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**Proceedings of the Newfoundland and
Labrador Regional Advisory Process
for Snow Crab**

**February 27 – March 2, 2007
St. John's, NL**

**Meeting Chairperson
Dr. Noel Cadigan**

**Editor
G.P. Ennis**

**Compte rendu du Processus de
consultation régional de Terre-Neuve-
et-Labrador sur le crabe des neiges**

**27 février – 2 mars 2007
St. John's, T.-N.-L.**

**Président de la réunion
D^r Noel Cadigan**

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April 2007

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Foreword

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

Avant-Propos

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

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SUMMARY

A meeting of the Newfoundland and Labrador Regional Advisory Process on Shellfish was held February 27 – March 2, 2007 in St. John's, Newfoundland. Its purpose was to assess snow crab stocks in Divisions 2J3KLNO, Subdivision 3Ps, and Division 4R. In addition, an overview of ocean climate conditions during 2006, in comparison to the historical record, was presented.

A Science Advisory Report (SAR) was written and reviewed in meetings from March 5 – 9, 2007. It includes overall and division-by-division summary bullets written and reviewed at the RAP meeting. Detailed rapporteur's notes of discussion on each working paper presented at the RAP, in question-and-answer/comment-and-response form, were produced. This Proceedings Report includes an abstract and summary of discussion for each working paper presented, progress on research recommendations from the 2006 RAP and a list of research recommendations from this RAP which includes those being carried forward from last year.

SOMMAIRE

Une réunion du Processus de consultation régional de Terre-Neuve et du Labrador sur les mollusques et les crustacés a eu lieu du 27 février au 2 mars 2007 à St. John's, Terre-Neuve. Le but de cette réunion était d'évaluer les stocks de crabes des neiges des divisions 2J3KLNO, de la sous-division 3Ps et de la division 4R. En outre, une vue d'ensemble des conditions climatiques de l'océan en 2006 a été présentée et comparée aux relevés historiques.

Un avis scientifique (AS) a été préparé et passé en revue au cours des réunions qui ont eu lieu du 5 au 9 mars 2007. Cet avis traite de la question dans son ensemble et division par division, dans un style télégraphique, et a été passé en revue à la réunion du PCR. Les notes détaillées du rapporteur sur les discussions tenues sur chacun des documents de travail présentés dans le cadre du PCR, sous forme de questions et de réponses ainsi que de commentaires et de réponses, ont été produites. Le présent compte rendu comporte un résumé et un sommaire des discussions tenues sur chaque document de travail présenté, fait état des progrès accomplis en regard des recherches recommandées au moment du PCR de 2006 et contient une liste des recommandations en matière de recherche découlant du présent PCR, y compris les recommandations mises de l'avant depuis l'an dernier.

INTRODUCTION

A meeting of the Newfoundland and Labrador Regional Advisory Process (RAP) on Shellfish was held from February 27 to March 2, 2007 in St. John's to assess snow crab stocks in Divisions 2J3KLNO, Subdivision 3Ps, and Division 4R, and to review ocean climate conditions during 2006 in comparison to the historical record. Terms of reference, the agenda and lists of participants and working papers presented at the meeting are provided in Appendices I through IV, respectively.

Participation included personnel of DFO Science and Fisheries and Aquaculture Management Branches, and representatives from the fishing industry, FFAW, the Provincial Department of Fisheries and Aquaculture and Memorial University. Open discussion and debate proceeded during and after each presentation. At the meeting, consensus was reached on overall and division-by-division summary bullets of results of the assessment. These are included in the Science Advisory Report (SAR) written and reviewed the following week.

These proceedings contain abstracts for working papers presented and summaries of the discussion on each. Additional information can be found in the SAR and in research documents cited or from contacts provided therein.

WORKING PAPER ABSTRACTS AND DISCUSSION SUMMARIES

Northwest Atlantic climate update for 2006. By E. Colbourne, J. Craig, C. Fitzpatrick, D. Senciall, P. Stead and W. Bailey. (Presented by E. Colbourne)

Abstract - The North Atlantic Oscillation (NAO) index for 2006 was below normal indicating widespread warming throughout the Northwest Atlantic. Annual air temperatures were at an all time record of 2.9°C above average on the Labrador Coast at Cartwright and 2°C at Bonavista on the Newfoundland east coast. Sea-ice extent during 2006 was below the long-term average for the twelfth consecutive year, the longest period of lighter-than-normal sea-ice conditions since record keeping began in the early 1960s.

At Station 27 off St. John's, the depth-averaged annual water temperature increased to 0.9°C above normal, the highest in the 61-year record. Annual surface temperatures at Station 27 increased to 1.7°C above normal, the highest in the 61 year record, bottom temperatures were also above normal by 0.8°C the 3rd highest in the 61-year record. Near surface salinities were above normal in the upper water column for the 5th consecutive year. The area of <0°C (cold-immediate-layer) water mass on the eastern Newfoundland Shelf during 2006 was below normal for the 12th consecutive year and the 3th lowest since 1948. In general, the near-bottom thermal habitat on the Newfoundland and Labrador Shelf continued to be warmer-than-normal, with bottom temperature anomalies reaching 1°C above average in many areas. There was however a decrease in fall bottom temperatures in 2006 compared to 2005. The area of bottom habitat on the Grand Banks covered by sub-zero °C water during the fall has decreased from >50% during the first half of the 1990s to near 15% during the past 3 years.

The CPUE of snow crab from NAFO Divs. 3Ps, 3L, 3K and 2J appear to be correlated with trends in the physical oceanographic environment at time lags of 6-10 years, indicating a possible environmental effect on the survival and recruitment of snow crab (Fig. 1). The results

show that cold ocean temperatures historically coincided with years of high production of snow crab as indicated by the CPUE time series, although the correlations are weak and occasionally breakdown on an annual basis. The relationships are however consistent across all regions and indicate that changes in the environment can potentially explain a significant amount of the variations in the CPUE ranging from about 25-70%, depending on the region and environmental index under consideration. Based on this analysis environmental conditions since 1996 and in particular during 2004 to 2006 have not been favorable for snow crab production in Newfoundland and Labrador waters.

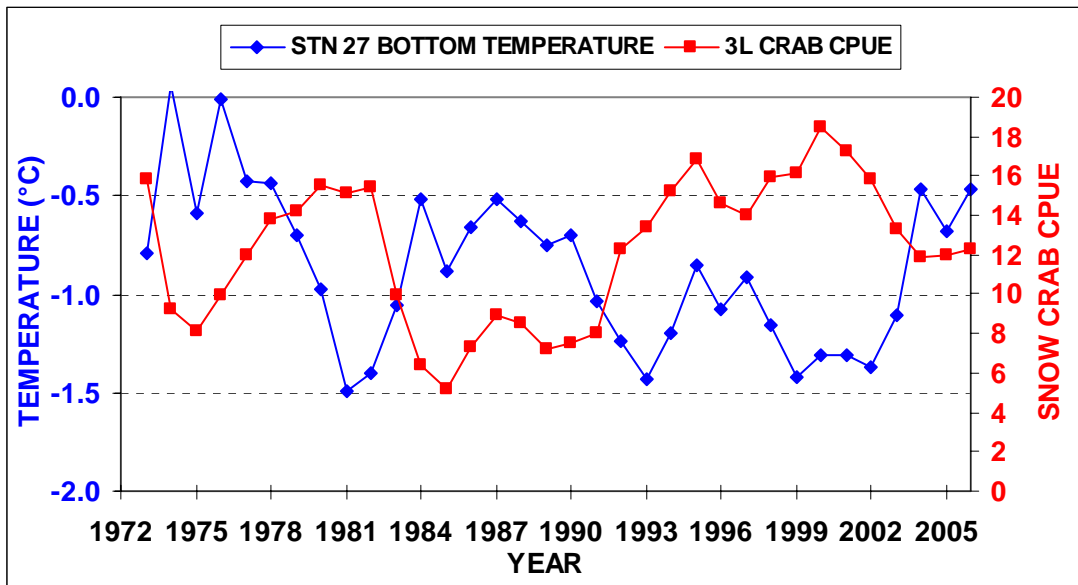


Fig. 1. Annual CPUE of snow crab in NAFO Div. 3L and the time series of Station 27 Jan.-June average bottom temperature at an 8-year lag.

Discussion - Review of ocean climate conditions throughout the Newfoundland-Labrador region of the NW Atlantic in recent years, in relation to long-term historical trends and averages, highlighted the current warming trend and the highest-on-record temperatures that prevailed during 2006, especially in the north of the region where recent warming has been more pronounced. Cooling that was evident in the fall of 2006 was first detected in data from a shrimp survey conducted farther north in Davis Strait in August. That cold water was advected southward and showed up progressively later off Labrador and eastern Newfoundland. It was considered too early to know whether this might be the start of a cooling trend, but 2007 could be somewhat cooler than the past couple of very warm years.

In correlations showing a negative relationship between temperature and CPUE in the fishery 7-9 years later for 2J, 3K and 3L, the most recent points were indicating a switch to a positive relationship. It was cautioned, however, that CPUE values for recent years may be biased upwards because of changes in fishing practices. Nevertheless, the negative relationships were holding up.

WP 2007/01. Effect of temperature on size at terminal molt in snow crab. By E. Dawe, D. Parsons and E Colbourne. (Presented by E. Dawe)

Abstract - This study was based on the observation of a high degree of spatial variation in the relative proportions of adolescent versus adult male snow crabs from trap survey samples. It was hypothesized that such small-scale spatial variation was related to a direct effect of ambient temperature on the size at which crabs undergo their final molt. This terminal molt is associated with sexual maturation in females, whereas in males (already sexually mature adolescents) it corresponds to achievement of adulthood, as reflected by the development of enlarged chelae. Data from inshore trap surveys on the Northeast Newfoundland coast (NAFO Div. 3K) showed that both female size-at-maturity and male percentage adolescents were directly related to bottom temperature. This suggests that in both sexes the terminal molt is delayed at high temperatures. This relationship was confirmed for females using data from 1995-2006 spring and fall multi-species trawl surveys. However those trawl survey data showed that the size-specific male percent adults was highest at 1° C and decreased at both lower (0 and -1° C) and higher (2-5° C) temperatures. This was consistent with previous studies that showed that adult males have their greatest positive energy balance at 1° C. Delayed terminal molt in warm areas resulted in large size of recruited males. Our study showed that effects of temperature differ throughout the life cycle. Cold conditions in early life favour survival while in later life they promote early terminal molt, thereby reducing the proportion that will recruit to the fishery. Negative relationships between bottom temperature and snow crab CPUE are apparent at lags of 6-10 years suggesting that the positive effects on recruitment of cold conditions early in the life history are stronger than the negative effects in later life. One implication of this study is that the very strong recruitment of the late 1990's was due to the combined effects of a cold oceanographic regime until the mid-1990's, that produced strong year-classes, and a subsequent warm regime that resulted in progression of a large proportion of those males to recruitment.

Discussion - Discussion of the preceding working paper on ocean climate extended into this one which explored details of crab biology underlying the negative relationship between temperature and catch rates in the crab fishery 7-9 years later. It has long been known that crab populations are affected by changing ocean climate. Cold conditions appear to favor survival in early life-history stages, but within a narrow range (~ 0 – 1.5 °C) low temperature also promotes terminal molting and maturation at smaller sizes which has a negative effect on future recruitment. On the other hand, at higher temperatures crab continue to molt and reach terminal molt at larger and larger sizes. This was seen as having a positive short-term benefit for the fishery because more adolescent males would reach legal size before terminally molting. It is generally believed that annual molting is the norm among pre-recruit crab but at smaller sizes molt frequency may be higher. Whether more than once-a-year molting among pre-recruits is also a factor contributing to the short-term benefit to the fishery in warm years is unknown. Overall, however, the positive long-term effects on the fishery of stronger future recruitment associated with cold ocean conditions are believed to outweigh the short-term benefits associated with warm conditions.

WP 2007/02. A brief description of Canadian fall multispecies surveys in SA2 + Divisions 3KLMNO from 1995-2006. By W. Brodie and D. Stansbury. (Presented by D. Stansbury)

Abstract - Stratified random multispecies trawl surveys have been conducted during autumn by the Department of Fisheries and Oceans in the Newfoundland and Labrador Region annually since 1977. Since 1990 these surveys have covered the offshore areas of NAFO Divisions 2J, 3K, 3L, 3N, and 3O. During 1995, the Campelen 1800 shrimp trawl was adopted as the standard survey gear, and coverage was extended to include the inshore areas of Div. 3K and 3L, parts of Div. 3M, Div. 2GH, and areas deeper than 1 000 m.

Some changes, planned and unplanned, have occurred to the survey series since 1995. Many of these unplanned changes have occurred because vessel breakdowns have not allowed full or timely completion of the entire survey area. The main problems with the 2004-06 surveys were the complete absence of survey sets deeper than 731 m in Div. 3LMNO, the lack of coverage in several other strata in Div. 3L, the reduction in coverage in some strata in Div. 3K, and the extension of the timing into January in 2005 and 2006. The approximately 650 sets completed in 2004 and 2005 surveys were the lowest numbers since the 1995 survey, but the number of sets in 2006 improved to 704.

There are at least three sources of uncertainty resulting from the problems encountered during the fall surveys of recent years: gaps in coverage (missed strata, reduced numbers of sets); changes in timing (survey coverage extended later, coverage of some strata/Divisions often spread out over a much longer period than planned); and vessel effects (few direct comparisons of the 3 vessels used, using vessels in areas where they have little or no coverage in previous years).

Careful attention to survey gear and fishing protocols, along with set-by-set monitoring with trawl sensors ensures minimal variability during tows. However, the problems with survey coverage and timing have introduced a further degree of uncertainty into the survey estimates for many species.

Discussion - The variable use of three different research vessels was considered not to be an important source of uncertainty in the fall multi-species survey conducted annually by the Region. However, there have been major inconsistencies between years in timing and degree of coverage for all Divisions caused for the most part by frequent mechanical breakdowns on the vessels. Coverage of inshore strata in particular and to a lesser extent deep (> 731 m) strata, has been poor and irregular. Inconsistencies in coverage of core strata have resulted in a great deal of uncertainty in the interpretation of trends in abundance/biomass indices and have frequently compromised inter-annual comparisons.

WP 2007/03. Commercial trials of escape mechanisms and a flexible bag system in the Newfoundland and Labrador snow crab (*Chionoecetes opilio*) fishery, 2005 - 2006. By W. Hiscock, P. Winger, C. Keats, K. Carroll and T. Brown. (Presented by P. Winger)

Abstract - The purpose of this project was to determine the performance and utility of escape mechanisms as selectivity devices for conical snow crab traps under commercial harvesting conditions. Building on the positive results of earlier laboratory and controlled field experiments, this project undertook the distribution of escape mechanisms to eleven harvesters in six communities along the east and south coast of Newfoundland for

commercial trials during the 2005 fishing season. Harvesters from the Petty Harbour region repeated the trials during the 2006 fishing season. During both years traps with escape mechanisms often caught significantly less undersize crab, and tended to catch the same amount of legal size crab, than traditional traps. Harvester feedback from the 2005 fishing season was positive and there was consensus that voluntary use of escape mechanisms should be permitted for the fishery, and that broader distribution of the selectivity devices would be a good idea, particularly in regions where smaller crab are abundant and handling-induced mortality is known to be high.

Discussion - Although the study lacked scientific design, it was clear that the use of escape mechanisms in traps allowed a high proportion of undersize crabs to escape on the bottom. This effect was most pronounced at short soak times in smaller mesh traps but evident at longer soaks and in larger mesh traps as well. Fishers indicate that the effect depends a great deal on the abundance of undersize crab in the area fished and suggest also that the more large crabs in the trap the more likely undersize are to escape.

Hard data were insufficient to evaluate some anomalous results that were included in the presentation. Suggestions were made for a much more rigorous approach to any further work that might be considered to fully evaluate the effects of these escape mechanisms. In the meantime, it was considered that the preliminary results considered here supported promoting the voluntary implementation of escape mechanisms in the fishery. In areas where the catching of undersize crab is a serious resource wastage issue, implementation could be made mandatory if that is what fishers want.

WP 2007/04. An assessment of Newfoundland and Labrador snow crab in 2006. By E. Dawe, D. Mullowney, D. Stansbury, D. Taylor, E. Hynick, P. Veitch, J. Drew, P. O'Keefe, D. Fiander, R. Stead, D. Maddock-Parsons, P. Higdon, T. Paddle, B. Noseworthy and S. Kelland.

Abstract - Resource status was evaluated, by NAFO Division, based on trends in biomass, recruitment prospects and mortality. Data were derived from the fall Div. 2J3KLNO and the spring Subdiv. 3Ps multi-species bottom trawl surveys, inshore Div. 3KL trap surveys, industry-DFO collaborative post-season trap surveys, and fishery data from logbooks as well as at-sea observer data. Data availability and reliability varied among divisions. Observer coverage, since 1999, has been highest and most consistent in Div. 3KL whereas it is inadequate in Div. 4R. A 3-year data series from industry-DFO collaborative trap surveys is available for Div. 3KL and Subdiv. 3Ps but not for Div. 2J3NO, and it is spatially inadequate for Div. 4R. The fall multispecies survey is conducted near the end of the fishing season and so is considered to provide an index of the exploitable biomass that will be available to the fishery in the following year. Trends in biomass within Div. 2J3KLNO were inferred based on comparison of trends in the fall survey exploitable biomass indices with offshore fishery catch per unit effort (CPUE) trends. Short-term recruitment prospects were inferred from comparison of fall survey pre-recruit indices with an observer-based index of crabs discarded in the fishery. Long-term recruitment trends were based on annual progression of male size groups through survey size frequency distributions. Mortality was inferred from exploitation rate indices, pre-recruit fishing mortality indices and prevalence of Bitter Crab Disease (BCD). No fishery-independent data were available for Div. 4R.

In Div. 2J recruitment and the exploitable biomass have recently increased. The fishery-induced mortality rate has decreased and recruitment prospects remain promising for 2007.

Fishery and multi-species survey data suggest that the exploitable biomass has become increasingly dependent upon immediate recruitment. An increase in exploitation rate in the short term that results in increased pre-recruit mortality could impair further recovery.

In Div. 3K recruitment increased in 2006 and the exploitable biomass has increased in both inshore and offshore areas. The fishery-induced mortality rate on the exploitable biomass was unchanged in 2006 whereas that on the pre-recruit population decreased to its lowest level. The proportion of the exploitable biomass represented by immediate recruitment has increased in the offshore but decreased in the inshore. The offshore fishery has become increasingly dependent upon immediate recruitment. Most of the exploitable biomass is distributed offshore. Any increase in exploitation rate in the short term that results in increased pre-recruit mortality could impair recovery of the exploitable biomass.

In Div. 3L recruitment and the exploitable biomass have decreased offshore since the late 1990's, but the exploitable biomass remains high relative to other divisions. Recruitment is expected to remain low in the short-term. Recruitment and the exploitable biomass increased inshore in 2006 and recruitment prospects appear promising for 2007. The fishery-induced mortality rate has changed little offshore in recent years. Most of the exploitable biomass is distributed offshore. Maintaining the current level of fishery removals in the short term will likely result in some increase in the fishery-induced mortality rate.

In Div. 3NO survey indices are unreliable. Commercial CPUE has changed little over the past 3 years and remains high relative to other areas. Recruitment has been low in recent years and short term prospects are uncertain. The effects of maintaining the current catch level on the fishery-induced mortality rate are unknown.

In Subdiv. 3Ps the exploitable biomass changed little in 2006 and remains very low. Recruitment should increase over the next three years. Increased removals, in the short term, would likely impair recovery of the exploitable biomass.

In Div. 4R the fishery has become concentrated in two localized inshore areas and industry-DFO collaborative post-season trap surveys indicate decreasing catch rates in those areas. There are insufficient data to assess overall resource status.

Overview of Divisions 2J3KLNOPs4R (Presented by E. Dawe)

Discussion - While looking at indices from the fall survey, it was suggested that a ratio of biomass/abundance might be more informative than presenting the two separately. It was pointed out that there had been a substantial increase in data from observer coverage over the past three years, all was being used and proving very useful in the assessment. Data from the annual FSCP post-season trap survey which started in 2003 were being used in the assessment for the first time this year. Review of the stations occupied in relation to the overall distribution of fixed stations for the survey revealed major inconsistencies between years in the degree of coverage and the distribution of stations occupied. Coverage was poor in the first year on the east coast but a fairly large portion of the stations have been occupied annually since 2004. Nevertheless, there have been significant inconsistencies. Coverage in 4R has been poor since 2003. Very little has been done in 2J and in 3L there is a large area that has not been covered at all. In 2006, covering stations that had been occupied in 2004 and 2005 was a priority.

Questioning focused on gleaning an understanding of reasons for the inconsistencies in coverage in the FSCP survey. Fishers are invited to participate under a contract arrangement, each is allocated a certain number of stations within a grid block and these are occupied essentially at his discretion and opportunity within a designated period. Fishing and sampling are carried out under established protocols. A number of operational constraints contribute to inconsistencies and gaps in coverage. The major factors among them are availability of observers, weather and running out of time within a designated time-window, and vagaries associated with subcontracting when the fisher is unable to complete the work. Starting in 2006, compensation was in cash rather than in extra quota allocation for the following fishing season as was the case from 2003 to 2005.

Division 2J (Presented by E. Dawe)

Discussion - It was explained that the index of recruitment from the observer data and the pre-recruit index from the trawl survey were different. The observer index is discards (soft-shell crab plus undersize) which include undersize adult males that are not included in the pre-recruit index. The sharp drop in discards in 2006 was due to avoidance of soft-shell crab in the earlier than usual fishery. The various components of the formula for deriving the pre-recruit mortality index, which is mortality due to fishing and does not include natural mortality, were explained in some detail.

Division 3K (Presented by E. Dawe)

Discussion - There has been a substantial reduction in effort in the past two years and a major shift in distribution of fishing effort to the southern part of 3K in 2006 compared to previous years was also noted. Fishing had been good in the south early on and that's where most of the fleet stayed for the season. Only a few vessels went north but fishing was good there too. As in 2J, it was noted that the fishery had shifted to the early part of the season in 2006. This resulted in a near elimination of soft-shell crab from the discards. It was noted also by fishers that there had been a gradual shift to use of larger mesh in recent years to target larger crab which was resulting in less undersize crab being discarded.

Attention was drawn to an apparent discrepancy in the time series (from 1995) of observer catch rates of commercial (kept) crab and those in the time series (from 2000) of old-hard and soft + new-hard crab in their detailed catch sampling. It was explained that the catch rate for kept crab (i.e. the commercial catch) is a mean value for all the trap hauls while the observer is on board. The discard catch rate is a mean value from the total weight of discards (undersize + soft shell) for all trap hauls as well. On the other hand, the catch rates for the old-hard and soft + new-hard breakdown are mean values for >95 mm crab from a very much smaller number of trap hauls which are actually sampled by the observers. The latter trap hauls are a subset of the total and differences in mean values for certain catch components are an artifact of the sub-sampling.

The absence of trawl survey sets inshore was noted, and it was explained that because of irregular coverage of inshore and deep (>731 m) strata, they were not included in the core strata used for estimating the various indices from the survey. Fishers suggested that the increased exploitable biomass in the southern part of 3K in recent years was linked to the fishery in years prior being concentrated in the northern part of the division.

It was noted that indices from the fishery, the trawl survey and the FSCP survey were all showing good sign of new recruitment. A fisher linked this positive view of recruitment with changes in fishing practice and associated responsible fishing. It was readily acknowledged that responsible fishing has been a factor in eliminating a great deal of soft-shell crab from the catch, but its role in reducing the catch of undersize crab isn't so clear.

Division 3L (Presented by D. Taylor)

Discussion - Problems with interpretation of changes in biomass indices related to wide confidence intervals that are provided in tables rather than in the figures were highlighted again. Particularly troublesome was an incomplete survey in 2005 that precluded comparison of the 2005/2006 exploitable biomass indices. Nevertheless, it was accepted that the index showed that exploitable biomass has been fairly stable since around 1999/2000. It was similarly difficult to interpret any trend in the pre-recruit index but accepted that pre-recruit biomass has been stable at a low level since then as well. Size frequencies from the survey also indicated low recruitment over the short term.

Discards in the fishery have been declining steadily since 1997. While soft-shell crab has not been a large part of the discards in 3L over the recent past, the steady decline in discards of undersize crab is reflected in an increasing mean size of commercial crab. However, interpretation of the discard pattern in terms of recruitment has been compromised because of a reported gradual shift over time to use of larger mesh in traps to target larger crab along with a shift to longer soak times, practices which tend to leave undersize crab on the bottom and could also be contributing to the increasing mean size in the commercial catch. However, it was considered that the foregoing was reflected in declining CPUE in the fishery over the recent past and that a decline in recruitment had occurred.

The practice of combining observer data from inshore and offshore areas was viewed unfavorably and it was agreed that data for the two areas should be summarized separately in the future. It was suggested that the 25 mile line would be the appropriate division between inshore and offshore areas of 3L. It was suggested also that observer data should be examined to determine if the effect on discard rate of changing mesh size could be evaluated.

Fishers have had concerns over the years about the apparent high incidence of BCD in samples of crab from Conception Bay. However, the disease seems not to have had any significant impact on the fishery. It was suggested that for some unknown reason the incidence of BCD in trawl and trap samples overestimates its prevalence in the population. BCD is most prevalent among small, soft and new-hard shelled crab and high incidence appears to be associated with periods of increasing recruitment.

Division 3NO (Presented by D. Taylor)

Discussion - Landings reported for 3NO have consistently exceeded the annual TAC's by a very wide margin ever since they were established in 1999. Reasons for the discrepancy are confused and complicated. They relate to a portion of the 3L fleet being allowed to take part of its quota in 3NO, to CMA 8B straddling the 3L/3NO boundary, and to a number of other management arrangements for certain segments of the offshore fleet. Concerns have been raised in the past and the issue was the subject of a research recommendation from the

2006 RAP which was not acted on. It was agreed that the matter should be dealt with and to carry forward the research recommendation.

Rather than continuing to say year after year that the trawl survey indices for 3NO are unreliable, it was suggested that it should be possible to say more. Even though it is a difficult area to trawl, the survey has caught crab there in the past but not in recent years. Not much is known about the distribution of crab in the area, but the fishery tends to target patches of high concentration. It was agreed that the trawl survey data for the slope/shelf edge area of Divisions 3LNO should be looked at in greater detail. It was suggested also that the area should be surveyed by trap, possibly as part of the FSCP survey.

Subdivision 3Ps (Presented by D. Mullowney)

Discussion - The earlier fishery in 2006 avoided a lot of soft-shell crab which usually start showing up in the catches by May. Fishers are arguing for a March 1 opening rather than April 1 – this would allow the fishery to pretty well avoid soft-shell crab completely.

It was recognized that observer coverage is heavily weighted to the offshore which obscures information for the inshore area when data are summarized for the two combined. It was agreed that in future, observer data for inshore and offshore areas should be treated separately in the assessment.

While the observer deployment scheme attempts to obtain good spatial and temporal coverage of the fishery, in practice there are all sorts of problems matching the planned deployment. Priority can change in response to problems in the fishery in certain areas. Inshore boats are small and the unpredictability of sailing because of weather is the big factor in limited coverage of the inshore fishery.

Division 4R (Presented by D. Mullowney)

Discussion - A dramatic decline in the fishery since 2004 has resulted in a serious lack of data on which to base an assessment of the resource. The much reduced offshore effort is concentrated just outside the inshore boundary and inshore effort is concentrated in Bay of Islands and Bonne Bay. More and more of the logbook records are coming from inshore boats which generally do not provide fishing position. The FSCP survey was discontinued in the offshore area after 2003 and coverage inshore has been mostly in Bay of Islands and Bonne Bay. Observer coverage has been very poor. It was agreed that better monitoring of the limited fishery is needed.

Even though the fishery is in bad shape right now, fishers would oppose closure. They want to fish opportunistically depending on economic considerations.

WP 2007/05. A comparison of trends in Divisions 2J3KL fishery and fall survey biomass indices. By D. Mullowney, E. Dawe, and E. Hynick. (Presented by D. Mullowney)

Abstract - This project compared commercial offshore fishery logbook catch per unit of effort (CPUE) data to biomass indices derived from fall multi-species trawl surveys for NAFO

Divisions 2J3KL from 1995 – 2006. In Div. 2J3K trends agreed between the two indices but in Div. 3L the trends differed. To investigate possible reasons for the agreement of index trends in Div. 2J3K and the disagreement in Div. 3L, seasonal and spatial (depth) comparisons were conducted between fishery CPUE and survey catch rates of legal-sized crabs within each division. In all three divisions segregation by size (carapace width) was apparent from the survey data with large crabs being more common at greater depths and small crabs being more common in shallower water. Fishery data showed that a shift of fishing effort, and a corresponding increase in CPUE, occurred from shallow to deeper water in Div. 2J3K throughout the fishing season but no such shift occurred in Div. 3L where effort remained relatively fixed within the 100-200m depth interval. Agreement in trends between the indices was stronger in Div. 2J3K than in Div. 3L because there was greater spatial overlap between the fishery and the survey-based exploitable biomass in those northern divisions. A greater (and annually more variable) portion of the exploitable biomass extended into depths greater than those commercially fished in Div. 3L than in Div. 2J3K. We hypothesize that the Div. 3L offshore fishery has continued to perform well within a limited depth range, while the survey-based exploitable biomass has declined, due to regular recruitment to the shallow-water fishery by means of immigration from greater depths..

Discussion - Correlations between the fall survey exploitable biomass index and CPUE in the fishery the following year might be more appropriately forced through the origin. Also, the coefficient of variation would be a more appropriate measure of variability in each index. The positive correlations for 2J and 3K were shown to be linked to size segregation by depth, with most of the smaller crab in shallower water and most of the larger crab deeper, and a nearly complete overlap between the distributions of fishing effort and the resource. By contrast, the relationship was absent in 3L where size segregation by depth was much less apparent and fishing effort overlapped only the shallower portion of resource distribution. The 3L fishery operates over the very broad expanse of the northern portion of the Grand Bank where catch rates have remained fairly high, and the fleet hasn't had to travel the greater distances to deeper water. However, it was not possible to conclude from the presentation just how much of the exploitable biomass was at the greater depths and not being targeted by fishery. It was suggested that this might best be done by looking at smaller areas where there is overlap between the fishery and the survey and comparing biomass at depth rather than survey catch rates, this would take into account the actual area in the deeper water.

It was hypothesized that the fishery was being supported and partly sustained by movement of pre-recruit and possibly some recruit crab from deep to shallow. The conventional view, however, would have small crab in shallow water eventually moving deeper. In addition, the distances involved in this case are considered well beyond what can be supported by existing knowledge of crab movements. Nevertheless, similar movement is hypothesized for crab on the Scotian Shelf and tagging studies in the Gulf indicate that movements on the order of hundreds of kilometers are possible and occur in this species. This suggests that the movement distances involved in this hypothesis for 3L crab are plausible. That the fishery is still doing well on the shallow shelf can be taken as supporting the hypothesis. However, it was clear that more convincing evidence will be required before this suggested deep to shallow movement of crab in 3L can be generally accepted. An important consideration is separation of recruitment occurring within the area fished from what may be moving in from deep water.

This work has made progress with explaining the long-standing disagreement between fishery and survey indices in 3L. However, there is more that can be done with existing data to further resolve the matter. In addition, more needs to be done with the survey data to

determine the veracity of the suggested disappearance of crab from the deeper strata in the recent time period and the possible contraction of the population into prime habitat. How the survey trawl performs in the deep strata on the steep slope/shelf edge where the current is always very strong is another ongoing concern that should be addressed.

PROGRESS ON RESEARCH RECOMMENDATIONS FROM 2006 RAP

1. Regarding 3K recruitment (White Bay). There is a trend in all of these strata with regards to a mode or a pulse moving through. This could be teased out somewhat. E.g. separation of hard-shell versus soft-shelled crab.

The data were separated by adolescents and adults rather than by hard-shell versus soft-shell to try and tease out trends in the size frequency data.

2. Concerning the fishery versus the research CPUE (inshore trap survey) error bars would assist in the interpretation of the information presented. This may have been requested in 2004.

This recommendation has not been acted on. In general, further work is required to determine how to compute reliable C.I.'s for all data series.

3. In past years, some of the landings for 3O were not taken. Some of the management areas overlap for the Divisions 3NO and the landings need to be partitioned out. The landings sometimes exceed the TAC. Rather than separate out the two divisions, it could be looked at as one. As noted by a harvester, in the composition of the fleet, the amount of the quota in Div. 3O is somewhat outside and inside 200. This is confounded by the vessel class/size and the amount of catch per trip a vessel can take. This would require some work with the harvesters and FAM. An attempt to resolve this issue as much as possible for the next assessment is advisable.

No progress was made on the foregoing research recommendation over the past year but it will be carried forward.

4. Compare the spring and fall 3LNO surveys. Relate this information in terms of quality of Subdivision 3Ps index.

This research recommendation was not addressed over the past year because there was no spring survey in 3Ps in 2006. The recommendation will be carried forward.

5. In Subdiv. 3Ps and Div. 4R we do not have the RV surveys and thus the post season pot survey may provide auxiliary information for these areas. Should Subdiv. 3Ps and Div.4R with no fall data be considered separately with regards to the post season survey? In 2007 we will have a three year time series. If the index is worth looking at for Subdiv, 3Ps and Div. 4R, then perhaps, it is worth looking at it for other areas. If the data were peer reviewed, it could be helpful in getting us to the five year useable index. The plan is to present this information in 2007. When the GEAC survey was started we looked at it without have a five year time series. It is a good idea to look at the post season pot survey, but to be cautious with regards what is taken from it. The biological data, but not the catch rates could be looked at for this index.

The recommendation was to review these data with a 3 year time series in 2007 with a view to considering the biological data, but caution with regards to inferences on catch rates.

The foregoing research recommendation was acted on and, for the first time, this year's assessment included a summary of the FSCP post-season survey data for all divisions except where the survey was not done.

6. The Quebec Region has a trap and a trawl survey. This may be a potential source of information for Division 4R. The Quebec Region will be attempting to do some comparative fishing using the Campelen. The Quebec survey occurs in August. E. Dawe pointed out that August would be an opportune time to survey crab.

Results from the comparative fishing exercises conducted by the Quebec region were not available for this assessment. Nevertheless, they do a multi-species survey in Divisions 4RS from which, over time, they will develop a crab abundance index that we should be able to access and make use of for the Division 4R assessment. Quebec also does a fairly extensive trap survey for crab along the North Shore as well as a small-scale beam-trawl survey in shallow water mostly for research purposes. The latter is done in Area 14 which is the closest Quebec crab management area to 4R. It was agreed to carry this research recommendation forward.

RESEARCH RECOMMENDATIONS FROM 2007 RAP

1. Investigate the possibility of standardizing crab logbook data so that year-to-year comparisons of commercial CPUE as well as comparisons between fishery and survey indices can be made with greater confidence.

2. Investigate the gradual change to larger mesh size in crab traps from the logbook data.

3. Continue efforts to determine how to compute C.I.'s for time series of mean values and estimated population indices.

4. Investigate the separation of 3L observer data by inshore and offshore and the effect of changing fishing practices on indices from observer data.

5. Undertake to compare data from the fishery and the trawl survey in 3L on a stratum-by-stratum basis to further examine the mismatch between the distribution of fishing effort and the resource.

6. Undertake to investigate further the apparent disappearance of crab from the deep water strata of 3L over the fall survey time series.

7. In past years, some of the TAC for Div. 3O were not taken. Some of the management areas overlap for the Divisions 3NO and the landings need to be partitioned out. The landings sometimes exceed the TAC. Rather than separate out the two divisions, it could be looked at as one. As noted by a harvester, in the composition of the fleet, the amount of the quota in Div. 3O is somewhat outside and inside 200. This is confounded by the vessel class/size and the amount of catch per trip a vessel can take. This would require some work

with the harvesters and FAM. An attempt to resolve this issue as much as possible for the next assessment is advisable.

8. Generate year-by-strata biomass/abundance estimates for the slope/shelf edge area of Divisions 3LNO.

9. Compare the spring and fall 3LNO surveys. Relate this information in terms of quality of Subdivision 3Ps index.

10. Present observer data by inshore and offshore areas separately for each division in the next assessment.

11. Access data from the Quebec Region multi-species survey in Divisions 4RS for use in next year's assessment of 4R crab.

12. Attempt to develop a recruitment index from the observer at-sea sampling data from the relationship of CPUE with mean size of legal-sized crabs.

13. Define and present more clearly the index of pre-recruit fishing mortality.

Appendix I: Terms of Reference

Meeting of the Newfoundland and Labrador Regional Advisory Process (RAP) on Shellfish

**The Gazebo, Clovelly Golf Course
Stavanger Drive
St. John's, NL
February 27 – March 2, 2007**

**Northwest Atlantic Fisheries Centre
80 East White Hills Road
St. John's, NL
March 5-9, 2007¹**

Meeting Chairperson: Dr. Noel Cadigan, Research Scientist, Groundfish Section, Aquatic Resources Division, DFO, Newfoundland and Labrador Region.

TERMS OF REFERENCE

Context

The status of Divisions 2J3KLNO, Subdivision 3Ps, and Division 4R snow crab was last assessed in 2006. The current assessment is requested by Fisheries and Aquaculture Management to provide harvest advice for 2007.

Objectives

- Assessment of snow crab stocks in Divisions 2J3KLNO; Subdivision 3Ps; and Division 4R.
- In addition, an overview of ocean climate conditions during 2006, in comparison to the historical record, will be presented.

Products

A Science Advisory Report (SAR) and associated research documents will be produced for the snow crab assessment. A Proceedings document will record the meeting discussions.

¹ As required, a second week has been planned to word craft the complete text of the SAR. Summary bullets for each stock will be agreed upon in plenary during the week of March 5-9, 2007. RAP participants are encouraged to attend the second week of discussions and assist in the drafting of the SAR.

Participation

- DFO Science, Newfoundland and Labrador and NCR
- DFO Fisheries and Aquaculture Management, Newfoundland and Labrador Region
- Industry Representatives
- Fish, Food and Allied Workers Representatives
- Provincial Department of Fisheries and Aquaculture
- Memorial University

Appendix II: Agenda

Meeting of the Newfoundland and Labrador Regional Advisory Process (RAP) on snow crab

The Gazebo, Clovelly Golf Course
Stavanger Drive
St. John's, NL
February 27 – March 2, 2007

The following is a tentative agenda that may change as the meeting progresses.

Tuesday, February 27 2007

1. 9:00-9:30. *Preliminaries* Noel Cadigan (Chair)
 - 1.1. Opening remarks Julian Goodyear (NL Regional Director, Science)
 - 1.2. Introduction of participants
 - 1.3. Terms of Reference
 - 1.4. Work Plan
 - 1.5. Comments on Agenda

2. 9:30-10:30. *Oceanography* Eugene Colbourne

10:30-10:45. *Break*

3. 10:45-12:00. *Working Papers*
 - 3.1 *Effect of temperature on size-at-maturity in female, and size-at-adulthood in male snow crab.* Earl Dawe
 - 3.2 *Overview of the multi-species survey* Don Stansbury
 - 3.3 *Commercial trials of escape mechanisms in the Newfoundland snow crab fishery during the 2005 and 2006 seasons* Paul Winger
12:00-1:00. *Lunch Break*

4. 1:00-3:00.
 - 4.1 *Overview of snow crab in Divisions 2J3KLNO* Earl Dawe
 - 4.2 *Division 2J* Earl Dawe
3:00 -3:15. *Break*

5. 3:15-5:00. *Division 2J* Earl Dawe

Wednesday, February 28 2007

6. 9:00-10:30. *Division 3K* Earl Dawe

10:30-10:45. *Break*

7. 10:45-12:00. *Divisions 3K+3L* Earl Dawe /Dave Taylor
 12:00-1:00. *Lunch Break*
8. 1:00-3:00. *Division 3L* Dave Taylor
 3:00 -3:15. *Break*
9. 3:15-5:00.
 9.1 *Divisions 3LNO* Dave Taylor
 9.2 *A comparison of fishery versus survey biomass indices* Darrell Mullowney

Thursday, March 1 2007

10. 9:00-10:30. *Subdivision 3Ps + Division 4R* Darrell Mullowney
 10:30-10:45. *Break*
11. 10:45-12:00. *Subdivision 3Ps + Division 4R* Darrell Mullowney
 12:00-1:00. *Lunch Break*

RAP Break

12. 1:00-3:00. *Review* Dave Orr/ Tim Sifred
 Set allocations for the Northern Shrimp Research Foundation
 Survey in NAFO Divisions 0B and 2G
 3:00 -3:15. *Break*
13. 3:15-5:00. *Review* Dave Orr/ Tim Sifred
 Set allocations for the Northern Shrimp Research Foundation
 Survey in NAFO Divisions 0B and 2G

Friday, March 2 2007
RAP Continue

- | | |
|--|---|
| 14. 9:00-10:30. <i>New analyses</i> | Earl Dawe/ Dave Taylor/ Darrell Mallowney |
| 10:30-10:45. <i>Break</i> | |
| 15. 10:45-12:00. <i>Summary Bullets</i> | Earl Dawe/ Dave Taylor/ Darrell Mallowney |
| 12:00-1:00. <i>Lunch Break</i> | |
| 16. 1:00-3:00. <i>Summary Bullets</i> | Earl Dawe/ Dave Taylor/ Darrell Mallowney |
| 3:00 -3:15. <i>Break</i> | |
| 17. 3:15-5:00. <i>Summary Bullets and
Research Recommendations</i> | Earl Dawe/ Dave Taylor/ Darrell Mallowney |

March 5-9 2007 (EPS Boardroom, NAFC, St. John's, NL)

Finalize summary bullets and SAR text.

Appendix III: List of Participants

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Appendix IV: List of Working Papers and Presentations

Colbourne, E., J. Craig, C. Fitzpatrick, D. Senciall, P. Stead and W. Bailey. Northwest Atlantic climate update for 2006.

WP 2007/01. Dawe, E.G., D. Parsons and E Colbourne. Effect of temperature on size at terminal molt in snow crab.

WP 2007/02. Brodie, W. and D. Stansbury. A brief description of Canadian fall multispecies surveys in SA2 + Divisions 3KLMNO from 1995-2006.

WP 2007/03. Hiscock, W., P. Winger, C. Keats, K. Carroll and T. Brown. Commercial trials of escape mechanisms and a flexible bag system in the Newfoundland and Labrador snow crab (*Chionoecetes opilio*) fishery, 2005 - 2006.

WP 2007/04. Dawe, E.G., D. Mallowney, D. Stansbury, D. Taylor, E. Hynick, P. Veitch, J. Drew, P. O'Keefe, R. Stead, D. Maddock-Parsons, P. Higdon, T. Paddle, B. Noseworthy and S. Kelland. An assessment of Newfoundland and Labrador snow crab in 2006.

WP 2007/05. Mallowney, D., E.G. Dawe, and E. Hynick. A comparison of trends in Divisions 2J3KL fishery and fall survey biomass indices.

Appendix V: Evaluation Form

MEETING EVALUATION FORM

**Regional Advisory Process (RAP)
Newfoundland & Labrador Shellfish**

Clovelly Golf Club, St. John's, NL
February 27 to March 2, 2007

I was:

Invited participant ___ Presenter ___ Scientific Referee ___ Other ___

Please assess each statement by circling the rating from 1 to 5

	Totally disagree		Agree		Agree entirely
Objectives of the meeting were met	1	2	3	4	5
Time was used efficiently	1	2	3	4	5
Information was presented clearly	1	2	3	4	5
All necessary information was available to me	1	2	3	4	5
I was able to express my opinion freely	1	2	3	4	5
The right people were present	1	2	3	4	5
I benefited from this meeting	1	2	3	4	5
I was comfortable to express myself in the language of my choice	1	2	3	4	5

Comments, suggestions, questions, etc.

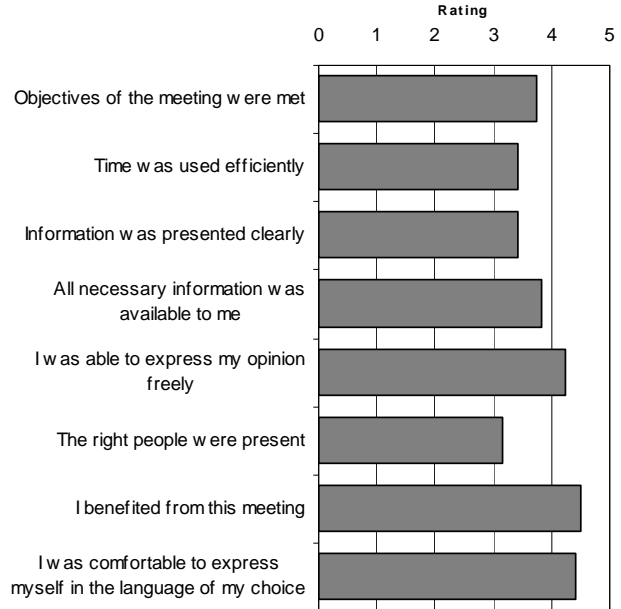
Appendix VI: Evaluation Survey Results

Number of evaluation forms received by participant's type

	Total
Invited participants	8
Presenters	2
Scientific Referees	0
Other	2
Grand Total	12

Rating scale used

Totally disagree		Agree		Agree entirely
1	2	3	4	5



Results by statement and participant type (average rating between 1 and 5)

	Objectives of the meeting were met	Time was used efficiently	Information was presented clearly	All necessary information was available to me	I was able to express my opinion freely	The right people were present	I benefited from this meeting	I was comfortable to express myself in the language of my choice
Invited participants	3.8	3.6	3.5	3.9	4.0	3.1	4.4	4.3
Presenters	3.5	3.0	4.0	4.0	4.5	4.0	5.0	4.5
Other	4.0	3.0	2.5	3.5	5.0	2.5	4.5	5.0
Grand Total	3.8	3.4	3.4	3.8	4.3	3.2	4.5	4.4

Comments

- Informative how data collected by observers is used
- As a fisheries observer the meetings were very informative as to how the data collected by observers is utilized and how it fits with other data
- In the future, is it possible that the RAP sessions be centralized - Gander or Grand Falls maybe?
- Presentations were great, making bullets is a painful process
- Need better or additional reviewers; should get an external reviewer; some indices could have been better presented
- All participants should be provided with an information kit in advance of the meeting. It should include a very clear statement regarding what the meeting itself is meant to achieve, guidelines for preparing and intended use (target readership) of the various components of the SAR, in particular the summary bullets, industry perspective, and conclusion/advice section.