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Proceedings of a Maritimes Science Peer Review of the Lobster Fishing Areas (LFAs) 34-38 Lobster (*Homarus americanus*) Assessment

February 12-14, 2013
Dartmouth, Nova Scotia

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Foreword

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

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TABLE OF CONTENTS

SUMMARY iv
SOMMAIRE v
INTRODUCTION 1
LOBSTER ASSESSMENT 1
TEMPERATURE REGIME 1
FISHERY PERFORMANCE 2
CATCH RATE FROM STANDARD (FSRS) TRAPS 4
SIZE AT MATURITY STUDIES (LFA 34): RECENT FEMALE LOBSTER SIZE AT MATURITY ESTIMATES FOR SWNS AND BAY OF FUNDY 5
SIZE AT MATURITY STUDIES AND REPRODUCTIVE INDICES (LFAs 35-38) 6
EVALUATION OF FISHERY INDEPENDENT SURVEYS 8
FISHING PRESSURE 10
REFERENCE POINTS 11
ECOSYSTEM CONSIDERATIONS 13
PREDATION AND FISHERY FOOTPRINT 13
BYCATCH 14
SUMMARY AND CONCLUSIONS 15
SUMMARY OF DAY ONE 15
SUMMARY OF DAY TWO 16
REVIEW OF SCIENCE ADVISORY REPORT 17
CONTEXT 17
SUMMARY BULLETS 17
BACKGROUND 17
ASSESSMENT 17
OTHER CONSIDERATIONS 17
REFERENCES 18
APPENDICES 19
APPENDIX 1. LIST OF PARTICIPANTS 19
APPENDIX 2. TERMS OF REFERENCE 20
APPENDIX 3. AGENDA 23

SUMMARY

A Maritimes Region peer review of the Assessment for Lobster Fishing Areas (LFA) 34-38 was held on February 12-14, 2013, in Dartmouth, Nova Scotia. Participation in this meeting included Fisheries and Oceans Canada (DFO), the provinces of New Brunswick and Nova Scotia, aboriginal organizations and communities, and the lobster fishing industry (participants from LFA 34 and Grand Manan). The results of this meeting were used to support management decisions related to the LFA 34-38 lobster fisheries in the subsequent years.

Compte rendu d'un examen scientifique par les pairs de la région des Maritimes portant sur les zones de pêche du homard (ZPH) 34 à 38 (*Homarus americanus*)

SOMMAIRE

Un examen par les pairs de la région des Maritimes portant sur l'évaluation des zones de pêche du homard (ZPH) 34 à 38 a eu lieu du 12 au 14 février 2013 à Dartmouth, en Nouvelle-Écosse. Les participants à cette réunion comprenaient Pêches et Océans Canada (MPO), les provinces du Nouveau-Brunswick et de la Nouvelle-Écosse, des organisations et des communautés autochtones ainsi que des représentants de l'industrie de la pêche au homard (participants de la ZPH 34 et de Grand Manan). Les résultats de cette réunion ont servi à appuyer les décisions de gestion concernant la pêche au homard dans les ZPH 34 à 38 au cours des prochaines années.

INTRODUCTION

The chair of the meeting, T. Worcester, Coordinator for the Centre for Science Advice in the Maritimes Region, welcomed everyone and thanked them for coming to this Fisheries and Oceans Canada (DFO) science peer review of the Assessment for Lobster in Lobster Fishing Areas (LFAs) 34-38.

LFA 34 lobster was last assessed in 2006, and LFA 35-38 lobster were last assessed in 2007. So, in 2012, DFO Resource Management asked for an assessment of the lobster resource in LFAs 34-38 as per the proposed 5-year assessment cycle. A framework review meeting was held in July 2012 to establish the assessment method (DFO 2013).

The DFO Science peer-review process is meant to be an open, transparent, and inclusive process, so participants (Appendix 1) were encouraged to ask questions of clarifications and to participate actively in the discussion. It was explained that the meeting would operate by consensus, where possible.

The Terms of Reference (Appendix 2) and Agenda (Appendix 3) for the meeting were reviewed, and nothing further was added.

LOBSTER ASSESSMENT

TEMPERATURE REGIME

Presentation by: D. Herbert

Rapporteur: T. Worcester

Presentation Highlights

The North Atlantic Oscillation plays a major role in year-to-year changes in ocean climate off eastern US/Canada. The NAO affects the air-sea interaction and general circulation in the Labrador Sea. In a high NAO year, warmer water is typically observed in the southwest Scotian Shelf. In a low NAO year, cooler shelf water is typically observed in the southwest Scotian Shelf. When the low NAO event in 1996 was tracked, it showed a transit time of 2+ years, with a flushing time for the Gulf of Maine of approximately 1 year. The impact of this was lower catch rates of sharks in Emerald basin and a change in the distribution of silver hake (among other things). Given that the NAO has significant impacts on interannual ocean variability, the NAO has the potential to impact lobster.

However, the predictive ability of the NAO is limited. The 2010 NAO index was the lowest on record. This low NAO index in 2010 was expected to impact the southwestern Scotian Shelf in 2011 or 2012, with an expectation of cooler than average bottom temperatures. However, 2012 bottom temperature were much warmer than average, with anomalies of up to 2 degrees. The predictive ability of the NAO was considered to be better before 2012, when the relationship between NAO anomalies and subsequent bottom temperatures appears to have broken down.

Collaborative work is now being done with the Ocean Tracking Network to monitor bottom temperature and salinity sensors at the Halifax line. Water warming has been observed there since April 2012, with the signal strongest close to shore. However, it is unclear from which direction the warm water is coming from. Additional records from this monitoring, including oxygen, have not been processed yet.

Discussion

What is considered to be surface water? The top 5 m, but the top 10 m is usually well mixed.

On the RV surveys, bottom temperature samples are taken a couple of meters off the bottom.

What can you say about the longer time trends? In the Bay of Fundy, there is an increasing temperature trend that is slightly significant. However, the Halifax station shows no long-term trend in temperature.

Are there temperature readings before 1981? Yes, but the most recent period is typically used for reporting.

Can you comment some more on the predictive use of the NAO? The 2010 NAO low was centered to the west over Labrador, which might have changed the pattern. We might not be using quite the right NAO indices for predictions on the Scotian Shelf (there are many to use).

The NAO for 2012 was positive, so warmer waters are expected in 2013 and 2014 (if the pattern holds).

Whether or not this information would be included in the Science Advisory Report was discussed. It was suggested that some information on the NAO could go into the section on ecosystem considerations or in the sources of uncertainties.

It was suggested that the summary bullets from this presentation should be made more widely available to fishermen, and it was suggested that they be circulated to the LFA office.

It was noted that the US National Oceanic and Atmospheric Administration (NOAA) also produces a status report on ecosystem trends.

FISHERY PERFORMANCE

Presentation by: J. Tremblay

Rapporteur: T. Worcester

Presentation Highlights

Data on landings is available from lobster catch and settlement reports (logbooks). It is reported by grid and grid groups. The grid groups are mostly used in LFA 34, as they do not add much information in the other LFAs. In the Bay of Fundy, this approach does not capture potential inshore/offshore differences because of the large size of the grids relative to the Bay of Fundy, and the grid configuration.

Total landings have been increasing and are at an all-time high, about a third higher than the last assessment. Landings are increasing in most grid groupings except 2A where there were reductions in effort. In LFA 34, there has been a shift in the distribution of landings to the midshore and offshore. Increases in landings have been similar in the Bay of Fundy, but they are greatest in LFA 35. They are almost 5 times the 50-year mean and are about double those at the last assessment.

Effort is adjusted because it may be underreported more often than landings. It is obtained from weigh-out slips. Total trap hauls are variable without trend in LFA 34, but they have increased in the Bay of Fundy. Effort is also investigated in terms of average days fished. There is a slight decrease in effort in LFA 34, with increases in LFAs 35-38. Not much trend is observed in the average number of grids fished (fishermen may not reporting changes or they may be shifting which grids they fish). Within LFA 34, a shift is observed in the distribution of effort to the midshore/offshore.

DFO Oceans and Coastal Management has been mapping fishery effort in terms of total lobster trap hauls per km^2. This work indicates that LFA 34 is fished more heavily than the Bay of Fundy.

In LFA 34, there is an increases in CPUE (kg/trap haul) in every grid group but to a greater extent in the midshore and offshore. Increasing catch rates in the midshore and offshore may provide an incentive to shift effort to these areas. In the Bay of Fundy, increases were observed in all LFAs, with the largest increases in LFA 35 and grid groups 1-5. Increases in CPUE with increases in effort help to explain the observed increase in landings.

Size trends in traps were investigated in LFA 34. The median female size has been trending downwards in some inshore and midshore areas. A similar trend is observed in the larger females. There may be some increase in the offshore. No trend is observed in LFA 38. In LFAs 35-36, there are some declining trends in size. Quite a difference is observed in the size of large females in different grid groups.

Discussion

The strength of the spatial shift in effort needs to be validated (e.g. with the observed records).

There is some analysis of the relationship between reported catch and observer catch (and locations) in terms of catch rates.

Fishermen's knowledge supports a shift in the patterns of effort. In LFA 34, fishermen are shifting towards fishing further away and staying out longer. There is more movement by younger fishermen. Logbooks and grids might not be showing that. Fishing in the Bay of Fundy (LFA 35) has also changed due to an influx in people from LFA 34. Heavier trawls and anchors are being used, with more time spent on the water. There used to be more day fishermen, at least in the Digby area. Similar people now fish LFA 34 and 35. This supports the observed increase in effort in LFA 35. With good catch rates in 35, fishermen stay there. People from LFA 34 are now also trying to move into LFA 38.

It was suggested that the 2012 results be compared with the last assessment period, as per the Terms of Reference.

Does the observed decrease in medium size relate to incoming recruitment? If this was the case, it is not clear why the size of larger females would also be declining. With increased recruitment, larger females would be expected to accumulate in the population.

Concern was expressed that the at-sea sampling is too spotty to detect these kinds of trends. However, even with the variability, a trend is still observed. Sample size impacts need to be considered.

Offshore fishermen see lots of female lobster in deep water around Christmas.

Grid group 6 in LFA 34 is the only grid group that shows a different trend in sea samples compared to the port samples (is the timeframe different?).

DFO Oceans and Coastal Management maps provide a number of different ways of presenting effort data. Different things are displayed in different maps, but all are useful. It may also be useful to provide kg/trap haul, since that is how it is reported in the assessment.

Recommendations

Even though the data analysis does not detect a change in fishing effort, it is still worth tracking. An attempt could be made to do some more detailed analysis to detect the extent of change in effort distribution.

Compare the 2012 assessment results with the last assessment (2006/2007).

CATCH RATE FROM STANDARD (FSRS) TRAPS

Presentation by: M. Cassista-Da Ross

Rapporteur: T. Worcester

Presentation Highlights

Catch rate is often used as an abundance indicator, but the catchability of lobsters can be affected by factors unrelated to abundance. Data from FSRS traps include sublegal and legal sizes. Here the emphasis is on the sublegal sizes. Two approaches were used, a Generalized Additive Mixed Model (GAMM) and a Temperature Corrected Abundance Index (TCAI). The TCAI attempts to correct for the effect temperature has on lobster catchability.. GAMM is considered to be the best fit for the LFA 34 data because it incorporates zero CPUE values, it uses a Poisson distribution, it allows for modeling of catch only (using effort as an offset), and it uses a smoother for the week of season variation. The temperature-corrected model assumes that populations within the selected spatial unit are subject to the same conditions (natural or man-made), the target size class is locally closed, and the same temperature-catchability relationship for the target size class applies within each fishing season, across fishing season, and across locations.

For LFA 34, the grid group was significant, but it was not for LFA 35. Ignoring that, the overall result for LFA 34 is a slight increase in the last few years. Grid group 2B has the highest catch rate. There was some increase in 2A but some decline in grid group 1.

The temperature-corrected abundance index does not show as much increase as the uncorrected CPUE. Something strange happened in grid group 1. The same reduction in CPUE was not observed to account for temperature. However, an increase in the abundance over time was seen.

An increasing trend was seen in the LFA 35 legal lobster, as well as recent increases in the sublegal lobster. Catch rates in FSRS traps were higher in LFA 35 than in LFA 34.

Discussion

Are these catch rates from the Fishermen & Scientists Research Society (FSRS) traps? Yes. Concerns have been raised previously about movement of traps and the fact that they were not designed to be used in this way.

These traps were designed to look at trends in sublegal lobsters – not adults. Inshore, people do maintain the location of the traps. This is a standard trap. It was originally called a recruitment index.

There are lots of participants and data in LFA 34, so these results are considered more robust. There is less data available for LFA 35.

What do you mean by a weak abundance trend? It was not robust.

The summary should include the conclusion that the temperature correction brings the abundance index down compared to the uncorrected index.

What is the size range of the sublegals considered? All caught.

Is the trend apparent for all sizes? It is very hard to see size modes in this data. There is lots of growth variability. The temperature correct index is based on sizes 9s and 10s. The GAMM includes more size groups, though most lobsters are above 60 mm.

The TCAI looks like there might be a year class or something other than abundance that is being captured. Temperature can impact many things, including catchability and productivity.

All sorts of lobster of all sizes are caught in the DFO RV survey.

Lobster are being caught where they have not been caught before. Change in temperature allows for a change in the distribution of lobster, but there may be a lower density over a wider area.

This approach provides consistent results with the other abundance indices.

It was clarified that the hoop size for FSRS traps is 5 inches.

Would you expect to see a seasonal change from spring to fall? Yes, seasonal patterns are expected, but it's hard to capture this from the FSRS data. Sample size restricts this.

Recommendation

Be sure to note the sources of uncertainty in using this index.

SIZE AT MATURITY STUDIES (LFA 34): RECENT FEMALE LOBSTER SIZE AT MATURITY ESTIMATES FOR SWNS AND BAY OF FUNDY

Presentation By: A. Silva

Rapporteur: T. Worcester

Presentation Highlights

There is a need to update size at maturity (SOM) information because it is old, there is missing information for important fishing areas, and we want to better understand the responses of lobsters to changing environmental conditions. Lobster size at maturity may also be an indicator of fishing effects.

Information on maturity was based on cement glands from LFA 31A to LFA 38, from June 1-27 in 2011 (N>4000). These results are compared to other areas in Nova Scotia.

Results show an increasing size at maturity as you head south, with the highest values in the Bay of Fundy. There appear to be some variation within the Bay of Fundy (variability of about 13 mm between the areas). Compared to earlier estimates, the size at maturity in the Bay of Fundy appears to have decreased.

Maturity criteria validation is still important. For example, there is a need to ensure identification of sperm plugs to ensure that mating has occurred.

Other considerations:

- Mature berried females may spawn again in some areas
- Mating success
- Would mating be occurring at different times
- Need a minimum of three years to have sufficient confidence in SOM estimates

Discussion

Temperature is an important factor in size at maturity, and the water (hence water temperature) is expected to be well mixed in the Bay of Fundy. Given the variability observed in the SOM, there must be some other factor involved. Perhaps mating failure is contributing to the variability in the SOM (role of males to be considered). Passamaquoddy Bay may be a "hang-out" for males, where females that have failed in mating may go to find a male. When these females are sampled, more false immature records are obtained. This hypothesis has not been tested or verified. Successful females may go offshore.

SIZE AT MATURITY STUDIES AND REPRODUCTIVE INDICES (LFAS 35-38)

Presentation by: J. Gaudette

Rapporteur: T. Worcester

Presentation Highlights

Lobster is the most valuable species in the Maritimes region, and a collapse would be catastrophic. Potential for lobster overfishing is an ongoing concern. For example, the Fisheries Research Conservation Council (FRCC) reports in 1995 and 2007 expressed concerns about high exploitation rates, the gap between minimum legal size and size at 50% maturity, eggs per recruit, etc. However, landings, recruitment and catch rates are all at highest levels seen. The main objective of this study is to develop egg production indices (potential and observed) to be able to compare to the past and then to track in the future.

Egg production potential is from spring sea sampling information, catch rates at size for non-ovigerous females, fecundity at size (from Campbell and Robinson 1983), and size at maturity estimates.

There has been a decrease in the size at maturity from 1978/79 to 2011. Estimates from North Head, seal cove and LFA 34 (GG 4A-2A) are available. There are also Grand Manan estimates for Dipper Harbour and Alma.

Observed egg production is the catch rate at size times the fecundity. In the Bay of Fundy, there is an increase in potential egg production but a decrease in the observed egg production in Alma, Dipper Harbour, and North Head. In Seal Cove, there are increases in both potential egg production and observed egg production. In LFA 34, there is a similar discrepancy between potential and observed egg production.

A downward shift (i.e., to lower sizes) is observed in the size contribution for potential egg production, but this is not always seen in the observed egg production.

Summary

There has been an increase in reproductive potential in the Bay of Fundy with the increased abundance of small females and a shift in SOM. However, there has been a decrease in the contribution of medium and large females. There has been a slight decline in LFA 34, with divergence between the potential and observed production. This may be related to the role of immature females in mating. This has been observed previously but its implications have not previously been accounted for. In the past, it was assumed that mature females mature at 100% and immature mated at 0%. This might not be the case. There are no fitness benefits in mating with immature females. Males seem unable to assess the maturity status of females accurately, but they will mate preferentially with large females. So, male mating choice is

playing a role in why small mature females are not contributing as much to reproduction as expected.

In North Head, potential and observed egg production matched historically. More recently, there is not as good a match, particularly for the medium sizes. There may be a lack of large males here. A lower mating rate is observed (88% now compared to 100%). The proportion of ovigerous females is lower for the recent years versus historically. There might be saturation of the mating grounds, which means that competition for shelter might increase and the opportunities for mating may decrease. Mate selection choice may be density-dependent, but there is not much literature on this.

The current reproductive status of lobster is a source of concern. No major increase in egg production was observed in spite of a substantial increase in population abundance. Small females have lower reproductive success. Sperm limitation may be a limiting factor to egg production. There are signs of a slow decline in the large broodstock in many regions. This reinforces the importance of the large animals for reproduction. Steps should be taken to rebuild the large broodstock.

Discussion

In the SOM calculation, the large females were excluded to get rid of false immatures. These do not seem to have been removed in this analysis.

Smaller females carry a smaller clutch, so they would contribute less to reproduction just from that.

Have you looked at survival of eggs from small females versus large females? Multiparous females (sometimes larger) tend to have better egg quality.

There is some work being done on senescence in the U.S.

Increasing the minimum legal size will not have an immediate impact on the egg production. Egg production is mostly coming from the larger females (above SOM). We should not rely on the small females.

Is there a difference in the catchabilty in the smaller females and the larger berried females? There may be some behavioural differences.

When a cod is in poor condition, it absorbs the eggs. Do lobster do this? This has been proposed as an experiment. They may still spawn but the eggs would not be fertilized.

Observed egg production is based on sea sampling. Differences between observed and potential egg production could just be that the observed sampling is not representative or sufficient. However, it is known that these processes are happening based on dissections.

Fecundity data is a definite source of uncertainty.

SOM may be a good indicator of stock health, but it is not clear that there is enough data to monitor this.

This is nice work that shows that the larger females are even more important than we previously thought. However, we need to be careful with what we conclude from this (e.g., how the mating system works is mostly conjecture).

Protecting large animals (v-notching, windows) may be more effective than increasing minimum legal size. Evidence for a male shortage or its role in this issue is unclear. Minimum legal size has implications for density dependence.

There are competing interactions that need to be taken into consideration, e.g., do large females/males also have larger territories that they defend, and does egg production lead to a pelagic fish predation response. Given the good condition of the lobster fishery now, it is important to continue to support the things that have worked well to date.

Even if egg production is increased, you cannot ensure that this will lead to increased recruitment. However, it's like insurance.

Is there a percentage of females that are carrying unfertilized eggs? We suspect so, in the fall.

How can you tell that they are unfertilized? We would need to look at them in the lab.

EVALUATION OF FISHERY INDEPENDENT SURVEYS

Presentation by: D. Pezzack

Rapporteur: T. Worcester

Presentation Highlights

There are lots of reasons to work towards some fishery-independent metrics of stock status. There are three groups of surveys that might provide information on stock status: the July RV survey, the ITQ survey (covering somewhat shallower areas), and the scallop surveys. All have been recording lobster information to some extent.

The objective of this work is to define areas covered by each survey, determine whether indicators of abundance could be generated from these, compare them with existing indicators, and, if useful, determine whether reference points can be defined.

The DFO RV survey shows a change (increase) in lobster abundance/distribution over time. A dramatic increase has also been seen in the proportion of sets with lobster since 1996. This is consistent with the trend in landings. Mean number per tow could also be used as an index. The trend in this index is not exactly the same, but an increase is observed in recent years. Another potential indictor is the mean number per tow for the Eastern Gulf of Maine. This area seems closer to the Bay of Fundy index than the LFA 34 index, especially in the 1980s. It is not clear why a different pattern is seen here, though it could be related to lack of RV survey coverage in the shallower nearshore areas. Increases may have been occurring here.

Despite the fact that the RV survey covers more of the offshore area, rather than the shallow areas where the bulk of the fishery occurs, it is still considered a useful source of information. Indicators should include both mean number per tow and proportion of sets with lobster as context.

The ITQ survey goes more inshore and covers a wider area. Where surveys overlap, similar catch rates are obtained. In the shallow portions of the ITQ survey, much higher catch rates are obtained. Increases are being seen in the ITQ survey in nearshore areas where landings are relatively flat. If you break out the legals and sublegals in the survey, similar patterns are observed.

The scallop survey does not cover all the fishing grounds. The relationship between the scallop survey mean number per tow versus landings for the various grid groups was shown. Increases have been observed in all areas in recent years. There is a very short time series in the Bay of Fundy with a longer time series for LFA 34. This may be a useful secondary indicator.

Sources of uncertainty include gear selectivity, lobster recruitment, lobster distribution, and water temperature.

Size information from the surveys indicates that the different surveys are monitoring slightly different components of the population. Changes in median size and size frequencies can be investigated. The scallop survey can pick up smaller lobster. All surveys show the drop in size frequency after the fishing season.

Discussion

RV Survey Indices

Draggers historically caught lobster and brought them into North Head. However, these would be using different gear, at different times, for longer times. They are not going to provide the same picture as the DFO RV survey.

There are only a few places where the fishery impedes the access of the DFO RV survey.

There was some discussion of recruitment within the Bay of Fundy and how it tends to remain there.

The various changes in DFO RV vessels used is not too important for its used as a lobster index. 2004 had a problem related to the net used.

Concern was expressed that the proportion of sets with lobster would not be sensitive at very high or low levels (especially if the saturation point is reached).

ITQ Indices

There may be other factors coming into play in the ITQ nearshore results. It may also be too small an area.

The ITQ survey could be expanded to cover a larger area. The ITQ survey does show a trend in the Bay of Fundy (shows an increase).

For the ITQ survey, it might not be useful to look at the proportions in the sets.

There is not a great future for the funding of the ITQ survey due to changes in Larocque. It may not be available in the future. If it is done, it may focus on the nearshore areas.

Scallop Survey Indices

The scallop survey might not be long enough time series in the Bay of Fundy to be useful. A text description may be more useful.

Do you have information on size/maturity from the scallop survey? Yes, there is size information and information on ovigerous females.

Size

Fishermen now bring a gauge on board because they are close to the size limit.

Other

Industry feels that the out of season trap survey was more useful for determining trends when it was done. However, it might not be feasible. It is a data poor situation in the Bay of Fundy. Other types of surveys might be possible to pursue.

There are issues with soft-shelled lobster and questions that we cannot answer with the trap survey. For example, the trawl survey may be better able to address questions about the diet of lobster. However, it would be hard to do diet studies without killing the lobster (perhaps extract the stomach contents with a syringe).

Recommendations

Report on the July RV survey mean number per tow (primary indicator) and proportion of sets with lobster (secondary indicator) for LFA 35-38 within the Science Advisory Report.

Report on the July RV survey mean number per tow (primary indicator), the proportion of sets with lobster (secondary indicator) for LFA 34, and the ITQ survey mean number per tow (primary indicator) within the Science Advisory Report. Include text on the trends in the scallop survey as supporting information.

FISHING PRESSURE

Presentation by: J. Tremblay

Rapporteur: T. Worcester

Presentation Highlights

Ideally, the assessment would be conducted using the lobster population model developed in Maine, which would provide estimates of exploitation. However, not all the required data is available to do this yet. In addition the model needs to be modified to fit Canadian seasons, sizes etc. Instead, the Continuous Change in Ratio (CCIR) method, which uses the daily within season rate of the proportion of legals to sublegals, is used to estimate exploitation. This method is not impacted by recruitment; however, it is a relative index and does not consider berried females or notched females. The exploitation rate will be higher than if females are considered. It represents an exploitation rate for the exploited population. For LFA 34, exploitation rates are in the order of 80-92%, with no increase from 2000-1. There is mixed evidence for increased exploitation in the nearshore in the last 10-12 years. LFA 34 generally has higher exploitation rates. LFA 35 has less data, so results for this area are less certain but suggest lower exploitation than in LFA 34 (along with other indicators). Current exploitation rates are unlikely to threaten the sustainability of lobster.

Length cohort analysis was done for males and females in LFA 34. Male estimates have high uncertainty. This analysis was not done for the Bay of Fundy. There is no indication from the length cohort analysis that exploitation rate has increased since 2000-2001. Exploitation rates were highest in the nearshore.

Yield per recruit estimates from analyses in the 1990s and early 2000s suggest that lowering exploitation would increase the yield of the population.

Discussion

Are these estimates based on what's caught? Inshore, catch is on smaller sizes in the fall. In the spring, larger lobster are seen.

Can you look at exploitation rates by size? CCIR only considers the first group above legal size.

It was clarified that this analysis is based on FSRS traps.

With these high exploitation rates, you would expect to see a skewed sex ratio in some areas. However, the distribution of females and males is not well mixed. There is sex segregation, with movement of females offshore; it is very patchy. There are not a lot of ovigerous females in LFA 34, but there are some hot spots.

Do see some changes in the offshore in sex ratio.

Some data indicate that males have been increasing.

Skew in the smaller animals would not be observed since they are new recruits.

It would be nice to do this analysis with the DFO RV survey data.

The exploitation rate in the Bay of Fundy is not well understood, as there just is not enough data. Either a bigger trap survey is required, or other methods will have to be employed. It was not possible to do modeling with the data available. Trapping is hard to do with resource limitations. It might be easier to convince DFO to go with an enhanced trawl survey.

How can you have 80-90% exploitation rate and then do a trap survey immediately afterwards that catches all kinds of lobsters? For example, the grey zone had a full fishery and another fishery was added, but fishermen were still able to take more.

The high exploitation rates are surprising.

Estimates are not available for Grand Manan, but it is probably different there.

The tightness of the error bars were questioned – either its great data or it is skewed a bit.

A fishing mortality of 80-90% does have the potential for some biological impacts in terms of changes in SOM and population characteristics. Strong selective effects are possible.

It is important to consider the possibility of density dependent effects in the yield per recruit.

Management Considerations

The lobster fishery has been doing things a certain way for a long time, and we need to make sure these measures stay in place if they seem to be working.

There are data collection issues, and issues with surveys and funding are a source of concern.

REFERENCE POINTS

Presentation by: J. Tremblay

Rapporteur: T. Worcester

Presentation Highlights

Landings based reference points were reviewed at a Maritimes Region peer review meeting in February 2012 (DFO 2012). Potential secondary indicators were also discussed at that meeting. At the current meeting, there are some proposals for new indices and upper stock reference points (USR). No lower stock reference points (LRP) are proposed at this time.

LFA 34

A commercial CPUE USR for LFA 34 is proposed based on the 70 or 80% of the median CPUE during the period 1998/99 to 2008/09, which does not include very high recent values.

In addition, a USR based on the ITQ survey number per tow (80% of the median for 1996-2009 period) is proposed.

CPUE of sublegals in FSRS traps (80% of median for the period 1999-2009) could be a potential back-up for the ITQ survey reference point in case it is not in place for some time.

LFA 35-38

A commercial CPUE USR for LFA 35-38 is proposed based on 65% of the median CPUE during the period 2006 to 2009, which does not include higher recent values. It uses a shorter time period as there is less data to base it on.

A reference point based on the RV survey mean number per tow (80% of the median for the 1985-2009 period) is proposed.

In all cases the proposed metric for comparison with the proposed reference points is the 3-year running mean (5-year was considered for the RV survey).

Discussion

LFA 34 CPUE

It was recommended that 80% of the median be used rather than 70% given that it's a 3-year running mean. It is important to be able to accommodate variability. Also, this is the DFO default value.

This current period may be anomalous, and it's possible that the ecosystem will go back to a previous state. If we believe that there has been a regime shift, we should state this and say that the reference points may need to be re-evaluated if conditions change.

Concern was expressed about a crash in the population due to something like a shell disease.

It was noted that lobster size structure is becoming truncated. The large broodstock (>100 mm) is declining, and egg production is going down. The population is limited by the reproductive output, so it may be useful to include a reference points for this.

It was clarified that a management response would be expected prior to reaching the upper stock reference point.

It is possible to recalculate the reference point every year to account for new data, which would mean becoming less conservative with time (if the population continues to grow), or we could recommend sticking with a set time period.

Is there another indicator that can be added related to size and spatial scale? It could be a secondary indicator that could be used to interpret the trend. Also, it would be useful to be able to describe the different patterns in nearshore, midshore and offshore.

It should be noted why no LRP has been proposed. The rationale is that the stock is so far from it at present, there is currently no biological basis to set one, and we would likely be re-evaluating the reference points anyway before it was reached.

LFA 35 CPUE

Some concern was expressed about how short a time period (4 years) the reference point is being based on. It will be hard to justify this. The shrimp reference point is based on a ten year period. Something else should be used to compare to it. If you have one reference point based on the short period and one based on a long period, they would need to be scaled relative to each other.

Participants were reminded that landings-based reference points already exists for lobster, though this is considered to be the least conservative approach.

LFA 34 ITQ Survey

It was recommended that this index be included for now. However, concerns about the future of the survey were noted. It was suggested that a note related to the use of the ITQ survey be included within the "Management Considerations" portion of the Science Advisory Report.

LFA 35-38 RV Survey

Is sampling relatively consistent over time? The number of sets has been going up since 2005/06. Before that, the Bay of Fundy strata had 15 sets per year; now it is > 20 sets.

It may be better to keep the 3-year running mean since it provides more opportunity to respond. If you hit the reference point 2 years in a row, you would want to be able to respond.

It was clarified that this index includes legal and sublegal lobsters.

It was asked why an index based on mean numbers was being proposed rather than one based on mean weight, as mean weight might be a better indicator of broodstock. The response was that they provide a similar signal, but catching small lobsters impacts the mean weight index more than a mean number index. It was suggested that small lobsters could be excluded from the index.

It was recommended that a secondary indicator looking just at the larger lobsters be considered. Alternatively, there could be indices for under legal sized and above legal sized lobsters.

General

Temperature may play a role in setting reference points.

These fishery independent reference points are more cautionary than the landings-based reference point.

Scaling of these indices relative to each other would be difficult. Indices are not comparable if they are based on a productivity period versus a longer time period.

ECOSYSTEM CONSIDERATIONS

PREDATION AND FISHERY FOOTPRINT

Presentation by: J. Tremblay

Rapporteur: T. Worcester

Presentation Highlights

Wolffish, cod, cusk, haddock, longhorn sculpin, sea raven, spiny dogfish, and white hake are considered to be predators of lobster based on stomach content analysis.

For LFA 34, a very small fishery footprint was calculated (using size of trap) of less than 0.2% of the area. The footprint in the Bay of Fundy is expected to be less than this.

Discussion

While haddock shows an increase in population size, a lot of inshore ground would not be subject to this increase, and haddock typically eat adults/individuals. Predation on pelagic forms may have a greater impact (eating potentially greater numbers). People often attribute the increase in lobster stocks to the lack of cod, but not many people think about the impact of reductions in mackerel.

Lobster larvae are not dense compared to other plankton that are out there.

There has not been much research on the pelagic predation of lobster.

Settlement rates in Gulf of St Lawrence and Maine were quite similar, but the performance of the fishery is quite different. The leads to an assumption that post-settlement mortality is a bigger factor.

Are there other species that we do not have enough information on? Nearshore species include cunners and longhorm sculpin. There is ITQ survey information on these, but it may not look different from the DFO RV survey results. Perhaps the Nova Scotia coastal Ecosystem Overview and Assessment Report (Bundy et al. 2014) would to provide a better sense of coastal community composition.

Long-horn sculpin are considered by some to be the main culprit.

BYCATCH

Presentation by: D. Pezzack

Rapporteur: T. Worcester

Presentation Highlights

Incidental catch in the lobster fishery has been evaluated to help estimate the total removals of lobster and the removals of other species (such as species at risk). This information can aid in rebuilding plans for these species, or it can be used in assessment and ecosystem models. It is also required for third party evaluation of fisheries.

Most species at risk sampling was focused in LFA 34, but other areas were covered to a lesser extent. The ratio estimator method was used to evaluate incidental catch, where bycatch equals the lobster landings times the observed bycatch over observed kept lobster. It is reported by kg/trap haul, as requested.

Discards include hermit crabs, sculpins, cusk, cod, ocean pout, spotted and striped wolffish, flounders, haddock, skates, monkfish. Retained species include rock crab, Jonah crab, (green crab), and sculpin/sea raven. The majority of discards are Jonah crab.

Seasonal differences in bycatch rates were also assessed, with weighting depending on where and when they were located. Discard survival/mortality was not accounted for in this analysis.

Additional sea sampling would be required to complete a more thorough assessment.

Discussion

Observers are supposed to have changed the minimum 1 kg reporting, but some records still include this value. The number caught field may be of some use in dealing with this issue.

Do not spend too much effort on this for hermit crabs as it is not a species of concern.

There was some concern that cusk might be overestimated based on use of hard bottom. Since a Recovery Potential Assessment is being conducted this year, the information available from the lobster fishery would likely be re-evaluated during this process. Weighting could be investigated (to expand observer rates to the whole fishery).

It was clarified that the analysis was done by grid group and by season.

Survival of cod and cusk will need to be taken into account. Cod might live if you do not cut them up.

This bycatch of Jonah crab is half the quota in the offshore fishery. Concerns were expressed about how this would be reported (depends on use).

In LFA 34, non-retained catch is 4.2%.

In terms of lobster discards, there are high lobster discards in some areas and periods of the year, which could be a concern. Tagging studies have shown high survival of discarded lobster, but discard mortality is not zero. Discard rates are highest in LFA 27 (more than retained), for LFA 34, the discard rate is 70%, mostly sublegal lobster with a small percentage of berried females. This raises question about whether the vent being used is the right vent on the trap. There are a lot of people that use more than 1 vent. They are factory made at 127 mm. If the vent is too short, lobster cannot go sidewise. Video footage shows the lobster exiting sidewise. Some have suggested using a longer (225 mm) vent, but a narrower vent can still be used.

There may be trap mortality that is not account for in the post-release mortality studies.

Winter temperatures / summer temperatures may play a role.

Seals can follow boats.

Add “population scale” impacts to species of concern.

This analysis does not address the issue of entanglement for turtles and right whales.

It is not possible to make a lobster trap or hook that does not catch a fish.

SUMMARY AND CONCLUSIONS

SUMMARY OF DAY ONE

D. Herbert provided an overview of the recent temperature regime of the Maritimes Region, focusing on the relationship between the NAO and subsequent water temperatures. In the past, the NAO has been considered a potential predictor of temperature in the following 2+ years, with a low NAO often resulting in lower temperatures on the southwest Scotian Shelf and Bay of Fundy. However, a very low 2010 NAO index resulted in very warm 2012 temperatures throughout the region and throughout the water column (up to 2 degrees higher than average in some places). The reason for this anomaly is not clear but may be related to a geographic shift in NAO pressure differential (leading to a change in the water masses influencing the region). 2012 had a high NAO. Based on previous patterns, might expect to continue to see warmer than average waters in LFA 34-38 in the next few years. In terms of longer term trends in temperature, in the Bay of Fundy, see a slightly increasing trend that may be significant, but the Halifax station indicates no long term trend in temperature. It was suggested that this type of contextual information might be useful as an Ecosystem Consideration or a Source of Uncertainty in the SAR. Ashton requested that this presentation be provided to the Lobster Advisory Council and others within industry.

J. Tremblay presented indicators of fishery performance. Total landings and landings in most areas (except GG 2A in LFA 34, where there has been a reduction in effort) have been increasing and are at an all-time high. Effort has increased in the Bay of Fundy but not in LFA 34 (average days fished has decreased slightly). In LFA 34, there has been a shift in fishing effort further offshore. Fishery CPUE has also increased in all areas (except GG 6-7). There appears to have been a decline in the commercial catch in the median female size and larger females from some inshore/midshore areas of LFA 34, and in LFAs 35-36. It was suggested that evidence for the shift in effort distribution could be further validated through additional analysis of movement between grids. However, fishermen’s observations and explanations are consistent with the science results that indicate an offshore shift and increasing effort in some areas. It was also suggested that the 2012 results should be compared to the last assessment for reference (rather than some earlier period). Ecosystem Management should be encouraged

to include a map showing kg/trap haul, since this would be consistent with how the assessment is provided.

M. Cassista-Da Ross provided a summary of the CPUE analyses using FSRS standard traps, including a GAMM model index and a temperature-corrected index, which are proposed as sublegal indices of abundance. LFAs 34 and 35 showed an increasing trend in the last few years (except GG1). The temperature corrected CPUE also showed an increase, but not as great. Catch rates were higher in LFA 35 than LFA 34. There is greater confidence in the LFA 34 results.

A. Silva provided an update on the work to estimate size at maturity throughout the region. A regional comparison of the 2011 results suggest that size at maturity increases from north to south, with highest values and surprising variability (13 mm) in the Bay of Fundy. Compared to earlier estimates, size at maturity appears to have decreased. J. Gaudette noted that temperature is expected to play a large role in the size at maturity, but given the variability observed in the Bay of Fundy, other factors may also be playing a role in the apparent change.

J. Gaudette discussed the current status of egg production indices (potential and observed). Unexpectedly, while there have been increases in the estimates of potential egg production in the Bay of Fundy, the estimates of observed egg production have decreased in most areas (except Seal Cove). This is potentially related to the increasing contribution of smaller females to the potential egg production, which is not supported by the observed egg production. The current hypothesis is that male mate selection may be limiting the role of the smaller females. Other hypotheses include lack of males (sperm limitation) or habitat saturation. Management implications are that large females may be playing a greater role in egg production than previously thought. Protection of large females may help to protect egg production but may also have other implications. Also, increasing the minimum legal size would not be expected to have an immediate impact on egg production, as current production may already be coming primarily from the larger females.

D. Pezzack reported on indices generated from fishery-independent surveys. The mean number per tow from the July RV survey (which covers more offshore areas), the ITQ survey (which covers more inshore areas), and the scallop survey (with patchy nearshore distribution) have all increased in recent years for LFAs 34-38, though in slightly different ways. The proportion of RV survey sets with lobsters has also increased since 1996. The ITQ survey shows higher catch rates in nearshore areas than offshore areas, and increasing catch rates in some areas with relatively stable landings (supporting suggestion that landings reflect reductions in effort rather than trends in abundance); this may be more useful for LFA 34. Finer resolution size information is also available from these surveys but has not been fully analyzed for use in this assessment. Potential issues with these indices were identified, including potential for saturation in the proportion of sets with lobster (at high abundance) and lack of sensitivity at lower abundance, future of the ITQ survey, as well as concerns with the limited coverage (and temporal duration) of the scallop survey. It was noted that some other surveys (e.g., diving surveys) have been dropped.

SUMMARY OF DAY TWO

Acceptance of the Working Papers

All working papers were accepted in principle with revisions suggested.

It was suggested that:

- Size information be added to the Fishery Independent Research Document.

- The fishery footprint analysis should be to the Assessment Research Document.
- Contextual/biological/stock assessment unit information be included in the Assessment Research Document. While there was concern with including it due to length, the last time this information would have been published was 5 years ago.
- Include additional information in the regulation table (e.g., changes in the number of licenses).

Additional comments on the working papers are to be provided to the authors within a month.

All five Research Documents are to be submitted within 2013.

Interim Reporting Procedures

Multi-year Assessment

A 5-year assessment cycle is proposed. It is also proposed that "Update Reports" be provided every year. The approximate timing of the updates still needs to be determined.

It is Canadian Science Advisory Secretariat policy that Update Reports use the Science Special Response format.

The Update Report should report on agreed to indices (landings, commercial CPUE, RV survey, ITQ survey) and lobster status relative to any reference points. Text and figures should be provided that describe the current year results in relation to the reference points, where applicable.

It was suggested that, until they are better understood, reference points should be reported for information only (as opposed to being adopted for management purposes).

It was noted that there may be a one year lag in the landings or survey results; however, the previous season information would be available.

Updates could be presented at the winter Advisory Committee meeting in March/April.

REVIEW OF SCIENCE ADVISORY REPORT

CONTEXT

Include new CSAS sentences.

SUMMARY BULLETS

May need to reduce text.

BACKGROUND

Reduce text on Stock Assessment Unit (rationale). Stick to the conclusion of the framework.

ASSESSMENT

Find a standardized grid group naming approach. Provide a map showing more of the divisions (shade one that's there).

OTHER CONSIDERATIONS

Concerns with the ITQ survey as a basis for an index.

Discard rate concerns.

REFERENCES

Bundy, A., Themelis, D., Sperl, J. and den Heyer, N. 2014. Inshore Scotian Shelf Ecosystem Overview Report: Status and Trends. DFO Can. Sci. Advis. Sec. Res. Doc. 2014/065.

Campbell, A., and D.G. Robinson. 1983. Reproductive Potential of Three American Lobster (*Homarus americanus*) Stocks in the Canadian Maritimes. Can. J. Fish. Aquat. Sci. 40(11): 1958-1967.

DFO. 2013. Proceedings of a Maritimes Science Peer Review of the Framework for Lobster Fishing Areas (LFAs) 34-38 Lobster (*Homarus americanus*); July 10-12, 2012. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2013/035.

DFO. 2012. Reference Points Consistent with the Precautionary Approach for a Variety of Stocks in the Maritimes Region. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2012/035.

APPENDICES

APPENDIX 1. LIST OF PARTICIPANTS

Review of Framework and Assessment for LFA 34-38 Lobster Stocks:
Part 2 – Assessment

12-14 February 2013

Lewis King Boardroom
Dartmouth, Nova Scotia

Chair: Tana Worcester

ATTENDEES

Participant	Affiliation
Cassista-Da Ros, Manon	DFO Maritimes / Population Ecology
Denton, Cheryl	DFO Maritimes / Population Ecology
Gaudette, Julien	DFO Maritimes / Population Ecology (SABS)
Hardie, David	DFO Maritimes / Population Ecology
London, Evelyn	Oromocto First Nation (Wolamuktuk)
MacDonald, Carl	DFO Maritimes / Resource Management
Pezzack, Doug	DFO Maritimes / Population Ecology
Rondeau, Amélie	DFO Gulf
Silva, Angelica	DFO Maritimes / Population Ecology
Sonnenberg, Klaus	Grand Manan Fishermen's Assn. (GMFA)
Spinney, Ashton	LFA 34 Mgmt. Board / Lobster Advisory Council
Stone, Heath	DFO Maritimes / Population Ecology (SABS)
Tremblay, John	DFO Maritimes / Population Ecology
Worcester, Tana (Chair)	DFO Maritimes / Centre for Science Advice

APPENDIX 2. TERMS OF REFERENCE

REVIEW OF FRAMEWORK AND ASSESSMENT FOR LFA 34-38 LOBSTER STOCKS

Regional Peer Review - Maritimes Region

Part 1 – Framework Review: July 10-12, 2012 (Digby, NS)

Part 2 – Assessment: February 12-14, 2013 (Dartmouth, NS)

Chairperson: Tana Worcester

Context

The landed value of the lobster fishery in Atlantic Canada ($396 million in 2010) is the highest of any fishery in Canada. Landings in Lobster Fishing Areas (LFAs) 34-38 (Gulf of Maine and the Bay of Fundy) comprise a significant portion of the Atlantic Canada total (44% in 2010). Landings in LFAs 34-38 are currently near all-time highs.

The status of the lobster resources in LFA 34 was last assessed in 2006; LFAs 35-38 were last assessed in 2007. DFO's Fisheries and Aquaculture Management has requested updated information on the status of the LFA 34-38 lobster stocks.

This assessment updates the indicators recommended in the 2006 and 2007 assessments, and builds on what was learned in recent assessments of LFA 41 and LFAs 27-33. In addition, some new fishery-independent indicators will be evaluated.

Current reference points for all of LFAs 27-38 are based on using landings as a proxy for abundance. Some alternatives to landings-based reference points will be evaluated.

Objectives

Part 1 – Framework Review

- Describe basis of the management units in context of stock structure.

- Identify strengths and weaknesses of fishery and survey data inputs for providing indicators of abundance, size structure, recruitment, effort, and spatial distribution of catch using:
    - Port and at sea sampling protocols
    - Observer sampling
    - Logbooks
    - Fishermen and Scientists Research Society (FSRS) information
    - Trawl survey data
    - Out of season trap surveys
    - Data on young-of-the-year (settlement)

- Present preliminary analyses of indicators of the following characteristics to assess whether changes have occurred in the last decade:
    - Fishery performance (landings, unstandardized CPUE, effort)
    - Abundance (legal sizes) (CPUE; available fishery independent)
    - Abundance of prerecruits and settlers (CPUE; available fishery independent)
    - Reproduction (spawners, egg production proxies)
    - Fishing Pressure (effort quantity and spatial distribution, exploitation estimates from

change-in-ratio; size-based)

- Review relevant biological and ecological information:
  - Life history, molting, recruitment, etc.
  - Present preliminary results of size at maturity studies: LFA 34, LFA 38
  - Incidental catch; fishery footprint
  - Environmental data, e.g., temperature

- Present rationale for current landings-based reference points; present potential alternative.

- Develop assessment schedule, including guidelines for the monitoring of the indicators and other events that would trigger earlier than scheduled assessment.

Part 2 – Assessment

- Address key issues identified during Part 1.

- Assess the stock status of the LFA 34-38 lobster stocks as of the end of the 2011-2012 seasons:
  - Report indicator trends.
  - Estimate relative exploitation rates over the last 10 years and evaluate the consequences of maintaining the current harvest levels.
  - Evaluate stocks status in relation to landings-based reference points and any new reference points identified in Part 1.

- Estimate the level of incidental catch (including lobster) and the retention of non-lobster species, and report on information available on the survival of discarded species.

- Provide implications for fishery management of the current estimates of the 50% size at onset of maturity for females, and other indicators of stock reproduction.

Expected Publications

- Proceedings
- Research Document(s)
- Science Advisory Report

Participation

- DFO Science and Resource Management
- Provincial representatives
- Fishing Industry
- Aboriginal communities/organizations
- Other invited experts

References

DFO, 2006. Framework Assessment for Lobster (Homarus americanus) in Lobster Fishing Area (LFA) 34. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2006/024.

DFO, 2007. Framework and Assessment Indicators for Lobster (Homarus americanus) in the Bay of Fundy, Lobster Fishing Areas (LFAs) 35, 36, and 38. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2007/037.

APPENDIX 3. AGENDA

Review of Framework and Assessment for LFA 34-38 Lobster Stocks:
Part 2 – Assessment

12-14 February 2013

Lewis King Boardroom
Dartmouth, Nova Scotia

Chair: Tana Worcester

DRAFT AGENDA

12 February 2013 – Tuesday

9:00-9:30 Introduction and Background

9:30-10:00 Temperature Regime

10:00-10:45 Fishery Performance

10:45-11:00 Break

11:00-11:30 Catch Rate from Standard Traps

11:30-12:30 Size at Maturity Studies and Reproductive Index

12:30-1:45 Lunch (not provided)

1:45-2:30 Size at Maturity Studies and Reproductive Index (continued)

2:30-3:15 Abundance Indicators – Fishery Independent

3:15-3:30 Break

3:30-4:45 Abundance Indicators (continued) and Fishing Pressure

13 February 2013 – Wednesday

9:00-9:15 Review of Previous Day

9:15-10:15 Reference Points

10:15-10:30 Break

10:30-11:30 Ecosystem Considerations

11:30-12:00 Interim Reporting Procedures

12:00-1:15 Lunch

1:15-3:15 Review of Science Advisory Reports

3:15-3:30 Break

3:30-4:30 Review of Science Advisory Reports

14 February 2013 – Thursday

9:00-10:15 Review of Science Advisory Reports

10:15-10:30 Break

10:30-11:30 Review of Science Advisory Reports

11:30- 12:00 Concluding Remarks