in the fishery.

Presentation:	Length-Frequencies and Catch at Length
Working Paper:	Assessment Framework for Atlantic Halibut Scotian Shelf and Southern Grand Banks (Div. 3NOPs4VWX+5Zc) Maritimes Region Science Advisory Process Data Inputs: Part II
Presenter:	K. Trzcinski

Presentation Highlights

Length frequencies were presented by area and year. The importance of this information for modeling was stressed, as was the hope of being able to detect pulses of recruitment moving through the population over time. It was noted that there are different growth rates and mortalities between males and females, and different growth rates between areas. Box plots are now scaled by sample size, with fatter boxes indicating more samples. The catch at length that has been generated is the first step towards developing catch at age.

Discussion

The lack of length-frequency information from port sampling was discussed. As the sex of halibut sampled in port sampling is not known, i.e., the gonads have been removed, this information can not be used to develop sex differentiated length-frequencies. The important of keeping information on males and females separate was stressed. It was suggested that the Pacific Halibut Commission may have had some success with sexing their port samples. It was agreed that someone would look into this.

The importance of having reliable estimates of discards was discussed, as were issues of scaling up observed discards to the whole fishery. Methods for estimating the size composition of discards was also discussed. It was suggested that a table showing weight observed versus weight landed would be required to determine scaling. It was also suggested that the proportion of kept versus discards could be investigated in the observer database (i.e., look at kept versus discarded by year). If discarding is 20% by numbers, than it is important to take into account. If it's only 0.5%, it may not be as important. In general, it was agreed that work to date on discards was heading in the right direction, but additional work was required.

Treatment of the different fleets was discussed. It was suggested that the longline fleet should be separated from the otter trawl fleet. Ideally, there would be different length frequencies from otter trawlers and longliners with different selectivities. Data may not be sufficient to do this, and in the end total removals at length/age are needed. It was suggested that in years where there

are not enough samples, the fleets should be combined, but when there is enough data to do so, they should be estimated separately. It may also be possible to establish length-frequencies of the otter trawl fleet over a five or ten year block, which could then be applied to the sampling each year.

Some concerns were expressed with the reporting of foreign landings. In particular, the large landings in NAFO division 3NO seemed high. It was noted that the foreign fishery is conducted in deeper depths. It was unclear to some how it was going to be addressed – either by assuming it is north of 3N and excluded or prorated. Whatever methodology is used should be clearly stated and reviewed.

Industry had some concerns about where the small fish samples were coming from, i.e., from the fixed gear survey or from the otter trawl fleet. It was felt that smaller fish might not be sexed; therefore, they might be treated as zeros.

Additional observer coverage of the halibut fishery, e.g., distinct from the survey, was recommended.

Questions were asked about the source of the NFLD landings and about the NFLD observer program. Recent NFLD landings are not in MARFIS, so landings were obtained from quota reports. NFLD landings can also be found in the ZIF and NAFO databases.

Updates on Life-History Information

Presentation:	Growth Rates and Ageing
Working Paper:	Assessment Framework for Atlantic Halibut Scotian Shelf and Southern Grand Banks (Div. 3NOPs4VWX+5Zc) Maritimes Region Science Advisory Process Data Inputs: Part II
Presenter:	K. Trzcinski

Presentation Highlights

S. Whoriskey had put together halibut growth information (length at age) for 4VWX in 2006. This could be done for other years. However, more work would be required to compare the growth rates between areas, e.g., 4RST is not separated into males and females. Males and females seem to be growing similarly in 4RST, which is not the case in 4VWX. There has not been interchange of information with the Gulf or Quebec Regions on halibut growth to date, but it might be useful to share otoliths. Based on movement, the assumption is that there are different stocks. However, additional work would be required to support any statements that the growth rate is different in the 3NOPs4VWX+5Zc management unit as compared to other areas. This is considered to be a longer-term project and not a high priority at present.

Since the last meeting, 200 more otoliths have been aged -- mostly from the RV survey in the recent time period. Efforts have been made to compare current growth rates with historic rates to determine if they have changed. At the last meeting, a comparison had been made between historic data from the RV survey and recent data from the halibut longline survey. It had been suggested that comparisons of samples from consistent gear would be more appropriate. Preliminary results suggest that there had been similar growth rates early on with non-significant differences in more recent times. However, results will be discussed in more detail at the next meeting.

Discussion

Analysis of the change in average length over time had been conducted using all gear combined. However, it was agreed that most of the halibut less than 7 years old were caught by otter trawls. It was suggested that the length at age should be redone by gear type. However, it was indicated that an analysis of changes in growth over time would be difficult to do based entirely on the longline fleet. A temporal comparison would not be possible as most of the older samples were collected using the otter trawl survey.

Results of the temporal analysis using the newly aged RV survey samples does not appear to indicate as much of a change in growth rate. It was noted that the large change in length at age seen in gadoids was not apparent in halibut. In NFLD, changes in size had been more apparent than changes in growth. Differences seen in the previous analysis for 3NOPs4VWX+5Zc halibut were likely to have been a result of the gear selectivity. If it is true that there have not been significant changes in the growth of Atlantic halibut, this would mean that the length at age key is applicable across large time periods.

Some discussion of the need for more ageing ensued. It was argued that an age-based model would depend upon a good ageing program. However, any further decision about ageing would depend upon the success of the model review. If the model was found to be useful, it may be a good idea to continue the halibut ageing program. It was suggested that no new ageing would be conducted in the short-term.

The sample years were clarified: historical data is from 1964-69 and 1970-1974 (185 samples), while recent data was from 1997 and 2007 (197 samples). A table of age determinations by year (indicating source) was recommended.

A question was asked about the availability of halibut otoliths from NFLD. It was noted that there were likely some available.

Conclusions were that a separate length at age key should be maintained for males and females, the NFLD RV survey should be investigated as a possible source of additional samples, and some ageing should be conducted every 5 years for verification. Existing historical information should be sufficient for the current assessment requirements.

Presentation:	Maturity
Working Paper:	Assessment Framework for Atlantic Halibut Scotian Shelf and Southern Grand Banks (Div. 3NOPs4VWX+5Zc) Maritimes Region Science Advisory Process Data Inputs: Part II
Presenter:	K. Trzcinski

Presentation Highlights

At the last meeting, analysis of Maritimes Region data had suggested that female halibut were maturing before the males. Since then, literature sources had been investigated for additional insight as it would be necessary to select lengths at maturity for the assessment model. It was felt that the most appropriate lengths at maturity might be those identified in Trumble et al. (1993) or possibly Sigourney (2006).

Discussion

A question was asked about why NFLD data would be used to establish the length at maturity. It was suggested that the NFLD data was more recent than that from the Scotian Shelf. However, if there had been no change in growth rate, than the Scotian Shelf data might be applicable.

It was noted that it was only the length at 50% maturity that was required – not age. Age at maturity would be a function of the length at age key and length at maturity. The model was not expected to be particularly sensitive to this, but a decision was required.

It was suggested that an intermediate value could be used (i.e., between that determined for the Scotian Shelf and that for NFLD), as it would be difficult to use different length at maturities for different parts of the management unit.

Presentation:	Condition
Working Paper:	Assessment Framework for Atlantic Halibut Scotian Shelf and Southern Grand Banks (Div. 3NOPs4VWX+5Zc) Maritimes Region Science Advisory Process Data Inputs: Part II
Presenter:	K. Trzcinski

Presentation Highlights

At the last meeting, it was suggested that there may have been some change in the condition in halibut over time. Additional analysis was conducted, and there appears to be greater variability in 3NOP than in 4VWX.

Discussion

Clarification was sought on the source of the observations, i.e., at-sea observations versus port sampling. All different sources were used in this analysis; no difference was observed in index samples from the port sampling. It was noted that fish have been landed with their heads on since 1999.

It was suggested that there has been no change in the condition of halibut from the RV survey from 1970-present.

It was also suggested that analysis could be done for a specific length range; however, it was noted that the commercial fishery is composed primarily of adults.

A question was asked about whether year differences might be related to the timing of sampling.

While a condition index could be useful, it would be important to clarify how it was developed. There was general agreement that an annual condition index should be based on RV sampling. It was unclear whether information on condition would be available from the NFLD survey, but it was expected that the numbers would be very low.

Ecosystem Interactions

Presentation: Bycatch
Working Paper: Assessment Framework for Atlantic Halibut Scotian Shelf and Southern Grand Banks (Div. 3NOPs4VWX+5Zc) Maritimes Region Science Advisory Process Data Inputs: Part II
Presenter: S. Whoriskey

Presentation Highlights

At the last meeting, there had been a request to investigate the use of index vessels to determine bycatch rates in the fishery. Names of 6 vessels were obtained from J. Hansen, but a few additional names are required. Index vessels are boats that are targeting halibut only. Using the 6 index vessels identified to date (51 trips), analysis was conducted of the total catch of the top 14 species (72 species total). Preliminary results indicate that the proportion of halibut in the catch is increasing. Thorny skate bycatch increased to a high in 2005. In addition, bycatch analysis was conducted for each NAFO division, with the proportion caught for all years combined in longline commercial sets only. Results indicate that white hake bycatch is high in 3OP and 4V. Cusk bycatch is high only in 4X and 5Z. Cod bycatch is high in 3O.

Discussion

Some surprise was expressed that spiny dogfish wasn't identified in the top 14 species - just black dogfish. It was expected that spiny dogfish would be reported in 4X. It was noted that of the index vessels identified to date, 2 weren't fishing on the Scotian Shelf and 2 were large offshore vessels. Addition of other vessels to the index wouldn't be expected to change the results dramatically, but they would be expected to provide a more complete picture.

It was felt that the results provided a good picture for 3NOP and 4VW.

It was suggested that the analysis should be done by season, depth, and year, though it was unclear whether the bycatch pattern was changing significantly from year-to-year. Cod bycatch was expected to be limited in depths over 200 m.

It was suggested that the results could be compared to the bycatch rates in the halibut survey.

It was clarified that the maximum depth of the fishing activity analyzed was 1000 m, which was why there was a mix of shallow and deep-water bycatch species.

The need for extensive caveats when presenting the results of this analysis was reiterated. For example, it was felt that "top-up fishing" might still be influencing the results. Also, much of the bycatch listed was landed and not discarded. This should be clarified, perhaps through use of a legend to identify landed species versus others.

It was noted that there are 3 things of interest to be determined from the bycatch analysis: what is the total number of species that the halibut fishery is catching, how is this affected by vessel depth, etc., and how does this change with time and regions. A question was asked about whether it would be possible to model the percentage caught.

It was noted that some rare species of concern show up as 'other'.

There was some discussion about the management implications of this type of analysis, and whether there were likely to be any management actions resulting from this work. It was noted that external agencies are looking for impacts of the fishery on the ecosystem, which is why it is important to include total numbers.

Some clarification was also sought on what would be presented in the assessment advice. It was suggested that changes over time were not required, but cumulated effect by area and quarter might be useful (though perhaps not necessary). It would be good to have quantities identified rather than percentages, and the totals should be put on the top of the histogram. Also, the total number of species caught by area may also be useful.

Updates on Indices of Abundance

Presentation: Gulf of St. Lawrence Research Vessel (RV) Survey
Presenter: D. Archambault

Presentation Highlights

Only about 70 halibut, generally from 60-80 cm, are caught in the Gulf RV survey each year. There appears to be an increasing trend in halibut in the 4RST survey. There is also some indication of increase in 4T, though there was a slight decrease last year (2007). Given the size of the halibut caught, this is considered to be an index of recruitment, but it is also considered to track adult status. The TAC has been increased recently from 250 to 475 mt. However, efforts have also been made to increase the minimum legal size to give these halibut a chance to mature. A study on female maturity is being completed, which includes collection of gonads and microscopic analysis. In this study, none of the samples up to 100 cm were mature. The fishery is currently directed at halibut 81-100 cm. Spawning biomass may not be protected.

Discussion

It was noted that there appears to be an increase in the 4VWX RV survey as well.

It is useful to track what is happening in other areas, even if they are not currently part of the management unit. It was suggested that these results should be incorporated into the Research Document.

A question was asked about the year that the RV survey switched from the *CCGS Alfred Needler* to the *CCGS Teleost*. This change was in 2004, and the increase in halibut abundance was evident before this point.

There was some discussion about whether this might reflect a change in the distribution of resource. This was not believed to be the case, and most halibut are still concentrated in the channels. In 4T, they are found around the Magdelen Islands and in depths greater than 200 m. A few more are found in the estuary. This has been the same pattern for the past 10 years.

There was also some discussion of whether this increase might be due to a recruitment pulses. However, length frequencies indicate a broad distribution of lengths.

The question was raised as to whether this was considered to be a separate spawning stock. It was noted that the management unit was based on tagging -- not on spawning. It is unclear where the spawning areas are. However, it is suspect that there is some spawning in the Gulf as halibut caught there in January/February appeared ready to spawn. Tissue samples are not

currently being collected, but they could be for genetic analysis. About 4-5 years ago, a student was given some tissue samples, but they went to BC and no one has heard back from them. Any requests for tissue samples should be sent to D. Archambault as the head of RV survey.

Presentation: RV Survey Indices
Presenter: D. Ricard

Presentation Highlights

At present, the Maritimes, Newfoundland/Labrador, Gulf and Quebec regions and the US NMFS use a similar stratified random sampling design in their RV surveys. However, in order to combine these surveys into a unified abundance index, it is necessary to know the surface area of each stratum and the area swept by the trawl. A request was made for this data in August 2007 and it was received in December. Efforts are now being made to normalize the database (done for Maritimes and Southern Gulf). Biomass estimates are now available for the Maritimes and the southern Gulf. Two products are mean numbers per stratum, raw length frequencies, and stratified length frequencies.

Discussion

Someone asked what strata were being used from the US survey. NMFS does go into 5Zc, which is in the management unit. It was noted that there is not much halibut caught in the survey, but it does show up in spring. It was also asked whether the US had done a halibut assessment using their RV survey information. While zeros were not felt to be a problem, there might be an issue with overlapping areas between DFO and NMFS surveys in 5Zc. Some standardized area would have to be defined over a period of time.

The limitations of the RV dataset, including low catchability, were recognized. However, it is a long time series that could be valuable for stabilizing the model.

It was agreed that each RV index would be used separately – they would not be combined. Also, it was agreed that the model input would be the stratified estimate. If the results show that the RV surveys are not informative with pattern residuals, then this will be stated.

Presentation: Fixed Station Index and Commercial Index
Presenter: K. Trzcinski

Presentation Highlights

Details of the fixed station index were briefly presented, including the number of target sets and the number of missing sets. The fixed station index seems to be fairly stable, while the commercial index does not appear to be stable. If the 2007 point in the fixed station index is accurate, it is the highest in the series. The 2007 commercial index point has not been plotted yet. The fixed station index appears to be independent of the number sets. At the last meeting, it was asked whether the stratification scheme used in the fixed station survey was useful (i.e., did it reduce the variance). Estimates of halibut abundance were made with and without the stratification scheme. Results showed a 35% decrease in variance when you use strata, i.e., it still appears to be useful – even after 10 years. However, it is possible that there is a better stratification scheme that could be used, e.g., depth. If the stratification scheme is used the length frequencies should be adjusted based on the stratification.

Discussion

It was clarified that no adjustments to the length frequencies based on the strata have been made to the commercial index.

Two philosophies of stratification were mentioned: one that suggests changing stratification over time and one that rejects changing the stratification scheme.

Results show that there are consistently good fishing grounds. This might be expected if fishing areas reflect habitat. Results indicate that habitat requirements for halibut are still met in these areas.

It was noted that there had been no spatial expansion, as it would make more sense to have a q coefficient in the model. There is greater confidence in doing spatial expansion when a survey has a random design.

It was noted that the fixed stations were not always the same every year. There have been 72 stations that have been done consistently every year. While it doesn't appears to matter that much, ideally the same stations would be done every year.

If there was going to be a change in distribution, it was suggested that declines were more likely in 'low' strata and increases were more likely in 'high' strata. It was suggested that new stations could be run to see if it's changed.

It was asked how the strata of new stations would be determined and whether they would have to be within the potentially mapped area. It was noted that the original strata were based on catch rates of the commercial fishery, and it was suggested that the catch rates in 1995 could be used to add new stations. It was noted that new stations were being added to address fishermen's concerns fishermen in those areas, e.g., in 4Vn and the Bay of Fundy. The survey would have to be redesigned if there was a change in distribution of species. It was suggested that it would be easier to stratify by depth since new stations could be added anywhere.

Some questions were asked about the stratification scheme used on the west coast, but the details weren't known. They were known to use a fixed station design. They had some issues with changes in fishing practices and fishing grounds, and they also had some problems with catchability that had to be addressed.

Presentation: Catch Per Unit Effort (CPUE)
Presenter: K. Trzcinski

Discussion

No update was provided on the CPUE of the commercial index. S. Lusseau was going to send a report from Scotland, but it hasn't been received yet. It was explained that the CPUE index was now using the same index vessels as were used for the bycatch analysis.

It was suggested that the recommendations from the last meeting should be brought forward and prioritized with the other action items. A proposal had been made for S. Whoriskey to do some work on this.

It was explained that it would take a lot of work to incorporate the CPUE index into the model. While a CPUE series could be provided for assessment, it might not be in a format that could be used within a model.

Closing Remarks

The chair thanked everyone for coming and reminded the reviewers to provide comments for inclusion in the proceedings.

REVIEW OF MODELS TO DETERMINE STATUS AND PRODUCTIVITY (16 -17 June 2009)

After welcoming participants (Appendix 2) and doing a round of introductions, the chair (T. Worcester) provided a brief introduction to the meeting.

She noted that this was the third in a series of meetings to develop a new assessment framework for Atlantic halibut. The focus of the meeting would be on the assessment methodology, and not on potential assessment results or management implications. What would be presented and discussed were the best efforts of the assessment team to develop an assessment model that would make best use of the information available at the present time to provide advice sufficient to make required management decisions in the next few years. We are not looking for the perfect model by the end of tomorrow, but rather a way forward, which will be implemented at the next assessment. We are also looking for a thorough and honest evaluation of that model, including a good description of its assumptions, uncertainties, peculiarities and other details that should be taken into account when providing management advice. By the end of the meeting, we should also have some agreement on what types of major changes would necessitate re-opening the halibut framework (e.g., growth changes, major changes in surveys, strong retrospective). However, we want to allow the assessment team the flexibility to make minor changes to the model and data inputs as may be required.

While everyone was invited to participate fully in the discussion and contribute knowledge to the process, participants were reminded that this was a science meeting and extraneous discussion would be limited. The external peer reviewers were introduced, including Bill Clark, previously of the International Pacific Halibut Commission, and Devora Hart, from the Northeast Fisheries Science Centre in Woods Hole. Finally, it was noted that halibut is currently being assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and information developed through this meeting would likely contribute towards their review.

The Terms of Reference for the meeting were reviewed (Appendix 1), including the objectives of this meeting, which were to:

- Determine the methodology to estimate the current state of the stock, including methods for estimating stock size and fishing mortality.
- Determine the methodology to characterize stock productivity including reference points for fishing mortality and spawning stock biomass.
- Determine forecasting methodology for providing advice on harvest levels.
- Provide guidance on inter-framework review activities, including
    - Review procedure and frequency of providing fisheries management advice
    - Review events that would trigger an earlier-than-scheduled assessment

The Agenda (Appendix 3) was reviewed, and nothing further was added.

Biology and Management Unit

Working Paper: Trzcinski, M.K., S. Armsworthy, S. Wilson, R.K. Mohn, and S.E. Campana. 2009. A framework for the assessment of the Scotian Shelf and Southern Grand Banks Atlantic Halibut Stock. CSA Working Paper 2009/24.
Presenter: K. Trzcinski

Presentation Highlights

Halibut are long-lived, reach up to 230 cm and 170 kg in size, and can live to 50 years. Analysis of habitat preference indicates that they commonly found along the shelf edge (~400 m). Landings, which are primarily from Nova Scotia, were unregulated until 1988 when a TAC was introduced. The current management unit is based on tagging work conducted previously by DFO. It excludes the Gulf population and areas in northern NFLD. Some of the stock (3N) is outside Canadian waters, so foreign landings must also be considered. Tagging data (<81 cm) have been investigated to determine the proportions recaptured in each NAFO division, and there appears to be a large amount of residency at the scale of a NAFO division. For example, individuals released in 4X were often recaptured in 4X (63%). Previous analysis of tagging data has suggested that younger halibut tend to move longer distances than older halibut and tagged halibut tend to move north (towards NFLD) more often than south (towards the US). Some halibut tagged in the 3NOPs4VWX+5Zc management unit have been recaptured in Iceland. Tagging information to date provides a preliminary understanding of the movement of halibut within the management unit.

Discussion

It was clarified that the movement results were based on tagging data that did not exclude the first month of recapture. It was simply a presentation of the raw data. Early recaptures (within two months) should be excluded.

It was also clarified that the 50 year-old fish mentioned in the presentation had been caught within the management unit, and it was a male. It was noted that natural mortality can be a little lower for male flatfish. In the Pacific, male halibut tend to get a little older than females.

Important factors in the movement of Pacific halibut were discussed. In particular, the movement of early life-history stages, including drifting of larvae and the counter current migration of juveniles, was found to be critical to understanding the dynamics of the stock. The movement of juveniles was considered to be an important gap in the understanding of Atlantic halibut.

Another gap was felt to be the location of spawning activity. It was asked whether the winter fishery ever caught spawning fish. The response was that spawning fish have been caught. The fishery has seen some spawning fish on the banks in May. However, the closure of the Haddock Box has limited fishing of spawning fish within this area. In late July/Aug, the fishery sees spawning fish in deeper water.

Questions of clarification were asked about the type of fishing gear that is used to catch halibut. It was explained that in some NAFO divisions (4VsW, 3NO), there is a directed fishery for halibut. In the southwest, it is a bycatch/incidental fishery, i.e., incidental to fishing for cod and haddock, though there may be more directing for halibut as other species decline. On the Grand Banks, it's pretty much a directed fishery. The halibut fishery is also very seasonal. In the south, the fishery occurs in the summer/fall and smaller boats are used. Further east, bigger boats are

used that can fish in more inclement weather. Some similarities with the Pacific halibut fishery were noted. In BC, there is an offshore fleet over 100 ft. Prior to 1984, they used a J-hook. Most people used 3s. In 1985, the circle (#16) became dominant. Today, the #14, which is used for cod and haddock also, is the most common. Spacing between hooks is typically 18 ft standard or maximum.

Some questions were raised about the tables that presented the tagging information. For example, it was unclear what happened to fish listed as tagged in 4T in Table 7, as 4T was not shown as a release area. Also, fish tagged in 3Ps appeared to be missing from Table 7, though 2 were indicated as released and recaptured in 3P in Table 8. It was noted that the tables only included tag returns to 2007 so some tag returns were missing. The absence of recaptures from 3L was also discussed. While halibut are found there and it is open to fishing, the catch rates are very small (approximately 5 mt). With such small amounts, it doesn't tend to get discussed much.

It was noted that of all the halibut tagged and released in the management area, only a few percent were caught outside. It was not possible at the time to say what percentage released outside were caught inside the management area. Concern was expressed about the mixing rates between 4T and 4Vn and the fact that there were no rewards for tags recaptured in the Gulf of St. Lawrence.

Fisheries Data

Working Paper: Trzcinski, M.K., S. Armsworthy, S. Wilson, R.K. Mohn, and S.E. Campana. 2009. A Framework for the Assessment of the Scotian Shelf and Southern Grand Banks Atlantic Halibut Stock. CSA Working Paper 2009/24.
Presenter: K. Trzcinski

Presentation Highlights

Port sampling started in 1948, but halibut weren't measured until 1989 since they were landed with their heads off. Observers have been placed on the otter trawl fleet since 1977 and on the longline fleet since 1988. A legal limit of 81 cm was first introduced in 1988 but only became apparent in the data in 1994. A short description of the halibut survey was presented. It started in 1998, and it is an important source of information for length-frequency data. Trip limits were introduced in some areas 1985. There are no trip limits in 3NOPs, so CPUE is considered to be a better reflection of abundance in these areas than in the rest of the management unit.

Patterns in foreign landings were presented, including the decline from the 1960s to the 1980s with some peaks afterwards. It was noted that landings were never very large (<1000 mt). Most of the Canadian landings are from the longline fleet, with some contribution from the otter trawlers (only 50-100 mt in recent years). Otter trawls are catching more small fish, but they are required to put them back.

Observer coverage peaked in the otter trawl fleet in the 1990s, and then gradually increasing from 1990 to the early 2000s. Coverage peaks in spring for the otter trawl fleet and in summer for longliners.

It is hard to determine the impact of the legal size limit. For the otter trawls, a large proportion of the catch is <81 cm. For loneliners, less than 20% are <81 cm. The sex ratio of the catch was also described; the proportion of females tends to increase over 100 cm due in part to different growth rates. Further analysis assumes a 50% catch ratio until 100 cm.

The mean length of the catch was quite low in the early years (50-60 cm), but has been increasing to 100-140 cm.

Discussion

It was mentioned that there was little observer coverage on the smaller longline boats in the southwest -- only on the large boats from the east. Observer coverage started in 1998 with the halibut survey (2 month window). There is very little observer coverage of the commercial fishery at all, which introduces some bias. More observer coverage was recommended. The reasons for the drop in observer coverage in 2005 were discussed. One reason was the reduced participation in the halibut survey in 2005, with 70 more stations done in 2006. Observer coverage has been increasing due to issues related to cusk. Most of the larger boats fishing in NFLD are Maritimes boats, and there has been an increase in observer coverage in 3NO related to cod bycatch in NFLD waters. It was clarified that observers do record discards.

Estimates of halibut discard mortality were discussed. J. Neilson did a holding tank study. The survival rate was estimated at 77% for longline caught halibut and a little less for halibut caught in otter trawls. However, the expectation is that the survival rate is higher than 77% in the longline fleet. Otter trawl survival has greater uncertainty. Survival rates are quite high in the Pacific (84%), but release methods are highly controlled. Survival depends on how the fish are handled. Some studies of otter trawl survival indicate much lower survivals (approximately 50%). On short tows with quick release, it might be longer.

It was asked whether the otter trawl landings included the foreign landings from the silver hake fishery. If so, this fishery is quite different from the other fisheries, including use of small mesh. It was suggested that these results should be separated out from the other fisheries. Also, it was suggested that the Canadian otter trawl percent coverage should be confirmed as it didn't look right.

It was noted that greater than 90% of the port sampling and observer data is occurring during the halibut survey (commercial index) in June/July. The halibut fishery is not extensively port sampled outside of that timeframe. Boats without an observer onboard are generally sampled. Halibut are landed in a large number of small ports. Most of the information comes from the survey, but not all. It was suggested that a plot be prepared of the proportion of the sampling coming from the survey versus not from the survey. It was agreed that there was not enough port sampling outside the 2 month survey period to compare to that sampled during the survey.

There was some discussion of the variations in CPUE within the management area. However, it was noted that there is only one model being presented for the whole area. It is not being broken down by area. While it is known that the CPUE won't be the same everywhere, this assumption is used to get the model running. It is worth looking at those differences, but it is not clear how they would be incorporated into the model yet. There is some effort being made to standardize for the differences between areas.

A question was asked about the results that had been presented. In particular, it was asked whether it was true that 90% (by number) of the fish being caught in the observed longline fishery were legal size. It was suggested that this may be high. It was noted that this result was dependant on the quality of the observer coverage.

Abundance Indices

Working Paper: Trzcinski, M.K., S. Armsworthy, S. Wilson, R.K. Mohn, and S.E. Campana. 2009. A Framework for the Assessment of the Scotian Shelf and Southern Grand Banks Atlantic Halibut Stock. CSA Working Paper 2009/24.
Presenters: K. Trzcinski

Presentation Highlights

Abundance indices from a variety of sources were presented, and comments were made about each. For example, the Maritimes RV survey catches few fish but goes back to the 1970s and includes some important signals. It does catch some small fish and may be a potential indication of recruitment. The NFLD RV survey index was not used in the model but was presented for comparison. The halibut survey covers the entire stock area, including Maritimes and Newfoundland & Labrador regions, but there are some challenges in standardizing it. The commercial index comes from both regions, but it is not standardized.

Catch rates in the longline fishery were presented by year, month, vessel, and NAFO division. It was noted that there may have been some decline in catch rates from 1988-1995. The CPUE index stops in 1995 due to the influence of trip limits. It was proposed that the CPUE data be presented and examined but that model not be tuned to the CPUE as an index of abundance.

Discussion

There was some discussion about whether or not to use the stratification mean for the Maritimes RV survey index. It was noted that the stratification had not been designed for halibut, was generally viewed as being more useful for cod and haddock, and there were lots of strata for very few fish. However, it was suggested that if the stratification is proportional by area, then this is not a concern. It was generally agreed that there was no downside of using the stratified mean and there might be some benefit. The area expanded method was also suggested.

Use of the NFLD RV survey data was discussed. It was agreed that the primary focus should be on the more important indices (e.g., halibut survey). However, it was suggested that the NFLD RV survey could be tested as an index in the model to see what happened. There is limited sampling in the NFLD part of the stock area, and the fishery thinks that it's a significant portion of the halibut population. It was noted that NFLD surveys hadn't always been completed in the past, and the stratified mean would have to be used.

It was clarified that the CPUE data comes from logbooks. It was suggested that the number of hooks recorded on logbooks might not be accurate, and it was noted that it was not mandatory to fill them out in earlier years. Scientists are generally hesitant to use the CPUE as an index of abundance unless there is nothing else available. Industry also expressed some concerns about its accuracy. For this analysis, data have been filtered to pick out directed halibut trips. It would be possible to use a better filter.

In the Pacific, port sampling, interviews with skippers, and other methods are used to improve the quality of the fisheries data. Mandatory logbooks don't solve everything.

The importance of standardizing the halibut survey for things such as hook spacing was stressed. While this is being investigated for the halibut survey, it might not be possible to investigate this in the commercial data. It was asked whether a skipper would tend to use the same spacing. The response was that it was likely, but it should come out in the vessel effect (if

they don't change from year to year). It was noted that the catch rate was influenced a lot by hook spacing in the Pacific, but there was no influence on halibut size composition. Hook size did not have a bit impact on catch rate in the Pacific.

Ageing

Working Paper: Trzcinski, M.K., S. Armsworthy, S. Wilson, R.K. Mohn, and S.E. Campana. 2009. A Framework for the Assessment of the Scotian Shelf and Southern Grand Banks Atlantic Halibut Stock. CSA Working Paper 2009/24.
Presenters: K. Trzcinski

Presentation Highlights

The ageing work that has been conducted to date on Atlantic halibut was presented as another important part of the assessment, as the proposed model is age-based. Growth parameters and potential changes in growth rates over time have also been explored, as changes in growth rate or growth parameters could result in large changes in the biomass estimates and trends from the model. However, there does not appear to be significant differences in growth between different areas or time periods (based on 80 otoliths per time period). An age-length plot was produced that showed greater variation in length for the larger/older fish. The model assumption is that growth is linear for younger fish.

Discussion

It was asked whether there have been any methodological changes in the ageing over time. The response was that new methods are being developed, but all otoliths (new and archived ones) are being aged in the same way, i.e., new methods are applied to the full collection.

Concern was expressed about the ability to draw conclusions about whether or not there had been any changes in growth over time based on only 80 otoliths per time period. There would be little power to detect a difference (though a power analysis was not conducted). It was suggested that it would be more appropriate to say that the data are inconclusive and to discuss what would be done in the future.

It was clarified that the analysis of changes in growth rate over time was done using only otoliths from the RV trawl survey since there were no longline samples from earlier times. It was asked whether the otter trawls have remained similar over time.

It was noted that one would expect to see non-linear growth at ages 10-12, which is indicated in Figure 19.

It was clarified that while consistent growth was assumed through the time period, it wasn't assumed that there was a constant growth rate. The von B parameters were not used to fit the data. The raw data itself was used. However, it was noted that this might be problematic if size frequency is changing. Also, any changes might not be independent of fishing mortality. Age structure and recruitment would effect the size frequencies. A single age-length key is used rather than doing it each year. However, it was suggested that this key should be updated every so often (every 5 or 10 years).

Some discussion ensued about the effects of gear on the lengths at age. While there had been separation of males and females, there had not been separation by gear type. Information on gear type may be important in the conversion of lengths to ages. For example, a 6-year old

male fish could be 30-40 cm longer in one gear versus the other. However, it was noted that there was not much overlap between the otter trawl and longline samples. It was recognized that this may not have a big effect, but it should be explored. It was not possible at the meeting to separate the trawl data into different fleets. It was suggested that results from the 130 versus 90 mm mesh data could be investigated since there were some samples from different meshes.

The assumption that growth is similar throughout the management area was discussed. No differences have been observed between 4VWX and the Grand Banks; however, this analysis is data limited. This might be something that could be tested in the future. Differences in age at maturity might also be explored.

If the growth model is out by 10% (sensitivity run), it was suggested that it might be appropriate to start questioning the model. Other criteria could also be developed.

Assessment Model

Working Paper: Trzcinski, M.K., S. Armsworthy, S. Wilson, R.K. Mohn, and S.E. Campana. 2009. A Framework for the Assessment of the Scotian Shelf and Southern Grand Banks Atlantic Halibut Stock. CSA Working Paper 2009/24.
Presenters: K. Trzcinski

Presentation Highlights

Methods

The proposed model is a length-based, age and sex structured population dynamics model.

Population dynamics equations used in the proposed model were presented. The suggested abundance indices to be used in the model were reviewed, including the 4VWX RV survey (1970-2006), halibut survey (1998-2007), and the commercial index (1998-2007). One year of tagging data was incorporated into the model (2006 recaptured in 2007). Model penalties and constraints were described, including penalties for abundances below 100, exploitation rate above 98%, and recruitment in 1970 is assumed to be less than R_{msy}. Recruitment in the last year is assumed to be the mean of the last three years.

Results

Some of the selectivity parameters went up against their bounds. The model appeared to fit the 4VWX RV survey trends fairly well with some residuals. It was arguable whether the model fit the halibut survey well. There was not much pattern in the commercial index. The model did fit to proportions at length. In general, the proposed model appears to capture the overall fit but misses some points (i.e., residuals).

Sensitivities

The base run included all indices. (Note: SSB scale should be 10,000 not 1,000). Removing the tagging information had a large impact on the results. Increasing the likelihood weighting of the survey indices (DFO RV and halibut survey) by 10 times led to a lack of convergence, but it did fit the halibut survey better. Incorporating just the first 20 ages also led to a lack of convergence. This suggests that the model is not dealing with them properly. A 20+ group might fix it. This needs to be investigated further before the assessment. Using a natural mortality of 0.2, which is probably an unreasonably high value for this species, gave similar patterns but impacted state

variables (SSB, exploitation rate). It is important to keep looking at this as there is some uncertainty in M. It might be better to use 0.15 as the high end. Removing R_{msy} penalties changed the biomass back in the 1970s and 1980s (increased by 22%). This is not important for providing advice next year, but it may be important for long-term trends, particularly for the COSEWIC assessment. An alternative to including the R_{msy} penalties would be to state that there is more uncertainty in the early years and provide confidence limits to help describe the uncertainty. There would have to be some discussion before older data (i.e., from the 1960s) was included.

Profile Likelihoods

1. Natural mortality: Ideally, a 'U' shape would be evident with a clear minimum. The proposed model is fairly complex, so it does have some trouble doing this. Some U shape is observed in the 4VWX RV survey (M from 0.9 to 1.4). There is also a little shape in the halibut survey, with M closer to 0.15. Suggestion: It would be useful to have 4VWX RV and length frequency data on the same plot (better plot if cut off at 0.7) to visualize the 'tug-of-war" of these data sets on the natural mortality.
2. Start Zs: This analysis shows that you could choose any value, as it is not defined by data (Not well estimated, insensitive). Contours display state variable of interest and the maximum likelihood.
3. Starting recruitment: No good information is provided, which is due to the problem with convergence rather than the profiles. While the 4VWX RV survey does have some length frequency information from back then (~30 individuals every year), the model has trouble starting with just a little bit of data. Suggestion: The value of starting recruitment should be randomized with the same parameters.

Plus and Minus Bins in the Length-Frequency Data

Many halibut were caught in the 100 cm range, but fewer were caught in the smaller and larger bins. Different sized plus/minus bins were investigated. Longline catch and otter trawl catch are relatively insensitive until you get to larger bins. The RV survey is more sensitive to bin size. There is a residual somewhere that's having a large effect, but it was unclear how to resolve this. Suggestion: Every residual greater than 3 standard deviations could be mapped and treat differently using multifan. Residuals do not appear to be undermining the advice at this point.

Conclusions

The model incorporates many of the data sets, including the abundance indices, catch length frequencies, and tagging information. It also captures the overall dynamics despite noisy data and few strong signals. The model could be simplified by removing sex differences (need good information from observers and port sampling -- observer data are more useful than port sampling data for sex composition). There will be a continued need to test for growth differences in the future. The sensitivity runs indicate some issues that need to be addressed, but they also suggest that the model structure is sufficient for assessment purposes. Biological reference points are still needed to guide management.

Discussion

Stock-recruitment relationships were discussed, including the use of the Ricker versus the Beverton-Holt relationship. It was noted that a stock-recruit relationship was weak in Pacific halibut. The population has been driven low twice there, but they still didn't see a strong relationship. Recruitment was found to be more strongly driven by environmental conditions. It was suggested that the Ricker model was meant for salmon and other fish that are constrained in space. Use of the Schaefer production model was also suggested. The selection of a stock-

recruit relationship will make a difference to the biological reference points, so a decision will have to be made or multiple approaches could be offered. It was suggested that the AICs (Akaike's Information Criteria) could be compared to determine which fits better; however, this type of analysis is not meant to make cross-model comparisons. It is meant for within model comparisons. Having both gives a sensitivity analysis. R. Myers had a paper that said you get a better fit at the origin with the Ricker model, which is more important. It would be possible to relax the sigma and see what kind of fit results. It was noted that sigma is at 0.6. It was also suggested that Beverton-Holt is usually more conservative. Use of a non-parametric fit was suggested, since neither the Ricker or Beverton-Holt relationships may be applicable. It would also be possible to constrain the model not to go outside the observations.

Generally, there was good recruitment in the 1970s for groundfish. It was asked whether one would expect to see a similar fit of recruitment to temperature instead of spawning stock biomass. It was suggested that temperature or other variables could be influencing recruitment and they could be investigated and used as co-variates if relevant.

Some questions were asked about the use of the tagging information in the model. It was noted that the last assessment made use of two years of tagging data, while the current model formulation only used one. There was a problem with the way the model was set up. There is a cohort release year and multiple recapture years. Currently the model is only running to 2007. It would require a bit more model development to incorporate multiple years. Concerns were also expressed about the lack of a “waiting time”, or time after release in which recaptures were not considered. It was agreed that this would be fixed for the assessment. It was then asked whether tagging data had been investigated to determine what it said about gear selectivity, and what sort of selectivities were used to predict the tag returns. The response was that selectivity at age was estimated and then used to generate the predicted population that would be recaptured. However, ages of the marked fish are not known. Length-frequencies are available for the observer data. An increase is seen based on selectivity up until about 90 cm and then it drops off. More small fish are seen in the tagging results than in the observer results. Recapture rate as a function of size at release has not been determined given the small number (135) of recaptures. In the Pacific, there tends to be domed selectivity with enough data in the larger sizes to be confident of these results. This is due to commercial selectivity and includes grounds as well as gear. In terms of the influence of the tagging information, it turns out that the results are similar whether you include the tagging information or not. The model has sufficient flexibility that, as the data reveals itself, changes can be incorporated. Any tagging program, even with large amounts of data, is going to be subject to assumptions. Trying to put everything (all sources of data) together is a good approach. There were some bad experience with the mark-recapture program on the Pacific, and the results have still not been interpreted (i.e., results indicate way more halibut than seems reasonable). Very few fish were recaptured, and the spatial distribution of returns is baffling. On the Pacific, the IPHC has chosen to believe the surveys and the assessment over the tagging results.

There was some discussion of the weighting of the abundance indices and the sensitivity of the model to the weighting. All survey indices are treated equally in the current model formulation. In the future, “natural weighting” based on the length of the survey series, the sample size, and the variance could be used. The underlying variance was not yet known and a comparison of CVs between surveys had not been conducted.

It was clarified that 22.9% was an exploitation rate and not a fishing mortality; the fishing mortality would be higher. It was noted that this value was a bit higher than that found from the tagging results in the previous assessment. It was noted that catch is currently divided by the vulnerable population. If it was divided by the total biomass, it would be possible to add the

exploitation rates together (as is more traditional). This wouldn't change the model or how it fits, but it would impact the way the data is summarized. It was not considered to be good form to have an instantaneous M but not an instantaneous F. The exploitation rate in Figure 34 was to be checked (appeared to be less than the 22.9% mentioned earlier).

It was noted that M was estimated to be 0.1. In the Pacific, it is 0.15 based on life-history. A good rule of thumb is that k / M should be roughly constant and less than 1. The estimated M used here appears to be roughly in the right ballpark. It was suggested that the female natural mortality could be fixed and then the male natural mortality could be estimated. It is hard to estimate both at the same time. This approach is also used to estimate catchabilities in the Pacific.

Since selectivities are mostly length based, it was suggested that selectivities could be applied to the length rather than the age. Since there don't appear to be large changes in growth over time, it doesn't matter whether you use lengths or ages. A length-based selectivity was considered to be a longer-term consideration. To simplify matters, it may be useful to use separate selectivities for males and females in the longline fishery but not the otter trawl fishery. Otter trawls catch mostly small fish, and at small sizes they are growing similarly. There was some surprised at the similarity in the longline fleet.

There was some discussion of the RV survey catchability coefficient. It was clarified that q was assumed to be constant through time. It was determined that no conversation factor had ever been estimated for halibut since not enough of them were caught in the 4VWX RV survey. The conversion factor for American plaice (less than 28 cm) was looked at, as were those for witch and yellowtail flounder. There was no significant difference observed for larger fish (>28 cm). It was suggested that an estimate of q could be made, with uncertainty around it, like a prior. Given the imprecision, this might be a better way to do it. However, one would expect that it will go to the prior if there wasn't any data to inform it afterwards. It was noted that conversion estimates have made a big difference for some species and could potentially improve the fit of the halibut model. It was suggested that q could be included as a random walk (penalties included).

Length-frequencies have a high natural weighting. This has been found for other species using a similar model framework. With those species, the length-frequencies were intentionally down-weighted. They have been and could be more (capped at 150 fish). It was suggested that rather than bounding the number of fish (e.g., 150) with a cap, it could be bounded by the number of trips. D. Hart has found that length-frequencies have more stability to them. It was suggested that there are two groups of people – those who like tagging data and those who like composition data. This model uses both sources of information. A lot of work has been put into making the tagging information robust. If survey indices and tagging results are evaluated independently, it would be possible to determine whether they are moving in the same direction. Sensitivity runs can be used to investigate this. For example, the NFLD RV survey was giving a different trend. The model would try to resolve this.

There was some additional discussion of the potential inclusion of other indices. Some suggested that all available survey indices should be included, if possible. It was suggested that the commercial index could continue to be used for the length compositions (port sampling) but could be dropped as a standardized catch rate. The model wouldn't be tuned to the magnitude of the commercial index, but the pattern would be incorporated. For the otter trawl fleet, observer data are used to estimate catch composition. For the longline fleet, both observer and port sampling are used. It was agreed that the commercial index would not be used as an index of abundance. Money has been spent to improve the CPUE index. The proposed model

formulation did not include the CPUE as a tuning index, but the trend in the CPUE could be compared to the model results. CPUE could also be incorporated into the model with very low weighting so that it doesn't affect the model fit. It was suggested that money could be better spent on improving the survey.

Industry expressed concern about whether the model results would reflect industry perception of the halibut population. Industry is currently seeing lots of fish. It was noted that the model indicates that halibut biomass has tripled from 1995 to present.

It was asked whether it was safe to assume a flat selectivity. The response was that it was safer for the fish. It was suggested that it is not good form to assume something for which there is no data, i.e., it is not good practice to assume domed selectivity unless there is data to support it OR at least one of the data sources should be flat. Industry noted that fishing vessels can go into deep water and catch big halibut, but they are worth less, the catch rates are lower and there have been other options available, so they are haven't been targeted even when quotas haven't been met. The survey only goes as deep as 400 fathoms. There is tagging data available to address this issue. If there is a domed selectivity, the likelihood of recapture for large fish should go down, but there currently is not enough data to estimate a dome-shaped selectivity. In terms of depth preference, Figure 2 indicates that there wasn't a huge relationship between size and depth (i.e., there does not appear to be an increase in size in deeper waters). Males are a little deeper than females.

Reviewer Comments

Bill Clark

With Pacific halibut, there were problems with having a management unit that was too small. Ideally, the whole stock would be included in the model, which seems to have been done for the most part for this stock.

Life-history and migrations are important to know, particularly of juveniles (before recruitment to the fishery). Finding spawning grounds is important but expensive (ickthyoplankton). Surprised you do not catch more juveniles in the small-mesh trawl gear. On the Pacific, you find lots of them.

Good estimates of catch and catch composition are important, which are dependent on the length frequencies. While it is tempting simply to use sampling from the commercial index, they are really needed from the whole fishery (whole area and all seasons). Using a weighted sum of all components – the way that has been done here – is a good approach, and there isn't really a better way to do it.

Having better information on ages on an annual basis or periodic ageing (3-5 years) can really improve the performance. Ideally, there would be an ability to track year classes. In the Pacific, staff reads 25,000 otoliths per year. For this management unit, even if it would be possible to age 1,000 per year, it would really improve the assessment for a relatively small price. It will be important to get a good representation across the survey.

One good abundance index that can be relied upon is needed. It is unclear whether additional abundance indices are really required. The halibut survey index is good and should be used the most. One suggestion may be to only include the halibut survey and then add the trawl survey index later. While it does only start in 1998, the production model in the Pacific only goes back to 1996. A simpler model could be used to model historical abundance trends. While the

inclination to use all the data available is understandable, it is not necessary. The trawl survey does seem to be fitting well and it is picking up the recruitment fairly well. More importantly, all removals need to be included.

The halibut survey estimates may need to be revisited. Make sure the survey is representative; the spatial and depth coverage may need to be increased. Also consider a hook spacing adjustment. It should be standardized in the future (e.g., 18 feet) and corrected for in the past. Bait standarization can be tricky, and a lot of effort has gone into standardize it in the Pacific (i.e., bait is supplied). Further discussion may be required, e.g., squid.

Devora Hart

The model should be viewed as a work in progress. It has some rough edges that need to be sanded down, but it's a nice first step.

It would be nice to add a forecasting mode, as forecasting is required for management advice. It would be useful to be able to run it forward under different scenarios. Surprisingly, Atlantic halibut seems to be almost data poor, with just enough data to do a model like this.

It may be useful to check some simple models against the more complex assessment model. It may be possible to do a Beverton-Holt equilibrium Z estimator, Skedansky-Honeg method, Depletion Corrected Average Catch (DCAC) method (initial fishing down period, meant for things that are long-lived, matched up well with Acadian redfish), or something else. Just to check for consistency. Use as a diagnostic tool. These alternative approaches can help to determine if you've gone completely wrong.

The assumed variability of the trawl survey could be increased.

It may also be useful to do some simulation testing. This can be done in R. Produce an input file to the program, then check to see how well the program works. Process error can be built in. Perhaps this would be something to aim for in the next framework. There was some additional discussion on how to generate simulation data.

Bob Mohn

Use of a simpler model was encouraged; e.g., ASPIC (A Stock Production Model Incorporating Covariates), SURBA (survey-based separable model of mortality), etc., some additional diagnostics were suggested, and more tables of the input/output data were recommended (e.g., catch at age, biomass). Use of contour plots was supported, as was random starts for to test model convergence.

Others

The Haddock Box closed area is currently closed to groundfish fishing year round. This needs to be monitored by the halibut survey (it was clarified that 7-8 stations had been conducted there in 2008). Make sure that both Western and Emerald banks are covered.

It is important to ensure that the halibut survey has good coverage in all NAFO divisions. Further investigation of depth and area coverage may be required.

Reference Points and Projections (Management Advice)

Discussion

A stock-recruit curve has been done, as has a yield per recruit curve. A total yield curve could be attempted. While virgin biomass is unknown, efforts could be made to try to estimate it. It may be useful to use both the Ricker and the Beverton-Holt relationships to provide management advice. Alternatively, the consequences of using a Beverton-Holt relationship if it's actually a Ricker relationship could be described.

Projections are still required. Software is readily available to do this.

At present, it is not clear what the management objectives for Atlantic halibut are. They tend to be quite vague. This is not entirely a management decision, but there needs to be some discussion with science also.

B. Chapman showed a table of the different approaches that have been used to set limit reference points for a variety of species, as well as a summary of Canada's precautionary approach. In the assessment, one might expect to review many different approaches and their results.

There should be some agreement on the reference points before going into the next assessment. For example, if the limit reference point is 40% of B_{msy}, this provides some guidance. It was noted that B_{msy} can be produced from the model.

Conclusions

Biology

There is reasonably good information for Atlantic halibut on:

- Adult distribution (depth/temp) based on the fishery/survey, including area occupied, though the northern distribution is not well known.
- Age / length structure, though the ageing program needs to be continued and results should be separated by gear type.
- Growth (while data on changes over time are inconclusive, evidence does not suggest any substantial change)
- Condition
- Fecundity
- Age, length and weight at maturity
- Natural mortality (a suggestion was made to fix the female rate and then estimate male natural mortality, but this was seen as a low priority)
- Feeding from stomach content analysis

There is limited information for Atlantic halibut on:

- Spawning locations
- Distribution and movement of juveniles
- Movement based on tagging. Industry expressed significant interest in mixing with the Gulf stock, and there are still some questions about movement across the US/Canada boundary. Additional tagging is required.
- Genetics

Management Unit

It was agreed that the previous management unit (3NOPs4VWX+5Zc) would be maintained for now.

How to manage different areas within the management unit (e.g., spatial disaggregation of the quota based on relative distribution of effort) was not resolved. It was agreed that Science should be asked a specific question on this topic, for review potentially at the next assessment. The question would not likely be asking DFO Science to determine the best method to allocate quota to each area, but it would likely be related to how much flexibility/risk there is in the concentration/distribution of effort.

It was noted that, in the Pacific, there is one assessment area but 5 quota areas. Quota is not transferable between areas. The policy in the US is to harvest in proportion to abundance based on survey estimates. For many years, separate assessments were conducted for each area, but this led to an overestimation of biomass due to movement. Survey allocation is controversial. Policy in Canada is not that structured. There is a general sense that it is not wise to deplete any one area. However, this is not the only sustainable way to harvest the fish. It flows from the management objectives.

For COSEWIC, DFO will be asked to comment on the Designatable Units (DU), i.e., would 3L be a separate DU?

Fisheries

There is a fairly good understanding of the fisheries activity over time in terms of:
- landings
- CPUE (is still under development and requires more standardization)
- management measures (need to be communicated to DFO Science regularly)
- gear/fleet
- observer coverage (more is recommended including coverage in 4X)
- discards from observers (less from small boats in southwest; no coverage in 4X outside of the survey), though the proportion of small versus large fish may not be accurate
- catch composition from observers and port sampling (less from small boats in southwest; silver hake should be separated from other fisheries; determined mostly during halibut survey)
- bycatch from observers

Survival of discards, particularly otter trawls, is not well known.

Indices of Abundance

A number of abundance indices are available, each with their strengths and limitations. It was agreed that the following would be used in the current model formulation:
- Halibut survey (1998-present)
- Maritimes RV survey (1970-present) using the stratified mean
- CPUE, perhaps with minimal weighting (or qs estimated outside the model)

Other indices were to be investigated further and incorporated only as appropriate:
- NFLD RV survey: This indices is not being used now, but there is an intent to use it in the future given limited sampling in NFLD waters. Stratified mean would need to be used.
- 3NO index (20 more years of data)

Assessment Model

In general, the proposed model formulation was supported as it seemed to be suitable to provided management advice over the short-term. Some suggestions for improvements were made, which were to be investigated and implemented prior to the next assessment. For example, the calculation of exploitation rate was to be revised (e.g., divide catch by total biomass rather than just vulnerable population).

It was felt that the Ricker stock recruitment relationship was ok to use for now, but the Beverton-Holt relationship and a non-parametric fit should also be investigated. The limited stock-recruitment relationship and greater influence of environmental drivers found in the Pacific should be kept in mind. These considerations will be particularly important in the selection of reference points.

The issue of domed selectivity in the fishery (and surveys) should be pursued. It would be ok to leave the survey asymptotic and let the commercial catch be domed a little. It shouldn't make much difference, but it would better reflect industry perception. If the model doesn't converge using this approach, then it doesn't have to be applied. If it does converge, model diagnostics would still have to be used to determine whether it was supported or not.

Some longer-term recommendations were also provided.

Selectivities are currently applied to the ages, but it may be easier to apply them to the lengths in the future. This would be something to address at the next framework.

The halibut survey design could be altered to add more deep water stations. The purpose of these stations would be to look at the size structure of halibut in deeper water to better estimate the selectivity of those individuals, not to add a stratum to the index of abundance. Alternatively, recapture rate by size could be investigated, which would require tagging a whole bunch of large individuals, or more yellow tags could be analyzed (while these fish were not large when they were tagged, they may be large now). Efforts to enhance standardization of the halibut survey hook spacing, bait, and soaking time were also recommended.

Given that the commercial index has 3-4 times more effort than the survey, standardization of the commercial index should also be pursued with consideration of a spatial component finer than by NAFO division.

It will be important to continue monitoring of areas that are not fished (e.g., the Haddock Box).

Research Recommendations and Next Steps

The following research and action items were discussed at this meeting and the two previous meetings, but they were not prioritized:

- Continue tagging program, using new tagging technologies where possible
- Gather better information on spawning
- Genetic analysis to investigate substructure (low priority)
- Investigation of effort (low priority), including spatial distribution of effort (e.g., work by D. Kulka). Make use of other projects, where possible. Consideration of 3Pn.
- Investigate different catch composition in 3LMN (low priority)
- Investigate area effects on length at age (and other parameters)
- Bycatch analysis separated by area and vessel class
- Changes in feeding behaviour over time (low priority)

- Bait standardization in halibut survey
- Effects of dogfish on catch rates (some work done on this in the Pacific)
- Effects of hook spacing on catch rates
- Add depth to the commercial index reporting sheets
- Resolution of maturity staging may require training (pilot study has been initiated already)
- Development of objectives and decision rules
- Management Unit:
    - Look at sensitivity of model to mixing/movement
    - Investigate mixing between 4T and 4Vn further (additional analysis possible using more of the tag returns), mixing across Canada/US boundary
    - Consideration of 3Pn
- More observer coverage in the commercial fishery
- Get NFLD RV survey data prior to next assessment meeting
- Before next year, add deeper water stations to the halibut survey and look at proportional allocation of stations.

Research recommendations (proceedings of the framework) were to be presented to managers and science staff. It was suggested that these items would need to be prioritized sometime this year. The list of action items could be reviewed at future meetings to track progress.

Management and industry asked that an effort be made to schedule the next assessment for sometime in November or December 2009. The halibut assessment has slipped into January or February recently, which makes consultation and decision-making difficult prior to the fishing season. It was also suggested that an annual assessment may not be required for such a long-lived species. Now that the assessment framework was complete, an assessment frequency of every two years may be appropriate.

V. Docherty was asked to arrange a management discussion (including science, management and industry) about spatial management options within the management unit, possibly to develop a more specific question for DFO Science on this topic.

T. Worcester was to circulate the proceedings and other documentation to participants as it became available.

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Trumble, R.J., J.D. Neilson, W.R. Bowering, and D.A. McCaughran. 1993. Atlantic Halibut (*Hippoglossus hippoglossus*) and Pacific Halibut (*H. stenolepis*) and their North American Fisheries. Can. Bull. Fish. Aquat. Sci. 227: 84 p.

APPENDICES

Appendix 1. Terms of Reference

Assessment Framework for Atlantic Halibut
Scotian Shelf and Southern Grand Banks (Div. 3NOPs4VWX+5Zc)
Maritimes Region Science Advisory Process

Hayes Boardroom
Bedford Institute of Oceanography (BIO)
Dartmouth, Nova Scotia

Fall 2007 – Winter 2008

TERMS OF REFERENCE

Context

A single management area encompassing the Scotian Shelf and southern Grand Banks (NAFO Divs. 3NOPs4VWX+5Zc) has been established for Atlantic halibut on the basis of tagging experiments conducted during 1958-73 which suggested that Atlantic halibut move extensively throughout most of the Canadian Northwest Atlantic. Halibut caught near the borders of the 3NOPs4VWX+5Zc management unit may belong to other management units (i.e. subarea 4RST) and requires a more precise definition of the boundaries of the 3NOPs4VWX+5Zc halibut management unit.

Prior to 1998, the assessment of the Atlantic halibut resource was hindered by absence of a reliable time series of abundance. The annual Department of Fisheries & Oceans (DFO) summer bottom trawl survey is thought to provide information on incoming recruitment (<81 cm), however, it does not monitor the complete geographic range of the stock and lacks information on the adult (≥ 81 cm) portion of the population. In cooperation with DFO Science, the halibut industry initiated a longline survey in 1998 that catches the full size/age structure over most of the stock area. Since its implementation, halibut stock status has been largely based on this survey's catch rate trends. While it was concluded that the industry/DFO longline halibut survey has the capacity to monitor the general magnitude and direction of change in halibut population status, by itself, it provides little insight into total abundance or exploitation rate, consequently there is a need for an assessment framework to guide resource management decisions.

In August 2004, members of the Atlantic Halibut Council, the fishing industry, DFO Science, and other agency scientists (other DFO regions and the International Pacific Halibut Commission (IPHC)) convened a two-day workshop at BIO to identify the research requirements of the assessment framework of Atlantic halibut. This framework requires elements additional to the industry/DFO survey time series, for example, an assessment model incorporating the survey times series, commercial information, and age-length information. A tag-recapture program providing independent estimates of fishing mortality and abundance can also be incorporated into the assessment framework.

The current review is to establish the assessment framework for Atlantic halibut. It is to be conducted over a series of meetings. The first and second meetings (30-31 October 2007 and 8–9 January 2008) will review the management unit, data inputs, and indices of abundance, while a third meeting in early June 2008 will review the model(s) used to determine stock status.

An assessment meeting, which will use components of the Framework, will be held 14-16 February 2008 to provide harvest advice for the 2008 fishery.

Objectives

Review of Management Unit, Fishery Data Inputs, and Indices of Abundance (30-31 October 2007 and 8-9 January 2008)

- Review information (e.g. tagging, distribution, morphometrics, meristics, growth) on the biological basis of the management unit in support of subsequent decisions on the management unit definition by Fisheries and Aquaculture Management (FAM) Branch and industry, including:
  - Interrelations of halibut with populations to the north and south of the management unit.

- Review fishery data inputs, including:
  - Sampling: Commercial and survey catch, distribution, size and age composition.
  - Biology: Growth, age, life history, sex, fecundity, natural mortality, spawning location and timing, recruitment.
  - Ecosystem information: Bycatch, trophic information, temperature.

- Review indices of abundance, including:
  - Fixed station and commercial index.
  - All relevant research vessel surveys (southern Gulf, northern Gulf, Newfoundland, and US).

Review of Model(s) to Assess Status and Productivity (June 2008)

- Determine the methodology to estimate the current state of the stock, including methods for estimating stock size and fishing mortality.
- Determine the methodology to characterize stock productivity including reference points for fishing mortality and spawning stock biomass.
- Determine forecasting methodology for providing advice on harvest levels.
- Provide guidance on inter-framework review activities, including:
  - Review procedure and frequency of providing fisheries management advice.
  - Review events that would trigger an earlier-than-scheduled assessment.

Outputs

CSAS Science Advisory Report outlining the assessment framework
CSAS Proceedings of the discussion of meetings
CSAS Research Documents

Participation

DFO Science, Maritimes and Newfoundland regions
DFO FAM, Oceans Maritimes, and Newfoundland
Committee on the Status of Endangered Wildlife in Canada (COSEWIC)
Aboriginal communities / organizations
Nova Scotia and New Brunswick provincial representatives
Fishing industry
Non-government organizations (NGOs)
External experts

Appendix 2. List of Participants

Review of Management Unit, Fishery Data Inputs, and Indices of Abundance: Part I
Bedford Institute of Oceanography, Dartmouth, NS. 30 – 31 October 2007

NAME	AFFILIATION
Armsworthy, Shelley	DFO Maritimes / PED
Baker Stevens, Nellie	Eastern Shore Fisherman's Protective Assn. (ESFPA)
Bentzen, Paul	Dalhousie University, Dept. of Biology
Boudreau, Cyril	NS Fisheries and Aquaculture
Boyd, Catherine	Clearwater Seafoods
Campana, Steve	DFO Maritimes / PED
Chapman, Bruce	Groundfish Enterprise Allocation Council
Cheney, Trisha	Maine Dept. of Marine Resources
Clark, Don	DFO Maritimes / SABS
Claytor, Ross	DFO Maritimes / PED
Courtney, Robert	North of Smokey-Inverness South Fishermen's Assn (NOSFA)
Davignon-Burton, Tania	DFO Maritimes / PED
Dedrick, Gary	Shelburne Co. Quota Group
Dedrick, Gerry	Shelburne Co. Quota Group
Docherty, Verna	DFO Maritimes / FAM
Ford, Jennifer	Ecology Action Centre (EAC)
Hansen, Jorgen	DFO Maritimes / FAM
Høines, Åge	Institute of Marine Research, Norway
Hurley, Peter	DFO Maritimes / PED
Jellett, Joanne	APCFNC Secretariat
Kanwit, Kohl	Maine Dept. of Marine Resources
Leaman, Bruce	International Pacific Halibut Commission (IPHC)
Lusseau, Susan	DFO Maritimes / PED
Maxwell, Judith	Scotia-Fundy Inshore Fishermen's Assn. (SFIFA)
Mohn, Robert	DFO Maritimes / PED
Rennehan, George	NS Fixed Gear Assn. 45'-64'
Richardson, Norma	Eastern Shore Fisherman's Protective Assn. (ESFPA)
Ruzzante, Daniel	Dalhousie University, Dept. of Biology
Showell, Mark	DFO Maritimes / PED
Stone, Heath	DFO Maritimes / SABS
Trzcinski, Kurtis	DFO Maritimes / PED
Whoriskey, Sophie	DFO Maritimes / PED
Wilson, Scott	DFO Maritimes / PED
Worcester, Tana (Chair)	DFO Maritimes / CSA
Zwanenburg, Kees	DFO Maritimes / ERD

Review of Management Unit, Fishery Data Inputs, and Indices of Abundance: Part II
Bedford Institute of Oceanography, Dartmouth, NS. 8-9 January 2008

NAME	AFFILIATION
Archambault, Diane	DFO Quebec / IML
Armsworthy, Shelley	DFO Maritimes / PED
Black, Jerry	DFO Maritimes / PED
Boudreau, Cyril	NS Fisheries and Aquaculture
Boyd, Catherine	Clearwater Seafoods
Brodie, Bill	DFO Newfoundland / O&E
Campana, Steve	DFO Maritimes / PED
Chapman, Bruce	Atlantic Halibut Council
Clark, Don	DFO Maritimes / SABS
Claytor, Ross	DFO Maritimes / PED
Dedrick, Gary	Shelburne Co. Quota Group / AHC
Docherty, Verna	DFO Maritimes / FAM
Emberley, Jamie	DFO Maritimes / SABS
Googoo, Chelsey	APCFNC Secretariat
Hurley, Peter	DFO Maritimes / PED
Mohn, Robert	DFO Maritimes / PED
Neilson, John	DFO Maritimes / SABS
Ricard, Dan	Dalhousie University, Dept. of Biological Science
Showell, Mark	DFO Maritimes / PED
Simms, Tom	North of Smokey-Inverness South Fishermen's Assn (NOSFA)
Stone, Heath	DFO Maritimes / SABS
Trzcinski, Kurtis	DFO Maritimes / PED
Wang, Yanjun	DFO Maritimes / SABS
Waters, Christa	DFO Maritimes / SABS
Wentzell, Ian	APCFNC Secretariat
Whoriskey, Sophie	DFO Maritimes / PED
Wilson, Scott	DFO Maritimes / PED
Worcester, Tana	DFO Maritimes / CSA
Zwanenburg, Kees	DFO Maritimes / ERD

Review of Models to Assess Status and Productivity: Part III
Dartmouth Sportsplex, Dartmouth, NS. 16 – 17 June 2009

NAME	AFFILIATION
Armsworthy, Shelley	DFO Maritimes / PED
Baker Stevens, Nellie	Eastern Shore Fisherman's Protective Assn. (ESFPA)
Black, Jerry	DFO Maritimes / PED
Boudreau, Cyril	NS Fisheries and Aquaculture
Bowen, Don	DFO Maritimes / PED
Campana, Steve	DFO Maritimes / PED
Chapman, Bruce	Groundfish Enterprise Allocation Council
Clark, Bill	International Pacific Halibut Commission
Courtney, Robert	North of Smokey-Inverness South Fishermen's Assn (NOSFA)
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Dedrick, Gary	Shelburne Co. Quota Group
Dedrick, Gerry	Shelburne Co. Quota Group
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Dooley, Tom	NL Dept of Fisheries and Aquaculture
Hart, Dvora	NOAA, NMFS
Lusseau, Susan	DFO Maritimes / PED
McMillan, Jim	DFO Maritimes / PED
Mohn, Robert	DFO Maritimes / PED
Moulton, Amy	APCFNC Secretariat
Nicholas, Hubert	Unama'ki Institute of Natural Resources (UINR)
Perley, Neil	Maliseet Nation Conservation Council
Rennehan, George	NS Fixed Gear Assn. 45'-64'
Showell, Mark	DFO Maritimes / PED
Trzcinski, Kurtis	DFO Maritimes / PED
Wang, Yangun	DFO Maritimes / SABS
Whoriskey, Sophie	DFO Maritimes / PED
Wilson, Gabrielle	DFO Maritimes / PED
Wilson, Scott	DFO Maritimes / PED
Worcester, Tana (Chair)	DFO Maritimes / CSA

Appendix 3. Agendas

Review of Management Unit, Fishery Data Inputs, and Indices of Abundance: Part I
Data Inputs
Bedford Institute of Oceanography, Dartmouth, NS. 30 – 31 October 2007

30 October 2007 – Tuesday

9:00 – 9:15 Welcome and Introduction

9:15 – 9:30 Overview Presentation

9:30 – 11:00 Review of the Biological Basis for the Management Unit
- Tagging studies

~10:00-10:15 Break

11:00 – 12:00 Review of Fishery Data Inputs
- Commercial catch

12:00 – 13:00 Lunch

13:00 – 17:00 Review of Fishery Data Inputs (cont.)
- Ageing studies
- Life-history information
- Ecosystem information: stomach contents and bycatch

Refreshment Breaks (15 min) at ~ 10:00am and 3:00pm

31 October 2007 – Wednesday

9:00 – 9:30 Review of Previous Day

9:30 – 12:00 Review of Indices of Abundance
- RV Survey
- Fixed Station Index
- Commercial Index
- CPUE

12:00 – 13:00 Lunch

13:00 - 15:00 Next Steps

15:00 - 17:00 Review of Meeting Conclusions

Refreshment Breaks (15 min) at approximately 10:00am and 3:00pm

Assessment Framework for Atlantic Halibut Scotian Shelf and Southern Grand Banks (Div. 3NOPs4VWX+5Zc) Maritimes Region Science Advisory Process: Data Inputs Part II

8-9 January 2008

Hayes Boardroom
Bedford Institute of Oceanography (BIO)
Dartmouth, Nova Scotia

AGENDA

8 January 2008 – Tuesday

9:00 – 9:15 Welcome and Introduction

9:15 – 9:30 Summary of Data Inputs I Meeting

9:30 – 10:15 Biological Basis for the Management Unit
- Updates
- Discussion

10:15 – 10:30 Break

10:30 – 11:15 Review of Fishery Data Inputs
- Updates
- Discussion

11:15 – 12:00 Review of Life-History Information
- Updates
- Discussion

12:00 – 13:00 Lunch

13:00 – 13:45 Review of Ecosystem Interactions
- Updates
- Discussion

13:45 – 14:30 Review of Indices of Abundance
- Updates
- Discussion

14:30 – 15:00 Summary of Completed Framework Elements

15:00 – 15:15 Break

15:15 – 16:00 Summary of Outstanding Framework Elements

16:00 – 17:00 Provision of 2008 Science Advice

9 January 2008 – Wednesday

9:00 – 12:00 Provision of 2008 Science Advice (con.) – As Required

Appendix 4. External Review Comments

Review of Management Unit, Fishery Data Inputs, and Indices of Abundance: Part I Data Inputs
Bedford Institute of Oceanography, Dartmouth, NS. 30 – 31 October 2007

B. Leaman
Queries, comments, and suggestions concerning background material

1. Management area/stock delineation. The implicit management assumption is that the management area delineates the managed stock, based largely on the tagging program. This raises several queries:

    1.1. Was tagging done outside the stock management area and if so, where were recoveries from this tagging made (this was partially answered today concerning U.S. tagging although the entire extent of other Canadian tagging was not clear)?
    1.2. What was the full extent of recoveries outside the management area from the two tagging programs inside it? Is the magnitude of the fishing effort leading to these recoveries known? Given the apparent uncertainty about reporting rate noted in Carl Schwarz's paper, these external recoveries could have significant meaning about the boundaries of the management unit, hence the estimation of the relationship between fishing effort and fishing mortality (i.e. *q*) that is estimated for the data from the management area.
    1.3. Do seasonal movements occur and what is their extent (i.e., outside the management area, where additional F may be generated)?
    1.4. One element of the stock assessment modeling should be a broader-area assessment, e.g., including Gulf and Newfoundland data.

2. Sub-legal tagging. Were all sublegal fish tagged, i.e., were even the smallest fish tagged? Was the same gear used to obtain sublegals as for the all-sizes tagging program? Has any survey or tagging effort used smaller hooks than are used normally in the commercial fishery?

    2.1. Fig. 2 shows a time and area aggregated movement summary, which is informative. However, it would also be useful to see movement rates by season and year of recapture for each release year. Similarly, it would be useful to see movement patterns by sub-area for this program, i.e., a release-recovery matrix by sub-area.
    2.2. Schwarz analysis. Carl's model assessment section sums up the issues with the study quite well, in particular the lack of resolution (at least with data to date) of the reporting rate for recovered tags. Examination of tag recovery rate during survey fishing might be used as a proxy for 100% reporting rate of tags/x # of fish, depending on the number of tags that are actually recovered during survey fishing (recall that the numbers in the two tier recovery scenario are also quite low). In general, the natural mortality rates estimated by this model are at odds with independent estimates of M from other sources, which does not commend the model results for use.

3. All-sizes tagging. I am not sure I understand the establishment of the fixed stations correctly. RAP Working Paper 2007/27 indicates that the fixed station survey stations are assigned on the basis of strata constructed by average trip landings, not average trip CPUE. Perhaps this is simply a terminology issue but is this correct? If so, these strata will not necessarily be in proportion to abundance because they are not corrected for fishing effort. On the other hand, the Delauney triangulation does appear to use CPUE as its basis although the

methodology is not described in detail. A more complete description of this procedure would be useful. At the heart of this query is a lack of understanding of how the application of tags is in proportion to abundance. For example if stations were either random or systematic and all fish from a fixed number of hooks were tagged, then tagging would be in proportion to abundance. However, if the fixed stations are not spatially systematic, or based on CPUE strata, it is not clear that tags are applied in proportion to abundance.

A second issue concerns the target application of tags by station. When the effort at each station is fixed, the number of tags released would presumably be in proportion to local abundance (however, note the issue above concerning whether the stations themselves are constructed in proportion to abundance). However, when the target number of tags by sub-area is not achieved, there has been an effort to apply additional tags, which appears to contradict the application in proportion to abundance, i.e., there appears to be a mismatch between tagging in proportion to local abundance as seen in survey catch rates and the area apportionment of tags. This raises a query as to whether the 'catch-up' procedure of applying additional tags in some areas to get to a target creates a spatial bias in tag application.

Lastly, a more complete presentation of the results of holding experiments to determine tagging mortality and tag shedding parameters would be useful.

4. Catch composition of the commercial fishery. For Fig. 11, would like to see the data broken out by year, to determine whether passage of significant cohorts through the fishery dominates the time-aggregated frequency distributions. Similarly, notched Box plots for Figs. 12-14 would facilitate understanding of sample size effects.

5. Length, weight, and age at maturity. Extensive discussion on this today suggests significant issues with the assessment of maturity relative to almost all other studies. Because these parameter estimates will be highly influential in any SSBR and productivity estimates, an alternate source (Maine study, Norwegian data) for such estimates is required. For the long term, some remediation of the maturity estimation procedures giving rise to the data presented appears warranted.

6. Indices of abundance. See previous note about strata construction and issues of catch vs. CPUE. A query on the station procedures: is bait standardized in either type or size? Results of experiments on Pacific halibut show bait size is a significant effect on catch rate, within bait type and the IPHC has found it necessary to standardize weights of baits used on each hook (average 0.25-0.33 lb chum salmon) to avoid having baiting practices on particular survey vessels bias survey CPUE.

    6.1. Length frequency information. Fig. 41: Similar to above comment, present data by year rather than aggregated over multiple years. The Box plots do not adequately capture individual cohort effects on length frequencies.
    6.2. Fig. 51 and Table 22. Perhaps I am misunderstanding this but the representation of the data appears, to me at least, to be conceptually incorrect. This non-linear estimation uses catch rate as the dependent variable, i.e., the estimation implies that catch rate is functionally dependent on number of hooks fished. An extension of this is that increasing the number of hooks set would result in increased catch rate, which is surely not the case. The number of hooks set will be a function of catch rate, i.e., harvesters fish more where catch rates are higher. While this issue may seem minor, this functional relationship is used subsequently in Table 23 to offset catch rate prior to analysis of deviance.