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Redfish Zonal Assessment Process

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Gulf Fisheries Center, Moncton

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ABSTRACT

The status of Redfish stocks in Unit 1, Unit 2, and NAFO Sub-Division 3O were assessed. Information on oceanographic conditions in the areas was also reviewed, relative to possible effects on stock status, distribution and productivity. Industry input was generally consistent with the results of analyses from monitoring, surveys, and commercial catches. The meeting concluded that status of redfish in 3O was unchanged, and that a multi-year management approach to this stock might be considered. Young fish in Unit 1 remain well represented, but are not recruiting to fishable sizes, and catches should remain below 10,000 t for all uses. The status of redfish in Unit 2 was also largely unchanged. There was some indication that two recent year-classes might be good, but it will be several years until these grow to fishable size. Major research questions were identified, and draft SSRs were reviewed and approved.

RÉSUMÉ

L'état des stocks de sébaste a été évalué dans les unités 1 et 2 et dans la sous-division 3O de l'OPANO. L'information sur les conditions océanographiques dans ces endroits a aussi été examinée quant aux effets possibles que celles-ci pourraient exercer sur l'état, la distribution et la productivité des stocks. L'information fournie par l'industrie était généralement cohérente avec les résultats des analyses des données de surveillance, des relevés et des données sur les prises commerciales. Les participants à la réunion ont conclu que l'état des stocks de sébaste n'avait pas changé dans 3O et qu'un plan de gestion pluriannuel de ce stock pouvait être envisagé. Les jeunes poissons dans l'unité 1 sont encore bien représentés, mais les recrues ne sont pas de taille exploitable, et les prises devraient demeurer inférieures à 10 000 t pour toutes les utilisations. L'état du sébaste dans l'unité 2 n'a pas non plus beaucoup changé. Il semble que les deux dernières classes d'âge pourraient être bonnes, mais il faudra plusieurs années avant que ces poissons atteignent une taille propre à la pêche. Les principales questions devant faire l'objet de recherches ont été cernées, et les ébauches de RÉS ont été révisées et approuvées.

INTRODUCTION

The meeting was opened at 09:05, 14 November 2000, in the 6th Floor small seminar/lunch room of the Gulf Fisheries Centre.

Dr. Jake Rice (DFO – Headquarters) welcomed all participants to the 2000 Redfish Zonal Assessment Meeting. All participants were experienced in the procedures and objectives of these meetings, so relatively little time was spent in reviewing operating procedures and rules. It was stressed that there was very little time between the completion of the ZAP and the commencement of consultations by the FRCC. This timing was arranged to accommodate the need for additional analyses of 2000 survey data, but meant that it was vital that a complete draft of the SSRs for Redfish in Units I, II, and 3O, and their overview, but prepared by the end of the meeting. The Chair also noted that this year Unit 3 redfish would not be assessed at the ZAP, but at a regional RAP where other stocks on the southern and eastern Scotian Shelf would be assessed.

The agenda was reviewed and approved. The Chair noted that he would try to stick closely to the schedule for presentations, discussions, breaks, and meals. This would facilitate efficient use of meeting time and accommodate translation requirements.

WP 1 - A PREVIEW OF THE OCEANOGRAPHIC CONDITIONS IN THE GULF OF ST. LAWRENCE DURING 2000

Jacques Plourde
Division of Oceans Sciences
Maurice-Lamontagne Institute

The preliminary analysis of the vertical temperature profiles collected during the August shrimp and groundfish survey in 4RS3Pn indicated that during 2000, the Gulf of St. Lawrence was warmer than average.

The analyses were carried on the temperature profiles for which the lower boundary of the cold intermediate layer (CIL) could be detected. These temperature profiles were classified as cold (T_{min} <0 ^{o}C) or warm (T_{min} >0 ^{o}C) according to their minimum temperature (T_{min}) and the frequency of cold profiles was computed. Over the last three years, a major decrease in the frequency of cold profiles occurred. In 1998, 95 % of the profiles were cold while in 1999 the frequency of cold profiles decreased to 78 %, to finally reached 30 % during 2000. As a result, the averaged minimum temperature warmed by 0.89 ^{o}C in 2000 relative to 1998. Within an historical context, 2000 ends the most important cold period observed since 1947. For the first time since 1983, the frequency of cold profiles is below 50 % ending a 17 years cold period. Moreover, the warming observed during 2000 is at the third rank of the most important warming since 1947, following those of 1958 and 1968.

Discussion – It was stressed in the discussion that the 1990s were the coldest period on record for the Gulf of St. Lawrence. The profile method of presenting the information made clear not just that bottom temperatures were low but extremely cold conditions were found throughout the water column, and were extremely widespread throughout the Gulf. It was also noted that the past periods of good production of *mentella*-type redfish were always under warm conditions. The extremely recent change from the cold conditions to average or warm was exceptionally swift, and warm profiles are also quite widespread. This suggests that the oceanographic conditions in the Gulf should be considered as alternating between different phases (cold and warm) rather than varying around some long-term average.

WP 2 – OCEANOGRAPHIC CONDITIONS IN NAFO SUBDIVISIONS 3PN AND 3PS

S. Walsh
Science Sector
Northwest Atlantic Fisheries Centre

The most recent cold period lasted from 1984-1990 with bottom temperatures up to 1^0 C below average and surface temperatures up to 2^0 C colder than the late 1970's and early 1980's. Temperatures in the deeper water off the banks show no significant trends. Since 1991, temperatures have moderated in some areas from lows experienced from the mid-1980s and early 1990s but negative temperature anomalies continued over large areas of the bank into the spring of 1995. Temperatures have shown a variable increasing trend from 1996-98 being above normal in 1999 and 2000. In 2000, only Hermitage Channel and the deeper portions of the southeastern slope of St. Pierre Bank showed below normal bottom temperatures.

The areal extent of the subzero ^{0} C bottom water covering the banks, while increasing during the 1980's, and subsequently beginning to decrease after 1994 and has disappeared in 1999 and 2000. As a result, the areal extent of bottom water above 1^0C has increased from 50 % in 1998 to 85 % in 2000. Salinity data showed a clear change in water mass characteristics during 1998 and 1999 shifting to a warm saltier condition compared to cold fresh conditions that prevailed during the early 1990's. The spring 2000 water mass was found to be fresher and warmer than normal and this fresher water may have been advected from the eastern Newfoundland shelf.

Discussion – It was agreed that the pattern of bottom temperatures and water profiles in the most recent few years is very different from the previous 10-15 years of very cold conditions.

General Discussion of Oceanography and Ecological Conditions

In response to a question about availability of and patterns in zooplankton data, it was reported that zooplankton data are being collected. The assessment of phytoplankton on large scale is very difficult and not being done. However, nutrient content of the surface layer was measured, and this may be informative about plankton production. The analyses done to date suggest that there is an increase in zooplankton in winter in the Gulf, but their longer-term pattern of zooplankton abundance has not been resolved yet. Also the work to establish the relationships among nutrient concentrations, plankton, and fish abundance and productivity are not yet completed.

It was noted that the large year-classes of redfish also seem to correspond to the periods of poor nutrient availability. One possibility suggested was that the low nutrient in winter may be due to poor mixing. The poor mixing might favour a different suite of phytoplankton, which in turn might favour recruitment of a different

suite of species. It was stressed that there are few data, so much of the trend is from the model structure.

In response to a query about the depth at which the nutrient data were taken it was clarified that the nutrient data are from the surface, but from a season with little stratification, so they may be somewhat representative of nutrients through more of the water column.

It was also noted that although the results were highly preliminary, and no one was leaping to causal associations, it is possible that the recent changes in water conditions might have improved the likelihood of good recruitment to redfish. If this is the case, then bycatch of small redfish in shrimp fisheries might be both an information source to be explored, and a risk (of unknown size) of reducing the potential size of the year-class before it ever recruits to the fishery or the spawning stock.

WP 3 – 3O ASSESSMENT

Don Power
Science Sector
Northwest Atlantic Fisheries Centre

Nominal catches have ranged between 3,000 t and 35,000 t since 1960. Up to 1986 catches averaged 13,000 t, increased to 27,000 t in 1987 with a further increase to 35,000 t in 1988, exceeding TAC's by 7,000 t and 21,000 t respectively. Catches declined to 13,000 t in 1989, and were about this amount annually through to 1993. The decrease of the catch in 1994, at about 5,400 t was related to a reduction in foreign allocations and catches generally remained at this level through 1997. Total catches in 1998 and 1999 have exceeded 12,500 t partly due to increased foreign activity outside the 200-mile limit. About 9,000 t have been taken up to the end of September 2000, about 1,500 t by Canada and the remainder by foreign fleets (primarily Portugal, Spain and Russia).

Catches by Portugal, which began fishing in the limited stock area outside the EEZ in 1992, peaked at 4,700 t in 1995, declined to 900 t by 1997 and increased to 1,900 t in 1998 and 5,400 t in 1999. Spain, who had taken less than 50 t before 1995, caught 1,200 t in 1997 and 1,900 t in 1998 and increased again in 1999 to over 4,500 t. Canada, which has had limited interest in a fishery in this area because of the small sizes of redfish encountered, landed less than 200 t annually from 1983-91, took 1,600 t in 1994, but only about 100 t in 1995. The fluctuation in Canadian catches between 2,000 t and 9,000 t since 1995 is due to a varying market for redfish sizes near the small fish protocol limit of 22 cm.

Information on size distribution from the 2000 Canadian and foreign fisheries to date indicated the predominant catch was from 22–27 cm. Length distribution information

available from Portuguese sampling showed that the bulk of the 1999 Portuguese catch consisted of fish from 21 cm to 26 cm.

DFO Stratified random groundfish surveys have been conducted in the spring and fall in Division 3O since 1991, with coverage to depths down to 730 m. The spring index suggests that the stock may have increased in the early 1990's, but has stabilized at around 100,000 t since 1994. The low 1997 value is considered a sampling anomaly. The autumn survey generally supports this pattern. The additional 2000 survey information for both spring and autumn continues to indicate that stock status has not improved, and may be declining somewhat.

Historically, the surveys catch fish in the 10 cm to 25 cm range. Prior to 1998, the surveys were considered to have sampled different size groups than the commercial fishery because the commercial catch was generally comprised of fish greater than 25 cm. Beginning in 1998 however, there has been greater overlap in the size distributions from the surveys and commercial fishery because the fishery has been targeting smaller size groups. Concern continues that there has been little sign of improved recruitment in the recent surveys despite using the Campelen trawl which is very effective at catching small redfish.

Discussion – With regard to the amount of recent foreign catch and effort, 1999 data are available, but much is self-reported. The length distribution data suggest a definite shift away from 1/3 of the catch under 22 cm, 1/3 in the range 22-27 cm and 1/3 above 27 cm.

The increase in parasites occurred at the same time as the catch of redfish less than 22 cm increased. In the past increases in parasite abundance has meant lots of *mentella* were recruiting to the fishery.

In response to a question about spatial distribution of past catches, the majority of catches used to be from 3Oc & e with some in d; now essentially ALL the catch is in e. Historically there were only four small areas where it was possible to find commercial concentrations of fish, and now only the one. It was proposed that the reasons for the change in distribution were a combination of environmental conditions and foreign harvesting. There have been periods in the past when there has been tremendous effort outside the 200-mile limit. Canadian fisheries on 3O redfish have always encountered problems with small fish and distance from the plant.

Asked if there was enough information to build up pattern of seasonal migration, it was reported that in 3O redfish tend to be shallower in summer and deeper in winter, having moved out along the slope. It is difficult to build a more detailed pattern than that from the pattern of catches in the 3O fishery.

With regard to patterns in the spring and fall surveys, except for the 1997 high anomaly, the survey results are decreasing. The data from the survey in autumn appear more stable than those in spring. There is also a tendency to get higher

survey result in spring that in fall or winter. The 2000 survey found a few large catches, and these were related to sites that had not provided large catches in the most recent few previous years. Although apparently lower in the 1990's, the survey results are quite variable. There may have been a decline in abundance, but not a significant one over the last three years.

From the industry survey, the locations of catches by the Canadian fishery, and the presence of foreign fleets all suggest that the fish have moved to a warmer area 3O, along the Shelf break. It is difficult to say exactly how the movement has altered redfish distributions in three directions. With regard to impact on the changes in distribution may have on vulnerability to fishing, it was reported that the trend in the data from the Campelen net (converted for selectivity differences from the Engels) suggests that there seems to be a progressive decline in data from the spring, but stability in fall.

With regard to the observed stability of length frequencies in the RV data, it was pointed out that there are a couple of messages in the stable size distributions. The fishery is increasing, but the stable sizes suggest that the resource is not being fished. Moreover, although the RV size data are interpreted as indicating that the 1988 year-class is dominant in the population, if industry catches were all mostly of this one year-class, then commercial length frequencies should be going up as it grows, but they are not. In this point, it was noted that the surveys have rarely captured fish >28 cm. Also going back to the 1973 year-class, in the spring RV surveys we did catch larger redfish down on the Shelf in 3O. In past 10-20 years the majority of the catch are <28 cm, and 1988 year-class should be larger than that by now. To reconcile these points, it was suggested that the consistency of size distributions in the RV catch may be size-dependent efficiency of the RV trawl on rough bottom. As an overall view of the RV data, it was suggested that we don't know if the new information allows us to say anything different than the trend we have been seeing for the most of the 1990's.

There were several questions about how much confidence can be placed in the Campelen – Engels conversion factor. For example, the 1992 survey vs 1992 commercial catch data does not line up like much of the rest of the data. Moreover, the 1997 survey point may also have been low. It was reported that if the 1994-95 data are adjusted for the gear conversion, then it may not be right to match up the longer series, because that might overestimate the increase in the stock. Discussants agreed that it seems bizarre that an increase in redfish would be so steep. It was noted that this increase was mostly *fasciatus*-type but some *mentella* were taken as well.

In response to a question about the ability of the Campelan gear to catch the larger redfish at all, it was noted that the net does take them in 3N and Unit 2.

Industry participants noted that they had begun to see change in size distributions even in the data from May. It was asked of this could be a strong year-class spilling

over from 3LN. That was not thought likely because there is no evidence of strong recruitment coming in either neighbouring NAFO area. If there were a portion of the total redfish which move outside the 3O area, one would expect to see some evidence of them in surveys that go on in those areas.

Overall, it was suggested that from the RV survey, there is nothing that would lead us to change our recent past opinion, arguing that multi-year approach to this stock might be appropriate.

WP 4 - UNIT 1 REDFISH

B. Morin
Science Sector
Maurice-Lamontagne Institute

DFO research survey biomass index has been stable at a low level since 1995. Two cohorts of juveniles are observed on the DFO research survey in 2000: the 1996 and 1998 year-classes. The majority of the fish of these year-classes are S. *fasciatus* and they appear to be weak in comparison to the 1988 year-class. GEAC grid survey catch rate index showed a decreasing trend between 1998 to 2000. CPUE from the index fishery were similar in 1999 and 2000 but lower than before the closure of the fishery in 1995. Sentinel fishery survey indices are stable during the 1995-99 period. However, the 2000 summer survey value is about half the 1999 estimate. Overall, the prognosis for this stock remains poor for the foreseeable future.

DISCUSSION - In response to a question about the reasons for the selected sampling sites, the basis was given as results of earlier surveys and the desire to match the main historical distribution of *mentella* in the Gulf.

There was also a question about the general patterns of currents, with regard to where extruded larvae would be taken. The fate of extruded larvae would depend on the weather, because strong winds make currents go faster. The prevailing wind during the key period of larval extrusion is not known, but there have been no major changes in winds so it was thought that the distribution pattern is stable. It was noted that the maturation information suggests *mentella* larvae should be extruded before *fasciatus* but the wind story seems to suggest *fasciatus* are released sooner.

It was also asked whether the larger size is due to *mentella* starting earlier or growing faster. This is the key question for whether the length distribution differences translate into reproductive success. With regard to follow-up work, the key is to get a handle on the time scale first.

In response to several questions about the RV survey information, it was reported that no correction factor for day-night differences was applied. The RV survey is a general groundfish survey and there was concern about the proportion of total catch

that are in redfish survey, and how the day-night pattern fits the data. It was agreed that day-night variability is significant, and was known for a long time. When the correction is applied it must be done uniformly over the full area. In Unit 3 the fishermen have noted the same variation, but feel it is stronger in some areas than others. Several suggested that the period of twilight is the most critical period, and maybe it could be separated from the core hours. Also density may have a function in the proper correction, and phases of the moon also have an influence. The conclusions were that there are a huge number of things that can be taken into consideration, and the complexity quickly becomes unworkable.

With regard to the survey results, the biggest decrease in survey catches has been in 4T. This may be a question of timing of movement of fish around the Gulf. The grid survey is also demonstrating an important decrease, so if the decline is due to redfish moving, if they have moved, where are they? No change in abundance was observed in the areas most likely for them to be going into. The data from the Needler survey looks stable but very low for the full period.

It was agreed that length frequencies look pretty much the same in all subdivisions and all show same declines over the 1998 >1999 >2000 period. In the commercial fishery there were some very good catches in September from mid-water trawling, and industry participants at the meeting reported that there were also some good tows in the same area by the RV survey. However the best catches were in 3Pn, and it was suggested that this may be because the redfish may have been bunching up before the winter migration. In this context, the Newfoundland survey found an aggregation within the 12-mile limit in 3Pn off Cape Ray, during the week of August 20, where they got 6 t in 10 minutes. At this time there were clearly some very high aggregations, as the vessel did some hydroacoustic mapping and established that it was a large aggregation.

There were several questions about the activities of the commercial fleet this year. It was noted that one vessel appeared to be using mid-water gear during the index survey. This was not the intention of the survey but it has happened before. In 2000 the skipper of the vessel in question was bottom trawling and saw the fish in the sounder, changed gear, and made a good catch. It was asked if they could have made a good catch also with bottom gear, and the thought was that the acoustics showed little opportunity for that effect.

With regard to migration effects on the index survey, it was noted that the grid survey was timed to avoid the migration transition. The environmental conditions in mid-June did not suggest any delay in seasonality, nor did the pattern of fisheries catches suggest a big immigration at late June or July. However, by the time of the Needler survey there was time for the redfish to have left the area sooner than usual. Concern was expressed regarding how closely DFO is monitoring change in route or timing of migration to differentiate such changes from a possible decrease in abundance. In response, it was asked with regard to delay of entrance of redfish into the Gulf, how can we determine how many fish are going into and out of the Gulf?

With the original revised management areas, there were a lot of redfish taken out of Unit 1 and Unit 2 in the early 1990's. It was asked if one would expect to see the same types of migrations with such a lower density. Following that point, concern was also expressed that if a lot of fish are leaving the Gulf in mid-summer and staying out, are the catches of the August/September index fishery too much to be taking out. Researchers agreed that relative to historic catches, the present 1,000 t is very small but with little or no recruitment that much catch may be a big problem.

Regardless of the magnitude of seasonal migration, for all these surveys, in the 1990's there was some indication of recruitment to *mentella* but it has not held up through the decade. The fishery still concentrates on *mentella* over 30 cm, but that group seems to be getting no input recruitment. Rather, almost all the survey fish under 19 cm are *fasciatus*, which do not make up any of the redfish >30 cm.

Discussion then moved to the observation that the environment has changed in the past two years, with fewer cold profiles and a much larger volume of warm water in all three dimensions, some very high catch rates in the past year. These swift changes may have big impacts on fish behavior. Industry participants noted that August was a slow time for all of industry, because the environmental changes were large and fish were of poor quality. The fish were all tight to the land, which also is very atypical. Researchers reported that surveys had been going over this area annually in late summer, and in the past there was always some evidence of fish on the sounder in that area. All discussants agreed that the aggregations of redfish have always moved around during that period. It was suggested that the main difference now is that the abundance is so low that one can miss them all. A total of 36,000 t of biomass, spread over the full area does not fill very much of 3Pn4RSTVn. It was also suggested that the survey estimate appears so stable, because the variability in low tow-by-tow catches does not appear as great as a comparable percentage variation when catches were much higher.

With regard to the question of the biomass, it does not appear to be going back into the Gulf, no explanations could be brought forward but the pattern seems general. Unit 2 biomass has been very stable and going back in history there was always a strong biomass there, even when there were only partial surveys. It was agreed that if the traditional wisdom of movement out of the Gulf has broken down, it would be important to know why. The contraction between the two surveys, with the DFO RV survey in August-September shows biomass stable around 36,000 t but the sentinel survey earlier in summer showing biomass stable at >100,000 t has to be resolved. It was agreed that the explanation was unlikely to be that the sentinel gear is 8 times more efficient than the research vessel in the Gulf, because both use shrimp trawl. In fact, the Laurentian RV is using even smaller mesh, so if it were a gear effect the difference should be in the other direction. Moreover, hydroacoustics shows that 80 % of redfish in August are distributed in the water column so they should be available to bottom gear. **There was strong agreement that it would be necessary to do some comparative fishing to calibrate the gears.**

With regard to trying to explain these complex patterns of different abundance through the summer, if we know that redfish are extruding larvae in April and May at least be in deep water around Anticosti Island, then the stock has to be there in the Gulf in late Spring. We know that redfish could not have spawned east of the Gulf because there is no oceanographic transport mechanism into the Gulf. Also, a reasonable proportion of the females taken in August surveys are recovering from spawning. There is a lot of evidence that f*asciatus* and *mentella* spawn at different times, with *mentella* first. Whatever the case, however, the spawning population is present in the Gulf in late winter through into at least early June. Decisions on where they go and when they move in July through September has a great influence on decisions about stock status and impacts of any level of harvesting.

The second day began with a review of the information presented on redfish in 3O. It was agreed that there were not major changes from the previous year's assessment, supported by another year with a low survey. It was suggested that an acoustic survey in that area might be necessary to resolve some of the major uncertainties. However, the major uncertainty with regard to the survey is the potential amount of redfish directly over the shelf edge and deepwater. A hydroacoustic survey may give signal on hard bottom but it will be spotty and it won't be possible to sample what fish are providing the signal.

With regard to adequacy of sampling of catches, sampling is done. Additional sampling would provide some additional information; it still will not resolve what is present in the shelf edge area. Nonetheless, at present a lot of the sampling is to enforce the small fish protocols. It might be possible to make more use of those data. Companies are taking measurements for their own needs, and it would just be a matter of making them available and making use of them.

It was noted that a perplexing aspect of 3O is that gill net catches show that there are large redfish, but they don't appear in survey and commercial trawl catches.

There were also questions of movements of redfish between NAFO Divisions, and how 3O redfish relate to adjacent stocks. In that context, interest was expressed in the Icelandic equipment developed for tagging fish underwater. It was agreed that the technology would be worth exploring, but it is costly and the money would have to be found.

Following that discussion, the meeting reviewed what should go into the SSR. It was a substantial discussion on how to phrase the uncertainty due to the disappearance of larger redfish from the survey, when they are not being taken in catches, and the related question of what to monitor as the basis of a multi-year management plan. It was also noted that if the survey ever did find the large adults, the small size of the strata along the shelf break means that they would contribute little to the total estimated SSB. It was suggested that with the current size/age composition data, one can't make strong conclusions about SSB from the information that is available, and maybe one should go to look at data from line surveys done 40 years ago to see

if large redfish were very abundant in 3O. All we can conclude is that there may be older fish there, but if they are, our surveys do not take them. All we can conclude is that the surveys do track recruitment, and right now there isn't any coming in.

When the discussion focused on the recruitment signal from its surveys, it prompted that question of how many more years will pass without a good recruitment signal before we reach a point where one would conclude current harvests are excessive. Are the current removals sustainable, pending new information that may come available? In response to the second question, it was noted that there is no reason not to believe the survey is good for tracking juveniles, and their abundance is holding up, even if they do come from some other area. As for where they may be coming from, the genetic profile of samples from 3O is closer to redfish in the east than to those from Unit 2. However, the species composition of 3O and 3N has not been contrasted in detail. This led to a **RECOMMENDATION to have the species composition information in Unit 2, 3O and 3N looked at for next year.**

Returning to the contents of the SSR, there was agreement to bring in some information on environmental variability into the SSR, particularly regarding possible impacts of warmer water on distribution among 3Ocd to 3Oe. It was also proposed to put in the Industry Perspective section their observations that fish have moved. It was agreed that the SSR would not be the association between temperature changes and possible movement of redfish but to be careful not to infer if there is a causal association between the two.

This discussion also led to a **RECOMMENDATION to get some analyses of temperature – distribution associations for the 3O survey**. It was also suggested that it would be informative to put temperature sensors on commercial vessels. Industry said that they were prepared to cooperate if there were a program to which they could contribute.

Next, there was a long discussion of where the incoming 19 cm fish come from. The observations are that there is *some* recruitment every year, and the amount of fish coming in to 3O is more than it can be accounted for from the size composition of survey catches. Moreover, the ~19 cm redfish are not being seen somewhere else and migrating in. It was pointed out that if we are not willing to stand by what conclusion should be drawn from the lack of information about recruitment, then we should be careful about putting lots of warnings in the SSR. Placed in that context, the overall signal was that we make a lot out of year to year variation. It was also suggested that we can say that stocks have been able to sustain catches of ~10,000 t and increase.

The chair proposed as a summary of main points for the SSR with regard to outlook for next year that we confirm the ability of the stock to increase when catches stay below 10K; an that DFO should watch the data about abundance in19-22 cm sizes. These sizes are well represented in surveys and catches and are good signal of continued sustainability. Based on the small changes over the past few years, we

could propose a multi-year fishing plan, supported by adequate monitoring of small fish. With current sizes taken in the surveys, this should provide warnings of greatly expanded opportunities for harvest several years in advance, supporting a multiyear approach to management.

WP 5 - UNIT 2 REDFISH

D. POWER
Science Sector
Northwest Atlantic Fisheries Centre

From 1960 to 1968, landings averaged about 20,000 t, but then increased to an average of 43,000 t up to 1975 mainly due to increased catches by foreign fleets. Catches then declined to the lowest on record in 1984 at 8,100 t. Since then, catches steadily increased to 27,000 t by 1993 but declined subsequently to about 10,000 t in 1997 due to reductions in TACs. Catches were about 11,000 t for 1998 and 1999. There was an adjustment to 18,240 t in 1999 and an extension to March 31, 2000 to allow for the transition to an April 1 to March 31 based TAC. The 2000-2001 TAC was set at 10,000 t. Up to early November 2000, about 4,400 t had been taken from the 2000-01 TAC.

Sampling of the fishery in 2000 indicated that the majority of the catch was comprised of fish between about 32 cm (13 inches) and 35 cm (14 inches), the bulk of which is predominantly the 1980 year-class. This is very consistent with the 1998 and 1999 fisheries. The 1988 year-class was minimally represented in the catches.

A DFO trawl survey series conducted in Subdivisions 3Ps, 3Pn, 4Vs and 4Vn during summer from 1994-97, and 2000 indicated the total biomass index has remained stable between 1994 and 2000. Acoustic data collected during the survey suggested that in most sets redfish were close to the bottom and the majority were detected within the effective fishing height (4 m-5 m) of the survey trawl. Mean availability to the trawl was estimated at about 80 % for the 2000 survey.

Industry stratified-random surveys were conducted by GEAC (Groundfish Enterprise Allocation Council) in 3Ps, 3Pn, 4Vs and 4Vn from 1997-2000. The 1997 survey was conducted in early December and the 1998-2000 surveys in August and September. The 2000 survey was conducted with a small mesh liner in the codend to provide a measure of recruiting sizes. The impact on the comparability with the 1997-99 surveys was minimal. The biomass index showed a downward trend particularly since 1998. The low 1999 survey estimate may be partly due to some high-density strata not sampled.

Length compositions from the DFO surveys, indicated four model groups, the peaks of which were 10 cm (4 inches), 18-19 cm (7 inches), 25-26 cm (10 inches) and 33-34 cm (13 inches) corresponding to the 1998, 1994, 1988 and 1980 year-classes in

2000. The 1994 and 1998 year-classes represented about 35 % of the survey abundance. The 1980 year-class, which has comprised the bulk of the commercial catches in the 1990s, accounted for 30 % of the survey abundance but 60 % of the survey biomass.

Length compositions from the GEAC surveys have consistently indicated the presence of both the 1980 and 1988 year-classes. In all surveys, the relative proportion of the 1988 year-class in the catches was lower than the 1980 year-class. The 2000 survey also indicated the presence of the 1994 year-class but the survey abundance was dominated by the 1980 year-class. The 1980 year-class represented 79 % of the abundance and 92 % of the biomass in the 2000 GEAC survey.

The commercial fisheries continue to target the 1980 year-class. Although the absolute size of the 1988 year-class is uncertain, it is now largely exploitable. Its relative strength in all surveys still suggests it is not as large as the 1980 year-class which has already contributed 10 years of yield. Therefore, there is reduced expectation about the overall yield that the 1988 year-class may produce. The causes of the apparent reduction of the strength of the 1988 year-class as estimated from two independent surveys, despite low exploitation, also are unknown.

DISCUSSION - It was noted that the timing of the fishery is largely market-drive, so interannual variation in timing if catches may not be informative about stock condition.

There was substantial discussion of parasites burdens and information those data might contain. The data supported a conclusion is that older fish have more parasites, but no evidence of a trend over years in infection rates. It was pointed out, however, that the size dependent pattern could also occur if *mentella* have more parasites and also grow larger than *fasciatus*. Aside from the common external parasite, ideas also noted that there were more codworm in everything in recent years, including cod, redfish, pollock, and especially in the Gulf and Scotian Shelf. The codworms are not present in any numbers in redfish taken in the Laurentian Channel.

This discussion led to a **RECOMMENDATION that a protocol for preserving parasite samples be developed and the samples sent in to John Brattey at Northwest Atlantic Fisheries Centre.**

There were some concerns expressed that the length frequencies in the industry samples were too spiky. Industry reported that every sample is 200 fish and that it is widely known that all the redfish are large and orange in 4Tf. These redfish can produce very significant differences in length frequencies from different areas in the same trip.

Redfish scientists observed that if these catches were all big orange fish, then there had to be a population of *marinus* in the Gulf, because the only large *fasciaus* in the entire area were on the edge in Unit 3.

It was noted that a good part of Unit 1 was sampled during the index fishery, with 20 trips and that there was sampling data from Unit 2 as well to be worked up. With the addition of the observer data it might be possible to see a pattern of differences in size distribution, and these might give a better idea of the mixing among the stock units.

Industry also noted the fishery has been prosecuted between January-April, with the same vessels for 4 years. Consistently about half the catch has come from 3Psg, ¼ from 3Psd, and the rest from other areas. Despite these consistencies in effort, CPUE had been highly variable with a big impact of windy weather from east or northeast dispersing the redfish and impacting CPUE.

With regard to length frequency data, it was asked if length frequencies are available by month and depth. These data might be very interesting for winter dynamics, and should be looked at. It was reported that industry samplers are trained by DFO and the data are believed to get captured in the system. Industry also reported that they try to avoid both very large and very small fish. With regard to large redfish, it was reported that in Unit 3 when the large *fasciatus* were found they were exploited heavily for about 6 weeks.

With regard to the GEAC survey there was a warning to be careful with the conclusion of stability in catch rates over the survey period. There are several major sources of uncertainty. CPUE in 2000 was actually much lower than in 1997, but in 1997 the survey was in December and undoubtedly took a mixture of Unit 1 and Unit 2. There was some comparative fishing with the DFO research vessel and the GEAC survey vessel but results are too preliminary to present at this time. It was agreed that it was not urgent to get the calibration of the two vessels perfect. The key message is that there is a complementarily size composition and distribution in both surveys.

With regard to the new hydroacoustic survey, it was suggested that running the survey at another part of the year when fish are more aggregated and up in the water column (December-January) might provide better indications of stock condition. It was also asked if the survey provided enough information to look at day-night? It was thought that they did but the effect had not been looked at intensively. Work in Newfoundland several years ago found little impact, but the more recent survey in the Gulf provides some evidence support for an effect. It was also proposed that where the hydroacoustic survey and trawling occurs together that the results be examined for a relationship between overall density and catch: there are more redfish missed when they are in dense schools where fish stack up outside the headline of the net.

There was a long discussion of the potential for mixing among Unit 1 and Unit 2, and the impact of mixing on assessments and management. The discussion focused on two aspects of mixing 1) the value of closing the fishery in 3Pn in November and

December to protect Unit 1 redfish, and does the closure begin early enough? 2) Should the eastward boundary of the area closed be moved further east?

The first question posed was what new information is available since the 1992 review when the current regime was established. There are monthly plots of spatial distribution of catches from 1990 to 1999 and length frequencies have been analyzed to see if they suggest that the units should be separated.

The next question was: What is the basis for the opinion several have suggested that the timing of migration out of the Gulf may have changed? The main evidence brought forward was the sentinel survey, which indicates a large drop in abundance by the end of September. The impression that there has been a change in timing is also widespread among the industry in the Gulf. It was argued that a lot of the fishery traditionally was right on the 3Pn3Ps line. In this decade the catches in 3Pn in October were only taken between 1993-96, but there has been almost no fishing since. The small boat quotas were largely taken by end of August as well, so there is no fishery. It was also argued that climate plays a factor in the timing, and if so, it may also mean that the migration may change back because of the changing winter ice distribution. For now the protection is there at least in winter and spring, because all the area in 3Pn and 4Vn is closed for spawning period in January to July. The research vessel survey also provides circumstantial evidence that movement may have become earlier especially the Needler survey in August. In summary, it was agreed that nothing is definitive, but the lines of reasoning are consistent. Facing the direct question of is there any evidence that the small-boat fishery in 3Pn 4Vn is taking Gulf fish, the best evidence is the similarities in size composition. However, the same year-classes are strong in both areas so size composition is not informative about area of origin of the catches. The other possible information is that index fishers DID find fish in the Gulf in September and October, and these were big redfish characteristic of redfish in Unit 1. At the same time Newfoundlanders were fishing in 3Pn and getting different fish than the index fishers were finding. The accepted summary of information about mixing noted that oceanographic conditions, temperature, and degree and timing of fish movement MAY have changed, but if so, it may be changing back. For the time being, it is safer to continue to not fish in October, while more directed study of parasites, and other sources of information (if they can be identified) are completed.

With regard to changes to position of the boundary between Unit 1 and 2 redfish caused by oceanographic conditions, 1994 and 1996 meetings of the Fisheries Oceanography Committee has provided some information, and this can be combined with more information from winter surveys. The genetics results did not allow differentiation of redfish from Units 1 & 2, and it was not clear that the length frequencies could be used to differentiate the stocks either. In most years there are more small redfish in Unit 1, but that is consistent with more sets in shallow water in Unit 1, and small redfish are in shallower water than larger ones. Multivariate analyses were able to track three groups by age structure, and depth, not the subdivisions or inside/outside the current boundary, seemed to be the most important

variable. It was noted however, that all data in that analysis are from August, and there was no reference information to allow separation by Unit 1 to Unit 2. It was also pointed out that we know that there is spawning in both areas in late winter – spring, so the question is to what extent there is mixing at other seasons.

We have little information on that question, because there has been no commercial fishery in the Gulf since about 1996. The fishing in 3Psd was well down into the channel, not up close to the 3Pn boundary, so that it also does not give information about the proper positioning of the boundary. It was proposed from a scientific perspective that there is not much that we can say about the position of the boundary. However, given the pattern of the fishery in the recent period, there is no cause for concern. Moreover, it was suggested that these are adjacent areas, so if it were attractive to fish there, it would have attracted effort. In the area of question data tabled at the meeting show that only 10 % of all the catches come from that season and area, so very little effort goes into the area.

Following the summary, it was stressed that if we have consensus that current line is reasonable, we should give the reasons in the SSR so the issue can be taken off the table.

Following this discussion a question was posed about the seasonality of spawning closure - Is May and June best? It was agreed that there is enough published information to indicate spawning times of *fasciatus* and *mentella* are different but probably overlapping. For *mentella* spawning is over well before the end of June; but for *fasciatus* it is better for the closure to include all of June. The closure should start before the first of May. It was also noted that spawning time is variable from year to year, but as much as a few weeks.

To get further information on this, it was proposed that researchers should check the observer reports on the fishery in April to check maturity/spawning conditions. Quality of the fish falls off when spawning occurs anyway, so effort is taken out whether there is a closure or not. After spawning there is a loss of yield per recruit, which some thought might be another reason to stop fishing. It was agreed that 10-15 % observer coverage should be enough to pick up spawning if it is occurring during the fishery, especially when complemented by full dockside monitoring.

Following these discussions, there was a summarization of the changes desired in each of the SSR for Unit 1, compared to the one produced following the 1999 assessment meeting.

For Unit 1:

- Abundance
  No big differences, Needler survey and fall sentinel surveys were about the same. The only substantial change was June and July when the indices were decreasing. The SSR should try to explain why those indices declined.
- Recruitment

The 1996 and 1998 year-classes can be mentioned with caution. It should be pointed out that these year-classes could be mainly *fasciatus*, and it is too early to know if they will contribute to the fishery. When there have been strong year-classes in Unit 1, they tend to be in the channels. Therefore bycatch in the shrimp fishery can present a real problem because the small redfish can go through the grid. The SSR should alert readers to this possibility. The Proceedings should also highlight that the problem needs to be investigated in the coming year, and that tools be explored for keeping the bycatch low if these year-classes do start to be taken as bycatch.

RECOMMENDATION - The Regional staff should monitor the observer database for small redfish in shrimp fishery.

For the SSR, it was agreed that there should be a paragraph stressing that good recruitment is essential for recover of this stocks, and although part of good recruitment is producing them, part is letting them survive. This suggests it would be wise to monitor redfish bycatch in shrimp fishery, and react swiftly if problems are encountered. It should also point out that the shrimp fishery occurs in areas previously used as preferred nursery grounds.

- Larval Transport and Abundance
  There was agreement to put the larval information into the oceanographic section of the overview. All that is needed is a couple sentences saying that we have seen promising work that will be developed further.
- Overall Status
  Main points are that the overall abundance of the1980 year-class has gone down since 1997 survey. Much of the recruitment coming along seems to be *fasciatus* where there is concern about absence of recruitment for *mentella*, which industry prefers.

The SSR should also point out that the 1988 year-class is now less frequent than the 1980 year-class, despite not being targeted by fishery. Use this to focus concern on establishing whether the 1994, 1996, and 1998 year-classes are more like f*asciatus* or more like *mentella*. Not as pessimistic as last year. It was proposed to split out *mentella* and *fasciatus* and estimate exploitation on each component, if the data could be presented that way. Also there should be a brief discussion of the male-female length frequencies, which suggest the erosion of the 1988 year-class seems more due to the females being lost.

In the Overview to the SSR it was agreed that the material on condition factor, age at maturity, length at maturity, environmental issues, predator-prey relationships, etc. should be reviewed, where there was new information that could be updated. However, it was expected that there would be little new to add, and even where there were some additional data, none of the messages had changed.

Finally, there was a discussion of whether it should be stated in the SSR that there is a clearer view of state of resource is because a DFO survey has been a reinstated

DFO survey. It was agreed that this would be communicated in a letter to DG's along with other follow-up activities recommended by the meeting.

The final day of the meeting focused on a review of each of the draft Stock Status Reports.

For Unit 1, the sections on Biology and Fishery were accepted as drafted. For the section on Stock Status, it was agreed that a few sentences would be added making the comparisons clearer about the research vessel and the different sentinel surveys. The larval survey results are interesting, but inconclusive at this time, because there is no standard for what would comprise a “large” or “small” catch of larvae, and the presence of larvae in May is not proof that the adults had migrated in before the ice was out in late March. For the section on Industry Perspective, it was agreed to strengthen the wording with regard to concern about the need to monitor bycatch of small redfish in the shrimp fishery. The Outlook was accepted as drafted.

For Unit 2, the sections on Biology and the Fishery were accepted. For the Abundance Indices it was agreed to put in figures for the surveys estimates and add the confidence interval. It was also agreed to add a sentence on the additional strata in the most recent survey, and that these contributed only 10,000 t of 260,000 t of estimated biomass. With regard to the use of acoustic information, it was agreed that the SSR will keep the statement qualifying the 80 % of the stock available to the trawl gear to this one year only, trying to make clear that the percent available in other years cannot be known from the one-year study. It was agreed that the information on length composition and research vessel surveys was accurate, but the section on the industry survey made too much of the detail, and should be edited slightly. Replacement text was approved for the Industry Perspective section, and a sentence was added about the about large redfish that were possibly *marinus* taken by industry in 3Ps-a. It was also agreed to work in the paragraphs on the environmental conditions extracted from the Working paper material, or the 3Ps cod SSR, and that a couple of sentences would be added on the implications of the oceanographic conditions for Unit 2 redfish. In the section on Sources of Uncertainty it was first agreed to make the sentences on mixing the same in the SSRs for Units 1 and 2, because these are the stocks that may mix. Then, a few sentences on the implications of this uncertainty for both the possible effects of a winter fishery in 3Pn were added, and finally, whether we are dealing with one or two production units. There was also agreement to add to the Uncertainty Section a sentence calling attention to the value of the 1980 year-class to future recruitment in Unit 2 and maybe Unit 1. After some discussion is was also agreed that there would be a major reworking of the paragraph on the erosion of the 1988 year-class, prior to recruitment to the fishery.

For the Outlook Section it was agreed to change the text to make clearer that there were two clear choices; in any case we expect some decline in SSB in the coming couple of years, but this is not a conservation issue in the short term. Rather the future of the stocks depends on whether or not the year-classes from the mid 1990's

continue to survive to contribution the stock and spawning biomass, and whether industry continues to target on the 1980 year-class in apparent preference to the smaller redfish from the 1988 year-class.

For Unit 3O, the sections on the Fishery and Resource Status were accepted. It was agreed that there would be a new section on Industry Perspective provided by the industry participants at the meeting. The overview was revised substantially, to highlight the concerns about inability to find older fish in the survey, risks of mixing, and general uncertainty about the stock indicators.

After lunch, revised SSRs were distributed and approved for Units 1 and 2. The meeting concluded with a computer video display of the June simulation of egg and larval transport in the Gulf in 1997, at a frequency of one picture per day. The simulation has wind, tide and current effects. Their presentation was received enthusiastically, and there was general encouragement to get additional data for model parameterizations from the fleet, also bouy temperatures from Coast Guard.

The meeting adjourned with thanks to the Simultaneous Interpreter, all the participants, and the Chair.

ANNEX 1: LIST OF PARTICIPANTS

NAME	ORGANIZATION
BOUDREAU, Paul	**Madelipêche**
BOURDAGES, Hugo	**DFO, Laurentian**
BRANTON, Bob	**DFO, Moncton**
CHAPMAN, Bruce	**Groundfish Entreprise Allocation Council (GEAC)**
CHIASSON, Yvon	**Government of New-Brunswick**
DEVEAUX, Joey	**Cape Breton ITQ Association**
GILLIS, David	**PEI Dept. of Fisheries and Tourism**
HÉBERT, Réjean	**DFO, Maritimes**
HENNESSEY, Frank	**PEI Groundfish Association**
HUGHES, Brad	**AMP Fisheries**
LEMELIN, Dario	**MAPAQ**
McLINTOCK, John	**AMES**
MORIN, Bernard	**DFO, Laurentian**
MURPHY, John	**Mersey Seafoods**
PLOURDE, Jacques	**DFO, Laurentian**
POWER, Don	**DFO, Newfoundland**
SMITH, Bill	**Fisheries Products International**
WALSH, Steve	**DFO – Newfoundland**

ANNEX 2: AGENDA

AGENDA
Redfish Zonal Assessment Process
Room: La Petite Caféteria,
Gulf Fisheries Center, Moncton
14-16 November 2000

ORDRE DU JOUR
Revue zonale d'évaluation du sébaste
Salle La petite Caféteria,
Centre des pêches du golfe, Moncton
14-16 novembre 2000

Tuesday	**14/11/00**	**Mardi**
Muffins and coffee	9h30	Café et muffins
Greetings	10h00	Mot de bienvenue
Presentation : A preview of oceanographic conditions in the gulf of St. Lawrence during 2000 (Jacques Plourde)	10h15	Présentation: Aperçu des conditions océanographiques dans le golfe du Saint-Laurent pour l'an 2000 (Jacques Plourde)
Assessment of Division 3O redfish	11h00	Évaluation du sébaste de la division 3O
Lunch	12h00	Dîner
Assessment of Unit 1 redfish	13h00	Évaluation du sébaste de l'unité 1
Wednesday	**15/11/00**	**Mercredi**
Assessment of Unit 2 redfish	9h00	Évaluation du sébaste de l'unité 2
Break	10h00	Pause
Assessment of Unit 2 redfish	10h30	Évaluation du sébaste de l'unité 2
Lunch	12h00	Dîner
Other presentations (mixing between Units 1 and 2, etc)	13h00	Autres présentations (mélange entre unités 1 et 2, etc)
Break	15h00	Pause
Reruns and SSR reviews	15h30	Corrections et révisions du RÉS
Thursday	**16/11/00**	**Jeudi**
SSR Reviews	9h00	Révisions du RÉS
Break	10h00	Pause
SSR Reviews	10h30	Révisions du RÉS
Lunch	12h00	Dîner
Final report review	13h00	Révisions du rapport final
Break	15h00	Pause
Final report review	15h30	Révisions du rapport final

ANNEX 3: TERMS OF REFERENCE

Terms of Reference - Zonal Assessment Meeting
Atlantic Redfish (except Unit 3)
November 14-16, Moncton, New Brunswick

1. Assess the present status and recent trajectories of the redfish (*Sebastes*) stocks in Unit 1, Unit 2, and 3O.

2. To the extent possible given the assessment results, project stock status for 2001 and evaluate sustainability of various harvest levels for those stocks.

3. Consider results of past scientific reviews, and any new information from science or industry, and provide a scientific evaluation of:
   a) the evidence for, and possible extent of, mixing between Unit 1 and Unit 2 redfish at various times of the year, but particularly in winter.
   b) if it is concluded that there is significant potential for mixing of redfish from different units at certain times of the year, identify and discuss potential effectiveness of additional management measures, if any, that might minimize fishing on concentrations containing mixtures of redfish from different units.

4. Provide results in a Stock Status Report and subsequent Research Document(s), with the SSR available in both official languages at the earliest possible opportunity after conclusion of the meeting.