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Fall Meeting
Marine Fisheries Subcommittee

Regional Advisory Process (RAP)
of the Maritimes Region

6-10 October 1997

Holiday Inn Harbourview
Dartmouth, Nova Scotia

Co-Chairs

M. Sinclair (Groundfish)
M. Chadwick (Invertebrates)

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ABSTRACT

These proceedings record the discussions held during 6-10 October 1997 (Holiday Inn, Dartmouth) Regional Advisory Process (RAP) meeting to review several groundfish and invertebrate management units. The groundfish species considered were 4X haddock, 4X cod, 4TVW haddock, Scotian Shelf and Gulf of Maine area pollock, 4X flatfish (winter flounder, yellowtail flounder, and American plaice), and 4VWX witch flounder. The invertebrate species considered were Stimpson's surf clam, red crab, northern shrimp, offshore lobster, offshore Jonah crab, ocean quahaug, and periwinkle. An overview of the oceanographic conditions during 1996 and 1997 was presented as well as an analysis of the time of spawning of haddock and cod on Georges Bank (in response to a Gulf of Maine Advisory Committee (GOMAC) question from industry concerning optimal timing for spawning closures). The meeting was co-chaired by Mike Sinclair and Mike Chadwick. The proceedings outline the main points of discussion, problem areas, analyses that required further work at the meeting, plus recommendations for future work. Stock Status Reports (SSRs) for the management units considered were produced.

RÉSUMÉ

Le présent document fait état des discussions tenues dans le cadre de la réunion du Processus consultatif régional (PCR) qui a eu lieu du 6 au 10 octobre 1997 (Holiday Inn, Dartmouth) et qui portait sur l'examen de plusieurs unités de gestion du poisson de fond et des invertébrés. Les espèces considérées étaient l'aiglefin de 4X, la morue de 4X, l'aiglefin de 4TVW, la goberge du plateau néo-écossais et du golfe du Maine, les plies de 4X (plie rouge, limande à queue jaune et plie canadienne) et la plie grise de 4VWX, pour ce qui est du poisson de fond, et la mactre de Stimpson, le crabe rouge, la crevette nordique, le homard de haute mer, le crabe nordique de haute mer , le quahog nordique et le bigorneau, pour ce qui est des invertébrés. On a présenté un survol des conditions océanographiques en 1996 et 1997 ainsi qu'une analyse de la période de frai de l'aiglefin et de la morue du banc Georges, (suite à une question du Gulf of Maine Advisory Committee [GOMAC] émanant de l'industrie et portant sur la période optimale des fermetures dues au frai). La réunion était présidée par Mike Sinclair et Mike Chadwick. Les délibérations rendent compte des principaux sujets de discussion, des éléments problématiques, des analyses qu'il a fallu approfondir à la réunion ainsi que des recommandations de travaux futurs. Des rapports sur l'état des stocks (RES) dans les unités de gestion considérées ont été produits.

INTRODUCTION

The meeting was opened by one of the chairs, Mike Sinclair, who welcomed the participants. In the introductory remarks, the objectives of the meeting were reviewed and the agenda accepted (Appendix 1). The list of participants is shown in Appendix 2. The minutes of the cod/haddock/flatfish working group meetings (Marine Fish Division (MFD) at the Bedford Institute of Oceanography (BIO)) are included in Appendix 3. The research recommendations developed at the meeting are included in Appendix 4.

OCEANOGRAPHIC OVERVIEW (Rapporteur: L. Van Eeckhaute)

A brief presentation on salinity and temperature trends on the Scotian Shelf was provided. New information on trends at intermediate depths (50cm) was of particular interest. The results indicated a cooling trend in recent years in eastern 4X that is not as evident from analysis of bottom temperature. The temperature trend at this depth may be consistent with the patterns of weight-at-age for cod and haddock in eastern 4X. The discussion highlighted the need to define specific oceanographic data products that are useful for different stocks. It was mentioned that this is an outstanding issue that needs to be addressed by FOC. Clarification was provided on a number of technical points made during the presentation. Environmental conditions during the summer survey were not thought to generate bias in the time series of groundfish abundance.

4X HADDOCK (Rapporteur: S. Campana)

The Fishery

Considerable discussion centred on changes in the distribution of fishing effort in 4X. While shifts in effort away from Browns Bank towards the Bay of Fundy were acknowledged by industry, the shift appeared to be due more to low haddock quota in a multi-species fishery dominated by cod and pollock than to shifts in haddock abundance. On the other hand, increased catches of haddock in 4Xs may reflect real increases in local abundance. Given that 4Xs and 5Y haddock catches are now counted against the 4X quota, but are not incorporated into the assessment

- It is **recommended** that the current practice of excluding 4Xs haddock catches from the 4X assessment be re-examined.

The age composition of the 1997 catch (first half) substantially underrepresented the expected contribution of the younger fish. On the basis of assertions from industry, results of boardings, and the observations of port technicians, discarding in 1997 was believed to have occurred less than in the past, and therefore is not a probable source of the discrepancy. Rather, retrospective

problems with the VPA and inadequate sampling of the longline (LL) catch are thought to have caused the discrepancy.

Resource Status

The Individual Transferable Quota (ITQ) survey of 4X provided much more detailed coverage of haddock distribution, both inshore and offshore, than did the DFO Research Vessel (RV) survey. While mean ITQ annual catch rates were tabled

- It is **recommended** that the annual proportion of the 4X haddock stock found inshore of the RV-surveyed region also be calculated to determine if existing assumptions concerning constant proportionality of abundance between inshore and offshore areas are justified. The additional benefit of an equivalent industry-based survey, based on fixed gear in eastern 4X, was noted.

Potential causes of the observed decline in size at age in eastern 4X (but not in the Bay of Fundy) were discussed. Potential causes include large-scale environmental effects, density-dependence along cohorts, and the possibility of faster sexual maturation during periods of reduced density, followed by reduced subsequent growth.

The results of the half-year ADAPT formulation using the new catch at age matrix were accepted as given. However, there was considerable discussion over the possible causes of the large downward shift in fishing mortalities compared to last year's assessment, and the validity of a monotonic decline in fishing mortality since the early 1980s. The redistribution of ages in the new catch at age (following re-ageing using more accurate criteria), as well as the likely underreporting of catch in the mid- to late 1980s, may well account for the change in fishing mortality (F). However, the group was not fully convinced that the time series of fully recruited F adequately reflected either fishing effort or the perceived stock history. This issue was not resolved, although no errors in the population model or assumptions were detected. Additional analyses carried out to substantiate the validity of the current assessment included:

- Arithmetic mean catch rates (with 95% confidence intervals) for haddock from the ITQ surveys. These were presented for all lengths combined and as greater than 43cm and less than or equal to 43cm.

- The ratio of the catch numbers-at-age from last year's assessment to those from this assessment for 1985-95.

- Total mortalities (Z) from RV surveys and relative Fs from catch numbers-at-age divided by survey numbers-at-age compared to Fs from the VPA.

- How age of fully recruited F varied over time.

- Plot of q-adjusted RV survey age 1 recruitment against SSB.

- Risk analysis plot that showed probability trajectory that 1997 SSB will be below 1996 SSB given a range of TACs in 1997-99 and that F will be above Flim (F0.1).
- Comparison of patterns in F5-7, F6-8, F5+, F6+ from VPA.
- Probability that correlations of RV year-class estimates at different ages are due to chance.
- Comparison of RV estimates of year-class abundance at ages 1-3 and 4-6.
- Mortality between juvenile (age 1-3) and recruiting (age 4-6) periods.
- Comparison of year-class estimates from ages 1-3 in RV surveys with SPA age 1.
- Comparison of year-class estimates from ages 4-6 in RV surveys with SPA age 1.
- Comparison of RV and SPA estimates of spawning stock biomass.
- Stock and recruitment data from the SPA and RV survey.
- Total mortality estimates from RV surveys for 5-year periods with 95% confidence intervals.

Notably, the history of population biomass which is now apparent is similar to that presented in last year's assessment.

A promising approach to precautionary management was presented, but proved difficult to apply given the apparent lack of a stock-recruitment relationship in this stock. With no obvious relationship between recruitment and biomass, it was not clear that efforts to maintain biomass at some particular level would result in any improved recruitment. Nevertheless, the idea that stock and recruitment were related at some level was accepted. Given a subjective S-R relationship, a risk analysis plot showing the probability distribution that the 1997 SSB would fall below the 1996 SSB, given a range of possible TACs in 1997-99, was tabled.

Outlook

Weight at age has declined in recent years in eastern 4X, although not in the Bay of Fundy. If the decline continues, catch projections based on the 1994-96 weight at age will prove to be overly optimistic. On the other hand, the projected size of the large 1994 year-class was downweighted in a manner similar to that applied to the large 1993 year-class in last year's assessment. The latter resulted in a more realistic population estimate (on the basis of the current assessment), and appears to provide an empirical correction for optimistic biases known to affect RV abundance indices of large year-classes.

4X COD (Rapporteur: C. Annand)

The Fishery

The following issues were discussed by the Subcommittee:

- changes in geographical distribution by fleets
- effort trends
- size composition, related to change in fishing pattern, or an overestimation of large fish in the population

Industry indicated that:

- The fleet is operating differently due to the short fishing season in 1995 and 1996, as compared to 1997. The fleet fished closer to land in 1995/96.
- Fleets looked for variety and not necessarily larger fish.
- The Nova Scotia side of Bay of Fundy hook and line fishery missed both the traditional spring and fall fishery.
- There were fewer big fish inside of Browns, a shift in effort by gillnets to Bay of Fundy for hake, more fish inshore prior to herring seiners, and small vessels cannot move too far offshore.
- The Browns Bank extended closure reduced the large fish fishery in February, thus a move to the Bay of Fundy for a better mix of fish had occurred.

It was noted that although sampling was poor in Digby Neck area, if analysis is correct, 3-4 year old fish should come inshore. Given weak recruiting year-classes, catches inshore would be expected to be low. Larger fish (age 5 and older) were in deeper water.

In summary, the fishery has changed for a number of reasons related to a decrease in abundance in certain areas, as well there being more interest in by-catch. These could result in a change in the partial recruitment (PR) pattern.

Discarding was raised as being pertinent to this stock in particular, related to stretching the season (quota mismatch), decrease of abundance in certain areas (east 4X), TVRP vessels in non traditional areas and gear shifts (gillnet shift to Bay of Fundy). Port samplers indicated that discarding was not as prevalent in 1997. Keeping quotas of cod and haddock closer to a 1:1 ratio would help reduce discarding. Comparison of IOP and commercial sampling indicated no significant differences (one would expect to see tailing at lower end if discarding was occurring). Surveillance boardings did not detect a discarding problem.

- It was **recommended** that the sampling design being used by port technicians be reviewed.

- It was **recommended** that an index of discarding practices over time be developed.

Effort appeared to be stable or decreasing. The analysis was questioned by industry, related to what was a directed species. Industry had a problem with the use of effort data due to changes in fishing practices.

Resource Status

It was noted that the RV survey did not reflect recruitment very well and since the ITQ survey picks up more small fish, perhaps this should be used as a recruitment index. It may be possible to try and interpret recruitment from length frequencies for next year.

The relative strength of the 1992 year-class was discussed. Several issues need to be dealt with prior to using the ITQ survey as a recruitment index, including:

- gear changes
- vessel differences between Scotian Shelf and Bay of Fundy
- standardization of tows

It was commented that matching the more recent surveys with the more historic data could provide some data applicable to discarding. This could perhaps be accomplished using US surveys to intercalibrate.

In general the SSB appears moderate, recruitment poor after 1992 and age structure skewed to a single year-class.

The change in partial recruitment was questioned, as well as whether 1997 biomass should be considered moderate in the historical context. The decline in recruitment and biomass was disturbing given the relatively constant F over time. It was suggested that F is actually higher due to discarding. There was some question whether the strong 1992 year-class alone would bring biomass back to moderate levels when the relatively strong 1987 and 1988 year-classes now had limited impact on biomass trends.

Sensitivity analysis was requested. It was noted that this work had been done and a strong retrospective pattern is not apparent.

The observation was made that the entire time series survey series is not used.

Overall there was considerable uncertainty associated with the VPA.

Information on the trends in length and weight at age should be included.

Outlook

Points of concern in the assessment were:

- The complex stock structure
- F0.1 may be changing due to changes in selectivity

Movement of the fleet to Bay of Fundy could change partial recruitment pattern as they fish larger fish at age.

A broad age structure is required for resilience and growth of a stock. Different growth rates, fleets moving and a complex stock structure all contribute to increased risk of overfishing.

Some felt that the age structure was similar to the past and not necessarily a problem. Poor recruitment was the major issue.

4TVW HADDOCK (Rapporteur: H. Stone)

Population Considerations

A question was raised about the current closed area for haddock (Emerald/Western Bank) and its influence on the observed stock distribution based on RV and ITQ surveys. It was indicated that the overall distribution has not changed and that the closure area has historically had a high biomass. Haddock distribution is also influenced by the 4 degree C isotherm, particularly in the eastern Shelf (Banquereau).

Discussion focused on the trends in mean weight at age and the reduction in the age at first maturity (from 5 to 3) and spatial differences in growth rates. It was commented that the "dramatic" decline in age at first maturity has not been accompanied by an increase in growth rate, which usually accompanies earlier age at first maturity for marine fish species. It was suggested that there may be different substocks with different rates of growth and that the "closure area" may be the fast growth area. As the population increases in size, it expands to adjacent areas where growth rates may be much slower. The question was raised as to whether the surveys were progressively sampling a narrower range of the distribution of the haddock population. It was indicated that although Emerald Bank was the only spawning area, year-class distribution probably extends to Banquereau and the inshore areas when abundance is high, but shrinks when abundance is low. Abundance is currently being sampled from a much smaller area of the overall distribution, and may be influenced by the colder water temperatures prevalent on the eastern shelf. It was also pointed out that bottom temperature may not affect growth rate because haddock move out of cold water areas.

No conclusion was made as to whether there is evidence of differential sampling of the population. A comment was made pointing out that if there are no spatial differences in 4VW haddock growth rates, then the problem of different size at maturity is non-existent and it was recommended that growth rates be examined by area. It was indicated that this has already been examined and no difference found in predicted weight for a given length over the survey area (i.e. 4V vs 4W). It was pointed out that fecundity of 4VW haddock, based on a study currently in progress, was low compared to other contiguous stocks (4X) and was not increasing with body

size. The question was raised as to how much variance there was around the data points presented for 4X haddock fecundity (from Waiwood and Buzeta).

Resource Status

Concern was expressed about the retrospective pattern from the VPA (opposite pattern than observed in other assessments) but generally it was considered to be acceptable. The group agreed that recruitment collapsed in the mid 1980s after a period of high biomass. There is currently no explanation for the reduced survivorship; natural mortality used in the model may not be appropriate. Suggestions were made as to other factors which may be affecting natural mortality (i.e. seal predation, scallop and clam dredging). It was indicated that the total mortality (Z) has been high (0.45) since the closure of the fishery, which is higher than the natural mortality used for the current stock assessment (M=0.2).

4VWX5Zc POLLOCK (Rapporteur: P. Perley)

The Fishery

The discussion began on why there was an absence of older fish and whether or not small mesh gear had any effect. It was questioned that RV surveys can accurately determine the absence of older fish. There were general comments on how the fishery had changed from the early 1990s due to changes in gear. Before 1990, two-thirds of the landings were caught by OTB TC 5 vessels; since then, the landings have been more equitably distributed among the gear sectors – approximately one-third by each gear sector. The longline fishery was noted to be doing very well, landing up to a 1000 lbs from Georges Bank and 300 to 400 lbs from 4X. It was noted that a large percentage of the landings were from the Bay of Fundy and that fish in 4X were smaller than those caught on Georges Bank. There were comments that since the quota was low, discarding would be a problem. Industry replied that in 1997, discarding was not a problem. It was also commented that draggers were limited to certain times of the year when they could fish due to gillnets and lobster gear.

Fish size was discussed, with the Jan-Feb landings down and this being a spawning period for pollock. Did this mean that big fish were not being caught? The mean length of fish caught in 4X in Jan and Feb in previous years was noted to be 55 – 58 cm.

The shifting of the fishery was discussed. What was the magnitude of the shift from unit areas, 4Xn ,m and o to 4Xp, q, r and s? Industry agreed that there was a shift from 4Xm to 4Xq and that the fishery was quota driven and that fish from the Bay of Fundy can fill the quota.

There is an increase in the number of gillnetters in 4Xq as well as longliners, targeting for white hake. Initially the movement of vessels was due to pollock but with the downturn in the cod and haddock, there is more concentration on white hake.

Resource Status

There are indications of the absence of older fish in the surveys.

- It was **recommended** to look at the size frequency in key strata as well as showing some analysis with the maps.

- It was **recommended** to use of the Canadian spring and US research surveys as well as looking at length composition over the long term average.

There were concerns with the commercial catch rate analysis that incorporated monthly patterns. The monthly pattern was assumed similar in all unit areas, with the annual pattern repeated each year in the series. There was a suggestion to drop unit area as a variable since if there is a low catch rate, the weighting of this area would be weighted upward. Does the increase in the catch rate reflect what is going on since the CPUE is across the whole unit area and the fishery is mainly in 4X? It was decided to run a new catch rate series for 4VW and 4X5 separately. This was done during the meeting, and the two series showed general concurrence.

There was a question of the residuals on ages 6 through 9. For the 1989 year-class, they appeared to be non-random but since the residuals were of low magnitude, it was concluded that this should not be a problem.

The question of the redfish fishery having an impact on the overall fishery, especially the shift to younger ages, was raised. Does this account for the change in the PR, to which it was concluded that there would be only a slight change, based on examination of the 1996 catch at age.

- It is **recommended** to examine patterns of partial recruitment in recent years and determine why the fishery appears to be focusing on the younger ages.

There is very little fishing in 4VW and this occurs along the Eastern Shore. There is also a test fishery in 4VW. It was noted that there is a 9% by-catch of pollock (very small fish) along the Eastern Shore – but just in 1996.

The new catch rate series for 4VW and 4X5 was presented and there was a question as to whether there was a correlation in catch rates between the two areas. There were comments that the RV surveys consistently sample the areas and that commercial fishing is driven by where the catch rates are the best.

Outlook

Regarding projection results, surplus production appeared very high. The response was that there are three strong year-classes entering the fishery and low exploitation rates would account for this increase. Projection results and risk analysis were reviewed during the meetings.

General comment was made that the fixed gear sector had caught their quota and that the TRVP vessels were being used to catch fish and usually fish areas where there is a variety of species.

It was concluded that the SSR should contain the unadjusted VPA. Clear identification of the many uncertainties in the analyses was advocated.

4X FLATFISH (Rapporteur: K. Zwanenburg)

With reference to management units, it was considered that a split between 4VW and 4X was appropriate for winter flounder based on the distributional characteristics. For both American plaice and yellowtail flounder, such a split was considered more problematic in that the distributions of these species appeared to be more continuous between the two areas. However, it was pointed out that eventhough the split was not warranted by distributional patterns observed, such a split would be a conservative approach to managing these stocks.

The most significant outstanding problem with the assessment of these resources continues to be the large proportion of the landings which are recorded as unspecified flounders.

In general, the group considered it difficult to determine changes in abundance of size classes for the species considered. It was suggested that the next assessment of the resource should investigate the potential of estimating the abundance of selected size intervals, representing age classes, as a means of comparing the most recent estimates of abundance at length to historical observations.

The group was informed that the allocation of sets to certain strata in 4X was modified in 1987. This appears to have caused a discontinuity in the survey series for this area, especially for winter flounder. The Cod/Haddock/Flatfish Working Group recommended that the causes of the discontinuity be investigated for the next assessment. In the interim, we considered that only the post 1987 values of survey abundance should be used in the evaluation of resource status. This recommendation was re-iterated during the discussions.

- It is **recommended** that the length frequencies from the ITQ surveys be analyzed and incorporated into the next assessment of this resource.

There appears to be an expansion of the effort expended on flatfish in recent years.

Survey catch rates of larger fish greater than 30cm show a modest increase since the late 1980s with a slight decline in 1994. It was noted that the confidence intervals around the annual estimates are wide.

It was noted that there appeared to be an inconsistency between the RV catch rates of fish greater than 30cm and the commercial catch rate index for this species, which appears to be showing a decline.

It was suggested that the survey catchabilities from the Georges Bank assessment of yellowtail flounder might be used to correct the survey estimates for 4X and thereby allow for estimation of biomass.

American Plaice

There was some concern that the trends in the commercial catch rate series presented were not indicative of resource abundance. There was some question of the relative mix of TC3 and TC1 vessels in the series having changed in recent years, which could have artificially altered the catch rates. Another potential problem with the catch rate series stems from the fact that prior to 1991 landings statistics were allocated to species by proportional composition of landings for the area, which is another variant of the unspecified flounder landings problem. It was suggested that the commercial catch rates be further examined for such confounding factors for the next assessment.

Winter Flounder

There was some discussion of the need to sub-divide the 4X winter flounder stock into smaller stocks or management units. Some felt that the distribution of the fishery appeared widespread enough so as not to warrant sub-division. It was pointed out that there was evidence from both tagging and genetic analysis (in US waters) to indicate that small stocks do occur. It was also pointed out that these generally occupied estuarine systems and that the present area of the fishery was not an estuary. There is also the potential for admixture of the spawning products from a series of coastal stocks during the larval stages. These local stocks would then represent areas of differential survival of the spawning products. Under this scenario, these stocklets would re-supply one and other during the pelagic larval stages and there would be little efficacy in trying to manage them separately. The debate did not reach a conclusion but there was not a considerable support for managing sub-stocks in 4X.

It was noted that winter flounder and American plaice appear to have mutually exclusive distributions as evidenced by survey catches. The spatial distribution of landings of these two species do not show the same exclusive patterns. The group felt that this could be indicative of either misidentification or species or of mis-reporting.

- It is **recommended** that suitable age-length keys were needed to be applied to the survey length frequencies of winter flounder to allow for the construction of catch curves and the estimation of total mortality.

- It is **recommended** that an appropriate number of winter flounder (spawning all lengths and both sexes) be aged to produce a preliminary age-length key which would allow for "ageing" of the survey and/or commercial length-frequencies to produce estimates of total mortality.

- It is **recommended** that commercial length frequency data be incorporated into the next assessment (see above). It was stated that as the mean length of the winter flounder landed in

the past number of years had declined, examination of the commercial length-frequencies would give some indication of the magnitude of this change.

Industry representatives indicated that the quota on 4X flatfish (including winter flounder) has not been restrictive in the past. There was some discussion on whether or not the quota should be restrictive given the evidence presented. It appeared that the group did not feel there was sufficient evidence presented in the assessment to state this unequivocally. It was suggested that the SSR be written with the strongest conclusions supported by the evidence presented.

Outlook

All species showed declining catch rates (eventhough the reliability of the catch rates was called into question).

All appear to show fewer older fish (although a more rigorous analysis of the survey data showing historical measures of central tendency and variance, and the analysis of commercial length-frequencies, would serve to better support this conclusion).

There is no evidence for strong recruitment for these species. There is some evidence of weak recruitment although again this requires a more rigorous analysis of the survey length-frequency information.

There are indications of expanded or increased effort, both technologically and spatially.

The quota in place has not been restrictive to date.

Industry representatives indicated that they would likely be recommending a 25% reduction in the overall flatfish quota.

4VWX WITCH FLOUNDER (Rapporteur: R. Halliday)

It was accepted that the landings statistics for witch in the DFO statistical system were reasonably reliable. Many problems were foreseen in deriving a measure of fishing effort for witch, however, as it is directed for, taken as a component of mixed fisheries, and as a by-catch. There have also been changes in the vessels fishing for witch, e.g. as a result of the TVRP, and many modifications to fishing practices brought about by regulatory restrictions. No conclusions could be reached about whether fishing effort had increased or decreased in recent years.

The accuracy of CPUE as an abundance indicator would be improved if set by set data were analyzed for smaller geographical areas.

Changes in commercial size compositions could not be interpreted as illustrating changes in population size structures, e.g. as reflecting either improved recruitment or decline in abundance of large fish, as they were on a percentage basis. Adjustment by catch rate was suggested. It was

pointed out that there had been a number of mesh size changes that may confound any interpretation. These should be documented.

Survey data gave a clear indication that the current population at fishable sizes was at or near its lowest in the last 28 years. However, a number of good year-classes were about to grow to fishable size soon.

Initial runs of a length-based model that estimated total mortality from survey population length frequencies and growth parameters gave results that were considered promising. It was thought that a thorough evaluation of the method for this species should be conducted. However, it was not possible to draw any conclusions on mortality at this meeting. It was noted that up-to-date ageing data, and an evaluation of trends in growth over time, would improve confidence in the results.

STIMPSON'S SURFCLAM (Rapporteur: M. Chadwick)

An assessment was not completed. Preliminary analysis of the industry-funded survey indicate that the biomass of the resource could be 1,000,000 tonnes, almost twofold an estimate made during the 1980s. A statistically-based stratification of the survey improved the precision of the biomass estimate by greater than 16%. A full stock assessment that includes the new estimate of resource biomass, a description of the fishery and a proposed long-term harvest strategy will be completed in 1998.

Issues

1. It would be useful to have a detailed description of the fishery and the seasonal and spatial distribution of fishing effort. These maps of fishing effort would be compared to the distribution of the resource. **Research Recommendation**

2. Commercial sampling information needs to be presented. Of particular interest is spatial variation in size frequency distributions. **Research Recommendation**

3. There needs to be a review of the life history of surfclam, in particular a better appreciation of how surfclam spawning and recruitment may or may not be impacted by hydraulic dredging. If larval recruitment occurs only on a local scale then fishing may result in permanent loss of the resource. Of relevance are the results of fisheries that have occurred in the same locations after time intervals of 5 to 10 years.

4. The selectivity of hydraulic dredges and the impact of this type of fishing gear on the survival of small, recruiting clams needs to be examined. **Research Recommendation**

5. More work is required on the potential strategy of using closed broodstock area to ensure the long-term viability of the resource. The degree to which unfishable areas contribute to recruitment needs to be better understood. Information on the efficiency of hydraulic dredges

and the importance of 'missed' or unfished resource needs to be examined. **Research Recommendation**

6. A workshop is needed to examine the ecosystem impacts of surfclam dredging. **Research Recommendation**

7. There needs to be some rationale for the alternation of the fishery between Banquereau and Grand banks.

8. Information on the ages of surfclam needs to be presented in the next assessment.

9. A proposal for a long-term rotational fishery needs to be presented.

RED CRAB (Rapporteur: M. Chadwick/D. Robichaud)

There has been a decline in catch rates throughout the range of this species. The TAC of 1300 tonnes is too high and it is unlikely that a long-term fishery could be sustained on a TAC greater than 650 tonnes. The fishing effort should not be increased above current levels. The minimum carapace size of males should be increased from 100mm to 115mm. This increase would be best implemented by modifications to crab traps.

Issues

1. The assessment is based on an analysis of catch rates, which have declined continuously throughout the history of this fishery. The decline in catch rates in all areas indicates that the resource has been exploited throughout its range. The areas of greatest declines are La Have and Browns banks. The most recent fishery on Georges Bank has also shown declines in catch rates.

2. There was some evidence that the soak time for crab traps had increased in 1997. This increase was mainly due to gear conflicts with the swordfish longline fishery.

3. There needs to be an analysis of changes in fishing effort to examine its role in the decline of catch rates. Spatial distribution of fishing effort is available from logbook data. **Research Recommendation**

4. There was a discrepancy in the 1997 length-frequency distributions between at-sea and port samples indicating that some sorting was occurring and that mostly crab larger than 115mm were being landed. Several issues were raised. First, the discarding of crab 100-115mm carapace width is based on the market preference for larger crab. This market preference changes from year to year. Some analysis of changes in the preferred market size would be useful. Second, the survival of small, discarded crab is unknown. Because of the great depth (greater than 600m) and narrow width (less than 1km) of the crab grounds, the survival is

probably low. Third, catch rates do not include discarded crab and are therefore biased downwards.

5. There was general agreement that the full distribution of the species was being exploited and that there was very little resource outside the known location of the fishery.

6. The effect of seasonal variation should be considered in a more detailed analysis of catch rates. **Research Recommendation**

7. The TAC has never been achieved and in light of the declining catch rates in all areas, it was considered to be too high. The initial TAC was set as 50% of the estimated exploitable biomass. The TAC should be reduced by the decline in catch rates, namely the ratio of early and recent catch rates. There is no need to apportion the TAC by fishing banks.

8. Recent work on the morphology of the reproductive organs of red crab indicates that the minimum carapace size should be increased from 100mm to 115mm. There were several reasons for this recommendation. First, males appear to have a very long intermolt period (perhaps terminal moult) and therefore the exploitation strategy of this species should be modelled after snow crab, which has a target exploitation rate not exceeding annual recruitment to the terminally-moulted commercial-sized group or 35-40% on hard-shell, terminally-moulted crab. Second, most males smaller than 115mm may be functionally immature. Third, the market for this species is for crab >115mm. Fourth, the minimum size is 115mm in the American red crab fisheries. Studies on reproductive biology of red crab needs to be continued covering a wide size range.

9. Red crab traps should be modified to allow the escapement of most males <115mm. **Research Recommendation**

OFFSHORE LOBSTER (Rapporteur: M. Chadwick/J. Tremblay)

The exploitation rate in this fishery is probably low. There is no reason to change the TAC. There should be no increase in the TAC until the impact of the midshore fishery is better understood.

Issues

1. Information on fishing patterns is not publically available until the year after the fishery, due to concerns by the two participants that publishing the information could influence fishing patterns of the other enterprise. This restriction prevents an up to date analysis of the status of the fishery. The best time to do the stock assessment is in the spring.

2. No catch rate data were available for the 1996-1997 fishery. The reason were that the season was not yet completed and data for the last quarter was not available, and fishing was effort data for Jonah crab and lobster have not been separated and links between the offshore crab

data base and the offshore lobster database are not yet completed. These data need to be presented. **Research Recommendation**

3. The expansion of the fishery eastward along the shelf is believed to be directed towards Jonah crab.

4. Length frequency information was not available for the 1996-97 fishery. No samples were taken during that period due to a reduced sampling program. In the early 1990s, it was decided that annual sampling was not required due to the stability of the size frequencies since the fishery began in 1972. Although it is expected that there has been no change in size, a comparison with previous years should be completed. Analyses should be standardized to the same time periods and locations. **Research Recommendation**

5. There is no method for calculating the egg per recruit of offshore lobsters, mainly because they are not known to be a closed population. The stock structure of the Gulf of Maine is complex and unclear. The potential exists that it is a metapopulation with several interlinked subpopulations with varying degrees of interaction. The absence of small lobsters in the offshore fishery suggests that it is not a closed population. On the other hand, the offshore size frequency might be explained by an outward migration of maturing animals from inshore and by changes in catchability with size at low densities. This explanation appears to be supported by size frequency data from shoalwater areas offshore, deepwater recruitment data, samples from other low F fisheries (Anticosti), USA trawl data from the 1950s and tagging data; the supporting data and analysis for this explanation need to be presented to the committee. **Research Recommendation**

6. The mid shore fishery has expanded greatly since the mid 1980s and removes large numbers of lobster along the 50 mile line that separates LFAs 34 and 41. The catches and size frequencies from the midshore fishery need to be compared to those from the offshore fishery, particularly for adjacent areas. **Research Recommendation**

7. There is no reason to change the TAC.

8. The lobster assessments in the Bay of Fundy and Gulf of Maine need to be integrated. The best time to do the stock assessment is in the spring.

9. Length-frequency distributions should be compared to those obtained from the U.S. offshore fishery. **Research Recommendation**

10. Future analyses should be completed for each of the five NAFO unit areas. **Research Recommendation**

OFFSHORE JONAH CRAB (Rapporteur: D. Robichaud/M. Chadwick)

There is no biological basis for providing a TAC in this fishery. The current fishing patterns ensure that the catch of female crab is low. The survival of undersized and female crab that are returned to the water is unknown.

Issues

1. It would be useful to calculate area-specific catch rates. **Research Recommendation**

2. Spring is the best time to assess this fishery.

3. From mid-July to mid-October, Jonah crab is the main directed species in the offshore trap fishery.

4. The biological consequences of a male-only fishery are unknown.

NORTHERN SHRIMP (Rapporteur: M. Covey/M. Chadwick)

There is no basis to change the TAC, which is approximately equal to an exploitation rate of 10%. Biomass has remained high and unchanged, 1995 to 1997. There appears to be fewer small shrimp (carapace length less than 16mm) in the 1997 research survey, suggesting that recruitment may decline. There is uncertainty about the role of shrimp as a forage species for groundfish, which have increased in abundance. The inshore trap fisheries in Mahone Bay and Canso appear to be directed towards different populations. There is a high incidence of egg disease in the inshore fisheries.

Issues

1. The fishery appears to have increased in the Louisburg Hole. It would be useful to calculate area-specific catch rates. **Research Recommendation**

2. Historical information from U.S. and Scotian Shelf surveys should be included in with the assessment. These data may be useful for understanding long-term changes in the ecosystem. **Research Recommendation**

3. Variance should be included with the biomass estimates. **Research Recommendation**

4. The estimate of absolute abundance is a minimum and should be adjusted to include estimates of shrimp missed by the fishing gear and of shrimp outside the survey area, namely waters less than 100m and non-clay sediments. **Research Recommendation**

5. A production model could be used to estimate biomass in the 1998 assessment. **Research Recommendation**

6. The target exploitation rate of 10% needs to be examined for Atlantic Canada. **Research Recommendation**

OCEAN QUAHAUG (Rapporteur: M. Chadwick)

A recent survey in St. Marys Bay indicates a mature biomass of 73,000 tonnes. The appropriate exploitation rate and the ecosystem impacts of hydraulic dredging are unknown.

Issues

1. There is no estimate of error in the biomass. A geostatistical technique should be used to calculate the error. **Research Recommendation**

2. The survey assumes that each station contributes equally to the mean estimate of size and abundance. However tow distance varied greatly and tended to be shortest in areas of high abundance. The aggregated size distribution should be weighted by tow distance. **Research Recommendation**

3. Estimates of tow distance are sensitive to position error, i.e. DGPS. The importance of this type of error should be examined. **Research Recommendation**

4. All stations should be included in the calculation of the mean.

5. There appears to be two modes in the distribution of survey catch rates, which suggest that future surveys should be stratified into at least two strata. Size distributions in the two strata should also be examined. **Research Recommendation**

6. Mean weights were available for only ten samples. Inter-milkbox variance needs to be incorporated into the mean weight. **Research Recommendation**

7. The 95% probability of a given minimum biomass needs to be calculated. **Research Recommendation**

8. The appropriate harvest strategies for ocean quahaug need to be examined. **Research Recommendation**

PERIWINKLE

No report is available for the discussion.

TIMING OF COD AND HADDOCK SPAWNING ON GEORGES BANK

No report is available for the discussion.

RESEARCH VESSEL SURVEY REPORTS AND SILVER HAKE ASSESSMENT UPDATE: (Rapporteaur: R. Halliday)

Two documents were reviewed that provided the results of the 1997 standard bottom trawl surveys in the Southern Gulf of St. Lawrence in September and on the Scotian Shelf in July. No suggestions for change in that for the Southern Gulf of St. Lawrence survey were made. In the case of that for the Scotian Shelf survey, it was proposed that the table indicating changes in stock sizes and recruitment prospects be eliminated, as year to year variations in survey results are difficult to interpret, and replaced by a list of authorities that can be contacted for further information on particular stocks. A revised projection of potential yield in 1998 for silver hake, based on the July survey estimate of the size of the 1996 yearclass at age 1, was reviewed. It was agreed that this is an appropriate inclusion in the survey update document, but that the title of the document should be modified to indicate the presence of this calculation so that it would not be overlooked.

OBSERVATIONS ON THE MEETING (Rapporteur: R. O'Boyle)

The chair convened a session to review the conduct of the meeting and what improvements could be made in future RAPs. The discussion covered three topics - the meeting, the documentation and follow-up activities.

<u>The Meeting</u>

The issue of having the groundfish and invertebrate assessments reviewed at the same meeting was raised. There were some who felt that the joint review was not a significant gain over separate meetings. There was little cross over between the invertebrate and fish scientists. However, most marine fish staff considered that joint review was a positive step. On the other hand, invertebrate staff felt that the stocks would be better served at their own meeting. Some of the industry participants were appreciative of the joint format as they were license holders of groundfish as well as invertebrate and could contribute to both discussions. However, others interested in the invertebrates mostly attended only those assessments and were annoyed when the schedule was delayed. It was recognized that maintaining participation of groundfish staff in the invertebrate discussions and vice versa was difficult. However, the joint format creates the possibility of joint participation whereas separate meetings don't provide this.

Regarding participation, it was noted that industry involvement at this meeting was lower than previous ones, but no explanation was given for this. There was a strong sentiment that effective peer review absolutely required the participation of technical experts who were not involved in the preparation of the assessments.

Regarding location, some noted that the meetings should not be held at a DFO facility but rather off-site. On the other hand, invertebrate staff were disappointed that the meeting could not be held in their lab. Meetings at hotels were considered to be too formal and expensive, making access to the scientific process more difficult for industry. Some of the industry suggested that RAPs be held in the fishing areas, such as Yarmouth or Sydney. Wherever the meeting is held, it was recommended that the data sets used in the assessments be available in a standard format (i.e. Word/Excel) to all participants. In addition, the large data sets (e.g. catch, survey) should be available on-line.

Documentation

There was considerable discussion on the need to have the working papers and draft SSRs in advance of the meeting. At the Gulf Fisheries Centre and for invertebrate RAPs, the documents were routinely circulated one week prior to the meeting. It was pointed out that the working papers were complete with text and not just a package of figures and tables. This allowed for 1) identification of reviewers for specific resources, and 2) more time to reflect on the analyses. There was general agreement for this approach. However, it was pointed out that this had been the intent of this meeting (as well as earlier RAPs) but the tight schedule between the end of the survey and the RAP had not allowed time for this. As well, at BIO this year, the evacuation of the labs due to the fungal problems made matters worse. Notwithstanding this, there was a general call to schedule the meetings to allow prior distribution and review of the documentation.

There was some discussion on the need to review the draft SSR right after the consideration of the working paper, rather than at the end of the meeting, as was the case here. Indeed, the sentiment was raised that the focus of the meeting should be the SSR rather than the working paper. However, in response, it was considered that the review of the SSR required careful consideration of the working paper. The two are linked. Re timing of the SSR review, this can only be done subsequent to any requested analyses.

The need for a 'bottomline' box in the SSR was raised. At the moment, the reader has to read the whole SSR to obtain this. It was suggested that the main observations could be displayed in bullet form at the front of the document, replacing the Background section. In response, this idea was accepted, however as an addition to the current SSR. The Background section was considered to be a valuable piece and should be left as is.

Follow-up Activities

It was pointed out that now that the assessments in 4X are completed, it is worthwhile and indeed imperative, to step back and take an ecosystem perspective. This is particularly relevant given the

mixed fishery nature of the region. This could be done at a subsequent short meeting of the Subcommittee.

It was noted that the RAP Coordinator, R. O'Boyle, will be convening meetings with staff in Halifax/Dartmouth, SABS and GFC to review comments received on RAP and foster dialogue on how the process can be improved. These meetings will be held in November with implementation of changes by 1 January 1998. The comments made at this meeting will become part of this process.

Appendix 1. Agenda.

RAP Marine Fisheries Subcommittee Meeting
6-10 October 1997
Holiday Inn Harbourview
99 Wyse Road
Dartmouth, Nova Scotia
AGENDA

	6 October Monday	7 October Tuesday	8 October Wednesday	9 October Thursday	10 October Friday
08:30 - 09:00	Travel	Cod 4X	Flatfish 4X	North Shrimp, SS	Periwinkle
09:00 - 09:30		Cod 4X	Flatfish 4X	North Shrimp, SS	Periwinkle
09:30 - 10:00		Cod 4X	Flatfish 4X	North Shrimp, SS	Georges Bank Closed Area
10:00 - 10:30	Introduction	Cod 4X	Flatfish 4X	North Shrimp, SS	Georges Bank Closed Area
10:30 - 11:00	Haddock 4X	Cod 4X	Flatfish 4X	North Shrimp, SS	Observations on the Meeting
11:00 - 11:30	Haddock 4X	Red Crab	Pollock	Witch 4VWX	Observations on the Meeting
11:30 - 12:00	Haddock 4X	Red Crab	Pollock	Witch 4VWX	Observations on the Meeting
12:00 - 13:00	*Lunch*	*Lunch*	*Lunch*	*Lunch*	*Lunch*
13:00 - 13:30	Haddock 4X	Red Crab	Pollock	Witch 4VWX	SSRs
13:30 - 14:00	Haddock 4X	Red Crab	Pollock	Witch 4VWX	SSRs
14:00 - 14:30	Haddock 4X	Red Crab	Pollock	Witch 4VWX	SSRs
14:30 - 15:00	Haddock 4X	Haddock 4TVW	Pollock	Ocean Quahaug	SSRs
15:00 - 15:30	Stimpson's Surf Clam	Haddock 4TVW	Offshore Lobster	Ocean Quahaug	SSRs
15:30 - 16:00	Stimpson's Surf Clam	Haddock 4TVW	Offshore Lobster	Ocean Quahaug	Travel
16:00 - 16:30	Stimpson's Surf Clam	Haddock 4TVW	Offshore Lobster	Ocean Quahaug	
16:30 - 17:00	Stimpson's Surf Clam	Haddock 4TVW	Offshore Jonah Crab	Ocean Quahaug	
17:00 - 17:30	Stimpson's Surf Clam	Haddock 4TVW	Offshore Jonah Crab	Ocean Quahaug	
19:00 onwards	Oceanographic Overview	4X Haddock and 4X Cod Reruns	SSRs for 4X Haddock, 4TVW Haddock, 4X Cod, Pollock, 4X Flatfish	Steering Committee Meeting (BIO): 4X Cod, 4X Haddock, 4TVW Haddock, Pollock	

Appendix 2: List of Participants

Name	Telephone Number	Fax Number
Mike Chadwick (co-chair)	(506) 851-6206	(506) 851-2387
Mike Sinclair (co-chair)	(902) 426-4890	(902) 426-1506
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Pam Decker	(902) 656-2404	(902) 656-2006
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Ken Frank	(902) 426-3498	(902) 426-9710
Jon Hansen	(902) 426-9046	(902) 426-9683
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J. Heikson	(506) 529-8854	(506) 529-5862
Peter Hurley	(902) 426-3520	(902) 426-1506
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Peter Lawton		
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Robert Mohn	(902) 426-4592	(902) 426-1506
Ram Myers	(902) 494-2687	
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Doug Pezzack		
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Name	Telephone Number	Fax Number
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Kees Zwanenburg	(902) 426-3310	(902) 426-1506

Appendix 3: Minutes of Cod/Haddock/Flatfish Working Group.

PROCEEDINGS OF THE COD HADDOCK AND FLATFISH ASSESSMENT WORKING GROUP - FALL 1997

Chair: S. Campana

Members:			
	G. Black	K. Drinkwater	P. Fanning
	D. Bowen	K. Frank	P. Hurley
	T. Lambert	R. Mohn	K. Zwanenburg
	R. Halliday	J. McRuer	W. Stobo

The *Cod, Haddock and Flatfish Assessment Working Group* met September 3, 10, 17, 24 and October 1, 3 to develop, evaluate and review the 1997 stock assessments and draft SSRs for 4TVW haddock, 4X haddock, 4X flatfish and 4VWX witch. The following represents a brief summary of the issues considered, major findings and recommendations for further research.

Environmental Overview

An overview of 1996 environmental conditions relative to previous years reported that bottom waters in 4VW are still cool compared to the long-term mean, but that there is some suggestion of warming in the past 1-2 years. Bottom waters were slightly warmer than average on the southern Scotian Shelf. Ice coverage in the Gulf of St. Lawrence was less in 1996 than in 1995, and considerably less than the long-term mean. Preliminary data for 1997 suggest that this year is very similar to last year, although 1997 mid-summer temperatures off of SW Nova Scotia were warmer than those of last year.

Precautionary Approaches to Management

A brief overview of some of the guiding principles of the precautionary approach to management were presented, including some of the target values which have been suggested. Trial runs using 1996 4X haddock data indicated that the selection of years applied to the stock-recruit relationship were very influential in defining precautionary yields. To provide a more objective basis for the selection of a stock-recruit relationship, the 25th and 75th percentiles of the conditioned bootstrap estimates of the Ricker recruitment parameters were adopted as precautionary and optimistic stock-recruit relationships, respectively. These relationships were then used to define the range of potential SSB/R and yields as a function of SSB. The advantage of this approach is that it uses real, rather than hypothetical, recruitment data to guide decision making. While assessment more than management is the primary objective of the WG, the majority of WG members agreed that the approach should be discussed and tested on one or both haddock stocks if time permits.

4TVW Haddock

The Fishery

The fishery has been closed since 1993. However, the 1990+ catch at age was recalculated using the new haddock ageing data and previously defined strategies for construction of age-length keys. Since the 1985-89 commercial otoliths have not yet been re-aged, RV keys from the corresponding years were used.

Surveys

The 1996 FG sentinel survey resulted in distributions, catch rates and length frequencies which were very similar to those of 1995, but skewed to larger sizes than RV surveys of the same area. In both years, sentinel catch rates were high at the western boundary of the survey grid, suggesting that the survey did not fully encompass a natural aggregation. The WG could not reach consensus concerning the extent of the unsurveyed population, but there was considerable discussion on the possibility of both directed and undirected movements of haddock between 4VW and 4X, despite the fact that recent tagging studies suggest that there is no large-scale mixing between the two stocks. The WG **recommends** that a comparable and coordinated sentinel survey to that in 4VW be established in 4X so as to both provide an index of abundance in eastern 4X and to more completely delimit the distribution of haddock in both stock areas.

While the spatial distribution of catches in the summer groundfish RV survey was broadly similar to that of the sentinel survey, the 1995 and (incomplete) 1996 spring RV surveys demonstrated that most haddock were found off the banks in deeper water in spring. Spring and summer length frequencies were comparable. 1997 numbers and weights per tow are about average and low compared to the long-term mean, with the vast majority of the haddock being found in 4W. There is no evidence of a reduced range of ages in the RV catch since at least 1990. However, the size range has declined considerably; the reduced size range was attributable to declines in the size of the older fish. Contour plots of RV numbers at age showed that year-classes tracked well to at least age 6, and perhaps longer.

A recruitment index based on age 1 and 2 RV catch rates indicates that the 1993 and 1994 year-classes are of about average size, as has been suggested by previous assessments.

Mortality rates based on Paloheimo z's suggest that mortality rates have remained relatively constant at 0.3-0.4 since 1991, although the time series did not track the general trend in fishing effort through the 1970s and 1980s. Therefore, the WG was not convinced that the more recent z estimates were realistic.

Biological Indices

Condition factor has declined 10-15% since 1970 in both the spring and summer RV surveys, although the condition of 4W haddock has remained roughly constant since 1994. The trend was

evident in larger (45-cm) fish in both 4V and 4W, but not in pre-recruits (30-cm). There was a significant correlation, and considerable parallelism between the condition of 4W cod and 4W haddock, suggesting that similar factors are influencing the condition of both species. The suggestion was also made that the factors that led to declining growth rates in these two species may also have reduced their condition, particularly since there is evidence of an upturn in both growth rate and condition since 1995.

A time series plot of mean length at age from the summer RV showed no apparent trends in size of age 0-2 haddock since 1970. However, substantial long-term declines in length at age become increasingly apparent at older ages, particularly for fish of ages 8 and above. The WG expressed concern that some of the apparent decline may have been due to the shift in ageing responsibilities (from Reg Thurber to Cecil in 1983, to BIO in 1985), as well as the shift from cracked otoliths to otolith sections in 1984. Indeed, discontinuities in size at age were apparent in 1983-84 for most ages above age 3. Residuals from year-class-specific vonB plots showed similar discontinuities. To determine if differences in ageing accuracy contributed to the apparent declines in growth rate, the WG **recommends** a matched pair comparison of sectioned vs cracked 4VW haddock otoliths be carried out, and if bias between the two preparation methods is absent, that one of the pre-1983 cracked otolith samples be re-aged and compared with original readings to determine if the historical ages are accurate.

In light of possible ageing problems with the pre-1985 data, analysis of mean length at age RV data was confined to the more recent period, in which significant declines in length at age were noted. Declines in L_∞ and increases in k from the vonB were also apparent. Comparison of year-class-specific vonB's with those of 4T cod showed comparable declines, although the comparisons were made across the time period in which ageing transitions were made in both stocks. Natural mortality rates predicted from Pauly's equation suggest that M would have increased from about 0.15 to 0.45 as a result of the lower growth rates, although the applicability of Pauly's equation was questioned due to the manner in which the temperature term was estimated. Verification of the accuracy of the pre-1985 age data will be necessary to determine the magnitude and time period over which the decline has occurred. However, declines in length at ages 3-6 were also apparent between 1976-82, as well as between 1948-59 for ages 5-8 as reported by McCracken (1961). In addition, the decline in length at age 5 was comparable to that of 4Vs and 4W cod over the same time period, although the rate of decline in 4W cod has been more marked than that of 4VW haddock since 1985. Taken together, the evidence of a decline in growth rate in the recent past was compelling, particularly since similar declines were observed in 4VsW cod, in eastern 4X haddock, and in 4T cod. The possibility of effects due to changes in the size-selectivity of the fishery associated with various gear closures was discussed, but not evaluated with data. The WG **recommends** that additional research be undertaken to assess the spatial scale of the change in growth rates, as well as the species that have been affected.

Preliminary estimates of length-specific fecundity were presented and compared to the mean 4X haddock relationship of Waiwood. The comparison suggested that 4VW fecundity was somewhat lower. A time series of L_{50} mature drawn from spring RV data indicated that the length at 50% maturity has declined by about 20% since 1990. While the WG discussed the

possibility of reduced growth rates having contributed to the change in the maturity schedule in 4VW, no analysis was presented.

Requirement for enhanced biological sampling of groundfish

The data available on the biological status of the Scotian Shelf groundfish stocks is currently inadequate due to the absence of seasonal information on the condition of fish and their maturity schedule (ogive). Monthly samples which monitored the weight of fish, including round weight, gutted weight, gonad weight and liver weight, along with length, sex and macroscopic maturity stage, would allow accurate determination of condition and maturity parameters throughout the year. The current view from egg and larval surveys and length at age 1 is that there is little evidence of a significant spring spawning component for 4VsW cod. The seasonal pattern of GSI would allow one to say something about spawning components in the same way it is used to partition spring and fall herring spawners. The opportunity may also exist to collect additional otoliths to supplement those obtained by the national sampling program. Therefore, it is **recommended** that monthly sampling of commercial fisheries be supported as a means of obtaining data on fish condition and maturity. While such sampling could be carried out in several ways, the WG noted that The Fishermen and Scientists Research Society has established a pilot project for members to bring samples of round fish in to a number of selected plants. In the plant the FSRS has placed sampling boards, gram-precision scales and associated sampling supplies. The fishers, in some cases with the assistance of plant personnel, conduct the sampling and record the data. The data are forwarded to the FSRS Data Analyst for entry and archiving. Unfortunately, the pilot project has struggled to maintain participation as there is no remuneration for the fishers or plant for the time and effort they provide. Support for this program is one way in which the monthly samples for the maturity and condition program could be provided.

Ageing

Approximately 7000 otoliths from the 1985-96 RV surveys and 5000 commercial otoliths from 1985 and 1990-96 have been re-aged by the new BIO agers in the past year. Age-bias plots show no bias between the primary and secondary agers, and precision (CV) has reached levels of less than 5% (which is considered very good for this stock). There was no bias when tested against the otolith reference collection (which is assumed to be of known age, given its ageing by international experts and bomb radiocarbon validation of similarly interpreted haddock otoliths) in Fall 1996, when the re-ageing of historical otoliths was begun. However, bias was evident when the primary and secondary agers were tested against the reference collection again in Fall 1997 (at the end of the re-ageing period). The magnitude of the bias was generally less than 1/2 year for the primary ager, but increased gradually to about 1 year at age 9 for the secondary ager. Given that about 80% of the otoliths were aged by the primary ager, it is unlikely that the accuracy of the RV or commercial catch at age has been noticeably compromised. The WG noted that the ageing bias would not have been noticed in the past, and was only detected now through the quality control procedures that are in place. The WG **recommends** that the ageing procedures being used by the primary and secondary 4VW haddock agers be reviewed, and if necessary, adjusted to eliminate the bias.

Population Analyses

Population numbers and Fs from the ADAPT suggested that population size was considerably larger, and Fs considerably lower, during the 1980s than was previously suspected. The discrepancy appears to be due to the use of the new, more accurate age data, which greatly expands the range of ages present in the catch and RV. However, both population size and F appear to be low in the 1990s. Runs with and without the pre-1985 data were comparable, suggesting that the unknown accuracy of the pre-1985 ages did not influence the population estimates. The most recent 3 years in the population model were based on by-catch only, which limits the estimation power of the model for the incoming year-classes. The retrospective problem was particularly bad in the 1980s, but appears to be more stable recently. It was not clear why the problem had disappeared, but hopefully was not just an artifact of the closed fishery. Q-corrected runs greatly improved the earlier retrospective problem, but had no influence on recent patterns. Estimates of residual mortality (Z-F) based on q-corrected runs suggested that significant unaccounted mortality has affected 4VW haddock since about 1991. The source of this unaccounted mortality was not clear, but could be due to an increase in natural mortality or emigration rate. However, recent tagging results suggest that emigration from 4VW to 4X has been minimal.

A recruit-SSB phase plot has broad similarities to that of 4VsW cod, with low biomass/ recruitment in the 1970s and high values of both in the 1980s. Bootstrapped estimates indicate that recent values have been in the lower (1970s) quadrant. A phase plot using only RV data (sum of age 1 & 2 vs 3+) showed a broadly similar dome, suggesting that the ADAPT-based model is robust.

Standard risk analyses were used to generate biomass and F probability distributions associated with a 1999 TAC of 100t. However, these were considered unrealistic compared to the bootstrapped S-R distributions, which better account for both process and measurement error in the S-R relationship. Sensitivity analyses of the effect of age at maturity showed that the selection of age at maturity is highly influential in modifying the yield vs F and yield vs SSB distributions at F greater than F_{max}. Yields at lower Fs were not substantially affected. Changes in gear selectivity had similar effects, although they also influenced Y/R.

The analytical tools which underlie ADAPT-based assessments have become increasingly sophisticated in recent years. This software is continuously evolving to meet new objectives, and while the code is often checked for accuracy, the possibility of undetected errors is inevitably present. Therefore the WG **recommends**: 1) that a test database be developed and analyzed in order to produce reference output of known accuracy against which modifications to software could be evaluated; and 2) that specific core analytical procedures be adapted and modified for non-expert generalized use in a PC environment.

4X Haddock

The Fishery

No substantive changes in landings or fishing patterns were noted. Length frequencies by gear type in 1997 were similar to those of 1996. Maps of catch distribution by OT gear demonstrated that most of the 4Xs catches were made very close to the 4Xr boundary, suggesting that the exclusion of 4Xs catches from the assessment may not be warranted. The WG **recommends** that the basis for the current exclusion of 4Xs catches from the 4X haddock assessment be reevaluated, and if warranted, changed.

The catch at age for 1997 appeared to under-represented the expected number of age 3 fish due to the absence of LL age-length keys for the LL catch. There were no obvious trends in commercial weight at age since 1988.

Surveys

The distribution of haddock caught in the 1997 ITQ survey was similar to that of 1995 and 1996, and provided excellent coverage of both the inshore and offshore regions. Overall distributional patterns were similar to those of the summer RV survey, although the ITQ survey provided coverage over a broader area and in greater detail. The WG was impressed by the additional information which the ITQ survey provides on the inshore, 'untrawlable' region of 4X. The WG **recommends** that time series plots of trawlable biomass (both pre-recruits and recruits) from the ITQ survey be developed as annual abundance indices and compared with those of the RV, and further, that the proportion of the pre-recruited and exploitable haddock stock found in the inshore "untrawlable" region of 4X be estimated.

Length frequencies in the inshore region of the 1997 ITQ survey were significantly different from those of the offshore region. Comparisons of the offshore ITQ strata with those of the RV showed subtle but significant differences in the position of the length modes; the sources of those differences were not clear. In general, the ITQ survey caught more larger fish than did the RV survey.

Year-by-year length frequencies from the summer RV survey continue to show signs of good recruitment since 1994. The size of the 1994 and 1996 year-classes both appear to be above average, although the 1996 YC is only prominent in the Bay of Fundy. A recruitment index based on the sum of q-adjusted age 2+3 RV numbers indicated that 1993 and 1994 year-classes were both well above average in size. An age composition plot based on expanding symbols provided the same view as the recruitment index concerning the relative size of the 1993 and 1994 year-classes. However, it also suggested that the 1995 year-class was relatively weak.

The number and weight per tow of recruited fish is at or slightly below the long-term mean, particularly on Browns Bank and in the eastern portion of 4X. There has been a small but significant compression in the RV age and length percentiles in recent years, probably associated with the strong incoming recruitment.

Ageing

Age bias plots between one set of primary and secondary age readers indicated no bias and good precision (CV=3.0%). However, age bias plots between the other set of agers indicated bias of about 1 year was present at age 8+ in both RV and commercial samples. Bias of about 0.5 year was also evident at ages 2 and 3 in the commercial samples. Tests against the reference collection in Sept 1997 demonstrated no bias by either ager, and excellent precision (less than 3%). Subsequent ageing of the agers needs to be monitored to insure that the previously identified bias does not return.

Biological Indices

The condition factor of both pre-recruited and recruited haddock has declined since 1990. The 1997 value is very similar to that estimated for 4W haddock. While no conclusion was reached, the WG noted the similar temporal trends of condition factor between 4VW and 4X haddock, as well as their similar terminal value. However, the fact that Bay of Fundy haddock (which are believed to be quite distinct from those further east) showed similar trends suggests that the 4VW-4X comparability is not merely a reflection of migrating fish.

Time series plots of RV length at age in the Bay of Fundy show no substantial changes through time. However, the length of age 4+ fish in the eastern portion of 4X has declined, beginning in about 1982. The decline in apparent growth rate was most acute for the oldest fish. The WG could not agree if the change in size was due in part to the transition between haddock agers. However, the fact that no changes were noted in the Bay of Fundy haddock aged by the same agers, suggests that the decline in growth rate was real.

Population Analyses

A half-year VPA was run so as to take advantage of the catch data from the first half of 1997. ADAPT runs using a variety of age-length key combinations for the 1985-87 period produced significant variation in the mid 1980s, but not in subsequent years. Since the run using annual RV keys for 1985-87 resulted in the best model fit, it was adopted for use. Tuning was against mid-year population size. Model fit was good throughout the survey period, with the exception of the 1978 RV point, which was clearly anomalous. CVs for the population estimates of 3-6% appeared unusually low, but no errors were found.

The time series of SSB based on Waiwood's maturity ogive (which was more conservative than use of 3+ biomass) produced extremely high SSB estimates for recent years, due to the estimated strengths of the 1993-94 year-classes. The ADAPT estimates of age 1 population size produced record levels for both 1993 and 1994; both of these estimates were considerably higher than the RV recruitment index based on q-scaled age 1 and 2, and were inconsistent with observations from the fishery. Since last year's empirically-based 50% downweighting of the size of the 1993 year-class resulted in a value which was close to the current year's estimate, a similar procedure will be used to downweight the size of the 1994 year-class in this assessment, and thus put it more in line with expected converged values.

Recruit-biomass phase plots suggest that the recent high recruitment is the product of relatively low biomass, but that biomass may well increase in the near future. Projections for unestimated year-classes will be based on the GM of age 1 for the years 1984-93, so as to avoid the influence of the recent record-high recruitment. This stock would appear to be an ideal candidate for precautionary yield estimates.

4X Winter Flounder, American Plaice and Yellowtail Flounder

Stock Structure

The WG reviewed published and published information to determine if the current split between 4X and 4VW assessment units is warranted. On the basis of seasonal RV distributions, there appeared to be partial segregation of winter, witch and yellowtail flounder between 4VW and 4X. However, the distribution of plaice into 4X may represent spillover from the more abundant 4VW distribution. Sparse ichthyoplankton distributions suggested spawning of witch and yellowtail, and possibly plaice, in both 4VW and 4X. Historic tag recoveries suggested that witch, yellowtail and plaice do not stray long distances from their tagging sites. Overall, there was no strong evidence for or against the current assessment unit. However, distinction between 4X and 4VW assessment units provides for conservative assessments in the event that distinct stocks do exist on the Scotian Shelf.

The Fishery

Approximately one half of the reported flatfish landings in 4X are listed as unspecified species by Statistics Branch. As a result, it is virtually impossible to prepare stock assessments incorporating fishery information for any of these species. This is a serious and unnecessary situation, since many fishermen record catch by species in their logbooks, but at weighout the species are often grouped into 'unspecified flounder'. Since the weighout is the only official statistic, the species breakdown information is lost - if Statistics Branch would use the log estimates to prorate the 'unspecified flounder' weighout values, the situation would be largely resolved. Thus the WG **strongly recommends** that immediate action be taken by Statistics Branch, with input from Science Branch, to resolve this problem. It is extremely important that Statistics Branch provide accurate landings data by species for flatfish landed in the Maritimes Region.

Preliminary prorations of the unidentified 1991+ landings using either identified landings or the species composition of the 4X ITQ survey suggested that about 75% was winter flounder, 15% plaice and 10% yellowtail. Within-year comparisons between commercial and ITQ survey were not well correlated, probably because of the large spatial variations in species composition and the fact that the ITQ data included pre-recruits (the survey was done with a liner). However, prorations by unit area resulted in improved correlations and, based on the use of witch as a control, reasonable accuracy overall, despite year to year imprecisions. Nevertheless, neither form of proration would provide landing statistics as accurate as those possible through proper coding of logbooks.

Preliminary analysis of logbook information indicated that large quantities of flatfish were identified to species in the logbook, but not recorded on the purchase slip by species and remained aggregated by Statistics Branch. Therefore, the log books are a promising source of information on flatfish catch by species. The WG **recommends** that the logbook information (which has already been keypunched for the period 1993-96) be further analyzed to estimate the flatfish species composition in the landings during recent years.

Consultations with industry indicated that few of the 4X industry data collected prior to 1991 were reliable, due to widespread misreporting. However, more recent data are believed to be reliable. Most fishermen surveyed were under the impression that flatfish stocks were in serious decline. The fishery continues to be prosecuted most heavily in the summer and fall.

Maps of fishing effort by species were in broad agreement with species distributions based on RV data. However, it was not possible to confirm the accuracy of the data.

The accuracy of the logbooks used to generate commercial catch rate indices was unknown. However, all species showed substantial declines in catch rates since 1990. Longitudinal catch rates, based on a specific subset of 22 fishing vessels, were considered more reliable since recent entries into the fishery would not have confounded the resulting catch rate estimate. This index also declined for all species since 1990. In general, the longitudinal catch rate index indicated a decline or stability for all three flounder species; this corresponded quite well with the recruited winter flounder RV index since 1986, but did not correspond to that of plaice or yellowtail as well.

Surveys

The summer 1997 RV distribution of the 3 flatfish species was similar to that of previous years. Both recent (1993-97) and long-term RV distributions of winter flounder suggested that there were concentrations of both juvenile and adult flounder in both the Bay of Fundy and in 4W, as well as adults on Browns Bank in the 1990s. However, previous inshore surveys and the ITQ survey have demonstrated that large numbers of winter flounder also live in the unsurveyed inshore region. Cumulative frequency distributions demonstrated that both winter flounder and yellowtail were generally found in water depths of less than 100m. The distribution of plaice was heavily concentrated in 4V, with relatively small amounts found in eastern 4X at both the juvenile and adult stage. It was not clear whether the 4X component represented a distinct stock, or merely overflow from the much larger 4V stock. However, the 4X component has represented a larger proportion of the total in the past 5 years. The depth distribution of plaice was largely at depths greater than 150 m. The distribution of yellowtail was closer to, but still distinct from, that of plaice, being concentrated in 4VsW. Relatively small numbers of both juveniles and adults have been captured around Brown Bank, both historically and recently. However, as was the case with plaice, 1993-97 proportions in 4X are much larger than those observed in the past.

Summer RV time series of abundance show some evidence of increase since 1987 for both winter flounder and yellowtail. Abundance indices for both pre-recruits and recruits of winter flounder indicated a curious stepwise progression in abundance (low in the 1970s, higher in the

1980s, highest in the 1990s) which was too abrupt to be consistent with normal population growth. Thus it was agreed that comparisons should be restricted to the post-1987; the WG **recommends** that the reason for the stepwise progression be resolved. Overall abundance has been relatively constant since 1988. The time series of length frequencies suggested that there has been some loss of larger winter flounder (greater than 40cm), but that abundance of 30-40cm fish has been about average. The abundance of fully-recruited plaice has changed little since 1987; the number of pre-recruits has also remained relatively constant since 1987, although there has been a decrease during the last 4 years. The abundance of fully-recruited yellowtail has increased gradually since 1987. There has been a decline in the last 4 years, but even with that, the abundance is substantially above that observed in the late 1980s. The abundance of yellowtail pre-recruits has been somewhat higher than average in the past 7 years, with a gradual increase between 1987 and 1997. However, the modes in the length frequency time series did not track well at all for either plaice or yellowtail, suggesting either that the true stock boundaries lie outside 4X or that the survey provides poor estimates of their abundance. This fact may explain why recent RV abundance trends were difficult to reconcile with the observations of industry.

Use of bootstrapped confidence intervals for the biomass estimates provided confidence intervals which were considered to be far more reliable than those available through STRAP.

Survey efficiency estimates for each of the 3 flatfish species indicated that the summer RV was reasonably efficient for winter and yellowtail flounder, but that the set allocation efficiency for plaice was very poor. The implications of this inefficiency were unclear, but there was no correlation with biomass. Despite large fluctuations in the both the set and stratification efficiency estimates from year to year, there has been no consistent trend in efficiency over the duration of the RV time series. The fluctuations in the yellowtail efficiency estimate were consistent with the knife-edge depth selectivity of this species, in that sets which were allocated to shallower depths within a given stratum were far more likely to catch fish than were deeper sets. In light of the consistent depth selectivity of yellowtail, the WG **recommends** that an abundance-depth calibration curve be used to adjust RV abundance indices for this species, and thus provide a more reliable index.

The ITQ survey caught large numbers of flatfish between 1995-97. When mapped, the catches produced an excellent overview of species distributions, including the inshore area which is unsurveyed by the RV. Winter flounder catches were common to the south and west in 4X, but rare to the east of Browns Bank. This pattern was consistent with that of the RV and fishing effort distributions. Catches of plaice were almost opposite to those of winter flounder, being concentrated in eastern 4X and virtually absent from the Bay of Fundy. Yellowtail distributions largely overlapped those of plaice, but were less easterly and more to the inshore. Given the excellent promise of the ITQ surveys as abundance indices for flatfish, the WG **recommends** that abundance time series, broken down into juvenile and adult size categories (possible only for winter flounder), be examined for evidence of change in stock status.

Ageing

There are no current published growth curves or age-length keys for flatfish on the Scotian Shelf. Growth curves exist for both the Gulf of Maine and the Gulf of St. Lawrence, but they may over- and under-estimate growth in 4X. 4VWX flatfish otoliths used to be aged in the 1970s and 1980s, but the validity of those age estimates (which were tabled at the WG) is unknown. Therefore, the WG **recommends** that an appropriate age-length key be developed for use in 4X, either through validation of existing data or by ageing a subsample of newly collected otoliths by a lab experienced in their age determination.

4VWX Witch

The Fishery

Unlike other flatfish species, witch landings are believed to be completely and accurately assigned to species since at least 1991. Recent landings have declined substantially in all divisions. Foreign catches have been minimal, and do not appear to be useful as a recruitment index. A map of fishing effort suggests that effort is rather evenly distributed between 4X and 4V.

Longitudinal catch rate series (following a discrete subset of fishing vessels) for several gear sectors were given preliminary examination as potential indices of abundance. The initial results were encouraging. Therefore, the WG **recommends** that longitudinal catch rates be further analyzed and developed as an index of stock abundance for witch flounder.

Surveys

The distribution of juveniles caught in the RV survey is centred in 4Vs, with only small numbers found elsewhere. Adults are more broadly distributed, mainly in 4V and in the Bay of Fundy. Based on seasonal surveys, there was no obvious shift in distribution associated with time of year. Since it was not clear if witch caught in 4X represented a different stock or merely overflow from a 4Vs-centred stock, the WG **recommends** that available information be given close examination to determine the most appropriate assessment unit for witch flounder.

Based on the RV time series, the relative abundance of witch in 4X is small compared to that in 4VW. Overall numbers are currently above average, although biomass is well below the long term mean. Most of the post-1992 increase in numbers appears to be due to strong incoming recruitment in 4VW, visible as obvious modes in the length frequency distribution. The incoming year-classes were also visible in the March RV surveys. There is no evidence of compression in the size distribution. Length frequency modes appear to track year-classes relatively well in this species, more so than in 4X flatfish. However, there is currently no basis for assigning length modes to year-classes. Published age-length keys for the Gulf of Maine and the northern Gulf of St. Lawrence differ, but presumably bracket the growth of witch on the Scotian Shelf. The WG **recommends** that an appropriate age-length key be developed for use

with witch, either through validation of existing data or by ageing a subsample of newly collected otoliths by a lab experienced in their age determination.

Significant numbers of witch were captured in the 4X ITQ surveys. Catches were concentrated near the mouth of the Bay of Fundy in 1995, but were more scattered in 1996 and 1997. The WG **recommends** that the 4X ITQ survey be developed as an index of abundance for the 4X component of the witch stock.

Preliminary estimates of z based on historic RV ageing and length frequencies indicated that estimates were highly variable across years, implying that cross-year averaging would be required. Averages based on 5-year blocks and sexes combined suggested that 4VW mortalities were higher than those in 4X, and had increased substantially since 1980.

Appendix 4: List of Research Recommendations.

4TVW HADDOCK

From the Cod/Haddock/Pollock Working Group

- The WG **recommends** that a comparable and coordinated sentinel survey to that in 4VW be established in 4X so as to both provide an index of abundance in eastern 4X and to more completely delimit the distribution of haddock in both stock areas.

- To determine if differences in ageing accuracy contributed to the apparent declines in growth rate, the WG **recommends** a matched pair comparison of sectioned vs cracked 4VW haddock otoliths be carried out, and if bias between the two preparation methods is absent, that one of the pre-1983 cracked otolith samples be re-aged and compared with original readings to determine if the historical ages are accurate.

- The WG **recommends** that additional research be undertaken to assess the spatial scale of the change in growth rates, as well as the species that have been affected.

- Therefore, it is **recommended** that monthly sampling of commercial fisheries be supported as a means of obtaining data on fish condition and maturity.

- The WG **recommends** that the ageing procedures being used by the primary and secondary 4VW haddock agers be reviewed, and if necessary, adjusted to eliminate the bias.

- The WG **recommends**: 1) that a test database be developed and analyzed in order to produce reference output of known accuracy against which modifications to software could be evaluated; and 2) that specific core analytical procedures be adapted and modified for non-expert generalized use in a PC environment.

- The WG **recommends** that the basis for the current exclusion of 4Xs catches from the 4X haddock assessment be reevaluated, and if warranted, changed.

4X HADDOCK

From Marine Fisheries Subcommittee

- It is **recommended** that the current practice of excluding 4Xs haddock catches from the 4X assessment be re-examined.

- It is **recommended** that the annual proportion of the 4X haddock stock found inshore of the RV-surveyed region also be calculated to determine if existing assumptions concerning constant proportionality of abundance between inshore and offshore areas are justified. The

additional benefit of an equivalent industry-based survey, based on fixed gear in eastern 4X, was noted.

From the Cod/Haddock/Pollock Working Group

- The WG **recommends** that time series plots of trawlable biomass (both pre-recruits and recruits) from the ITQ survey be developed as annual abundance indices and compared with those of the RV, and further, that the proportion of the pre-recruited and exploitable haddock stock found in the inshore "untrawlable" region of 4X be estimated.

4X COD

From Marine Fisheries Subcommittee

- It was **recommended** that the sampling design being used by port technicians be reviewed.

- It is **recommended** that an index of discarding practices over time be developed.

4VWX5Zc POLLOCK

From Marine Fisheries Subcommittee

- It was **recommended** to look at the size frequency in key strata as well as showing some analysis with the maps.

- It was **recommended** to use of the Canadian spring and US research surveys as well as looking at length composition over the long term average.

- It is **recommended** to examine patterns of partial recruitment in recent years and determine why the fishery appears to be focusing on the younger ages.

4X FLATFISH

From Marine Fisheries Subcommittee

- It is **recommended** that the length frequencies from the ITQ surveys be analyzed and incorporated into the next assessment of this resource.

- It is **recommended** that suitable age-length keys were needed to be applied to the survey length frequencies of winter flounder to allow for the construction of catch curves and the estimation of total mortality.

- It is **recommended** that an appropriate number of winter flounder (spawning all lengths and both sexes) be aged to produce a preliminary age-length key which would allow for "ageing" of the survey and/or commercial length-frequencies to produce estimates of total mortality.

- It is **recommended** that commercial length frequency data be incorporated into the next assessment (see above). It was stated that as the mean length of the winter flounder landed in the past number of years had declined, examination of the commercial length-frequencies would give some indication of the magnitude of this change.

From the Cod/Haddock/Pollock Working Group

- The WG **strongly recommends** that immediate action be taken by Statistics Branch, with input from Science Branch. It is extremely important that Statistics Branch provide accurate landings data by species for flatfish landed in the Maritimes Region.

- The WG **recommends** that the logbook information (which has already been keypunched for the period 1993-96) be further analyzed to estimate the flatfish species composition in the landings during recent years.

- Abundance indices for both pre-recruits and recruits of winter flounder indicated a curious stepwise progression in abundance (low in the 1970s, higher in the 1980s, highest in the 1990s) which was too abrupt to be consistent with normal population growth. Thus it was agreed that comparisons should be restricted to the post-1987; the WG **recommends** that the reason for the stepwise progression be resolved.

- In light of the consistent depth selectivity of yellowtail, the WG **recommends** that an abundance-depth calibration curve be used to adjust RV abundance indices for this species, and thus provide a more reliable index.

- Given the excellent promise of the ITQ surveys as abundance indices for flatfish, the WG **recommends** that abundance time series, broken down into juvenile and adult size categories (possible only for winter flounder), be examined for evidence of change in stock status.

- 4VWX flatfish otoliths used to be aged in the 1970s and 1980s, but the validity of those age estimates (which were tabled at the WG) is unknown. Therefore, the WG **recommends** that an appropriate age-length key be developed for use in 4X, either through validation of existing data or by ageing a subsample of newly collected otoliths by a lab experienced in their age determination.

- The WG **recommends** that longitudinal catch rates be further analyzed and developed as an index of stock abundance for witch flounder.

- Since it was not clear if witch caught in 4X represented a different stock or merely overflow from a 4Vs-centred stock, the WG **recommends** that available information be given close examination to determine the most appropriate assessment unit for witch flounder.

4VWX FLATFISH

From the Cod/Haddock/Pollock Working Group

- The WG **recommends** that an appropriate age-length key be developed for use with witch, either through validation of existing data or by ageing a subsample of newly collected otoliths by a lab experienced in their age determination.

- The WG **recommends** that the 4X ITQ survey be developed as an index of abundance for the 4X component of the witch stock.

STIMPSON'S SURFCLAM

From Marine Fisheries Subcommittee

- It would be useful to have a detailed description of the fishery and the seasonal and spatial distribution of fishing effort. These maps of fishing effort would be compared to the distribution of the resource. **Research Recommendation**

- Commercial sampling information needs to be presented. Of particular interest is spatial variation in size frequency distributions. **Research Recommendation**

- The selectivity of hydraulic dredges and the impact of this type of fishing gear on the survival of small, recruiting clams needs to be examined. **Research Recommendation**

- More work is required on the potential strategy of using closed broodstock area to ensure the long-term viability of the resource. The degree to which unfishable areas contribute to recruitment needs to be better understood. Information on the efficiency of hydraulic dredges and the importance of 'missed' or unfished resource needs to be examined. **Research Recommendation**

- A workshop is needed to examine the ecosystem impacts of surfclam dredging. **Research Recommendation**

RED CRAB

From Marine Fisheries Subcommittee

- There needs to be an analysis of changes in fishing effort to examine its role in the decline of catch rates. Spatial distribution of fishing effort is available from logbook data. **Research Recommendation**

- The effect of seasonal variation should be considered in a more detailed analysis of catch rates. **Research Recommendation**

- Red crab traps should be modified to allow the escapement of most males <115mm. **Research Recommendation**

OFFSHORE LOBSTER

From Marine Fisheries Subcommittee

- No catch rate data were available for the 1996-1997 fishery. The reason were that the season was not yet completed and data for the last quarter was not available, and fishing was effort data for Jonah crab and lobster have not been separated and links between the offshore crab data base and the offshore lobster database are not yet completed. These data need to be presented. **Research Recommendation**

- Length frequency information was not available for the 1996-97 fishery. No samples were taken during that period due to a reduced sampling program. In the early 1990s, it was decided that annual sampling was not required due to the stability of the size frequencies since the fishery began in 1972. Although it is expected that there has been no change in size, a comparison with previous years should be completed. Analyses should be standardized to the same time periods and locations. **Research Recommendation**

- There is no method for calculating the egg per recruit of offshore lobsters, mainly because they are not known to be a closed population. The stock structure of the Gulf of Maine is complex and unclear. The potential exists that it is a metapopulation with several interlinked subpopulations with varying degrees of interaction. The absence of small lobsters in the offshore fishery suggests that it is not a closed population. On the other hand, the offshore size frequency might be explained by an outward migration of maturing animals from inshore and by changes in catchability with size at low densities. This explanation appears to be supported by size frequency data from shoalwater areas offshore, deepwater recruitment data, samples from other low F fisheries (Anticosti), USA trawl data from the 1950s and tagging data; the supporting data and analysis for this explanation need to be presented to the committee. **Research Recommendation**

- The mid shore fishery has expanded greatly since the mid 1980s and removes large numbers of lobster along the 50 mile line that separates LFAs 34 and 41. The catches and size frequencies from the midshore fishery need to be compared to those from the offshore fishery, particularly for adjacent areas. **Research Recommendation**

- Length-frequency distributions should be compared to those obtained from the U.S. offshore fishery. **Research Recommendation**

- Future analyses should be completed for each of the five NAFO unit areas. **Research Recommendation**

OFFSHORE JONAH CRAB

From Marine Fisheries Subcommittee

- It would be useful to calculate area-specific catch rates. **Research Recommendation**

NORTHERN SHRIMP

From Marine Fisheries Subcommittee

- The fishery appears to have increased in the Louisburg Hole. It would be useful to calculate area-specific catch rates. **Research Recommendation**

- Historical information from U.S. and Scotian Shelf surveys should be included in with the assessment. These data may be useful for understanding long-term changes in the ecosystem. **Research Recommendation**

- Variance should be included with the biomass estimates. **Research Recommendation**

- The estimate of absolute abundance is a minimum and should be adjusted to include estimates of shrimp missed by the fishing gear and of shrimp outside the survey area, namely waters less than 100m and non-clay sediments. **Research Recommendation**

- A production model could be used to estimate biomass in the 1998 assessment. **Research Recommendation**

- The target exploitation rate of 10% needs to be examined for Atlantic Canada. **Research Recommendation**

OCEAN QUAHAUG

From Marine Fisheries Subcommittee

- There is no estimate of error in the biomass. A geostatistical technique should be used to calculate the error. **Research Recommendation**

- The survey assumes that each station contributes equally to the mean estimate of size and abundance. However tow distance varied greatly and tended to be shortest in areas of high abundance. The aggregated size distribution should be weighted by tow distance. **Research Recommendation**

- Estimates of tow distance are sensitive to position error, i.e. DGPS. The importance of this type of error should be examined. **Research Recommendation**

- All stations should be included in the calculation of the mean.

- There appears to be two modes in the distribution of survey catch rates, which suggest that future surveys should be stratified into at least two strata. Size distributions in the two strata should also be examined. **Research Recommendation**

- Mean weights were available for only ten samples. Inter-milkbox variance needs to be incorporated into the mean weight. **Research Recommendation**

- The 95% probability of a given minimum biomass needs to be calculated. **Research Recommendation**

- The appropriate harvest strategies for ocean quahaug need to be examined. **Research Recommendation**