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Canadian Science Advisory Secretariat (CSAS)

Proceedings Series 2013/035

Maritimes Region

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

July 10-12, 2012

Digby, NS

Tana Worcester: Chairperson

Tana Worcester: Editor

Bedford Institute of Oceanography
Fisheries and Oceans Canada
PO Box 1006, 1 Challenger Driver
Dartmouth, Nova Scotia B2Y 4A2

October 2013

Canada

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.

Published by:

Fisheries and Oceans Canada
Canadian Science Advisory Secretariat
200 Kent Street
Ottawa ON K1A 0E6

http://www.dfo-mpo.gc.ca/csas-sccs/
csas-sccs@dfo-mpo.gc.ca

ISSN 1701-1280

Correct citation for this publication:

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.

TABLE OF CONTENTS

SUMMARY

Maritimes Regional Peer Review of the Framework for Lobster Fishing Areas (LFA) 34-38 was held on July 10-12, 2012, in Digby, Nova Scotia. Participation in this meeting included Fisheries and Oceans Canada (DFO), the province of New Brunswick, academics, non-governmental organizations, aboriginal organizations and communities, and the lobster fishing industry. The results of this meeting will be used to support management decisions related to the LFA 34 lobster fishery for the next few years.

Compte rendu de l’examen scientifique par les pairs de la région des Maritimes du cadre relatif aux zones de pêche du homard (*Homarus americanus*) 34 à 38

SOMMAIRE

L'examen régional par les pairs de la région des Maritimes du cadre relatif aux zones de pêche du homard (ZPH) 34 à 38 a eu lieu du 10 au 12 juillet 2012 à Digby, en Nouvelle-Écosse. Les participants à cette réunion comprenaient Pêches et Océans Canada (MPO), la province du Nouveau-Brunswick, des universitaires, des organisations non gouvernementales, des organisations et des communautés autochtones et l'industrie de la pêche au homard. Les résultats de cette réunion serviront à appuyer les décisions de gestion concernant la pêche au homard dans la ZPH 34 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 Framework for Lobster in Lobster Fishing Areas (LFAs) 34-38.

As mentioned in the Terms of Reference (Appendix 1) for the meeting, LFA 34 lobster was last assessed in 2006 and LFAs 35-38 were assessed in 2007. Since that time, assessment frameworks have been developed for LFAs 27-33 and LFA 41. In addition, landings-based reference points have been developed for lobster in the Maritimes Region. The purpose of this meeting is that DFO Resource Management has asked for an assessment of the lobster resource in LFAs 34-38, and there is a need to review the assessment framework prior to completing this assessment. The LFA 34-38 assessment will be conducted sometime in February 2013.

The DFO Science peer-review process is meant to be an open, transparent, and inclusive process, so participants (Appendix 2) 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 Agenda (Appendix 3) was reviewed, and nothing further was added.

Discussion

A question was asked about how sources of mortality other than lobster fishing, such as impacts of aquaculture, would be addressed within the framework. It was not clear to the participant why these other sources of impact were not typically considered within a stock assessment. It was suggested that the scale of analysis required to assess impacts of aquaculture and impacts of stock status were quite different. Data availability to address these finer resolution questions is often a challenge.

LOBSTER FISHING AREA 34-38 ASSESSMENT FRAMEWORK

BACKGROUND

J. Tremblay presented bullets from the previous LFAs 34 and 35-38 assessment to remind participants of how the assessment had been conducted in the past. For the upcoming assessment, there was expected to be increased reliance on available data from commercial logs and from the Fishermen and Scientist Research Society (FSRS) lobster program, data from trawl surveys which record lobsters in the catch, and improved statistical models of catch rate as an index of abundance.

BIOLOGICAL INFORMATION

D. Pezzack presented information on lobster distribution. American lobster (*Homarus americanus*) are bounded by cold temperatures to the north and warm temperatures in the south, with the Gulf of Maine as the core of lobster distribution. There is a diversity of lobster habitat types in this region. There is high mortality of lobster at the settlement stage (primarily natural mortality), as well as going from immature and mature lobster (primarily fishing mortality).

While the moult usually occurs in late summer/early fall, the timing of moulting may be changing within the region, as recently some signs of moulting has been observed as early as May. The

rate of growth of both sizes declines with size, but in females it declines to a greater extent once they reach maturity as they put energy into egg production. Lobster have a 2-year reproductive cycle, and they mate in the summer. Once females become mature and bear eggs, they are protected from the fishery every other year.

Mature lobster appear to move more than immature lobster, with large ones moving more than small. They move to deeper water in the fall and move to shallow water in the spring. However, movement patterns can be site specific. Reasons for migration may be related to temperature optimization, to avoid winter storms and ice, for mating and egg hatching locations, or feeding. Lobster appear to have a great range of movement in the Bay of Fundy.

Lobsters feed on live fish, eggs, shellfish (scallops, mussels, clams, gastropods), crabs, brittlestars, sea urchins, and worms. Lobster will also scavenge on dead organisms. Predators include sea birds, cunners and other small fish, crabs (small lobster), sculpin, skate, wolffish, sea bass, monkfish, and cod.

Discussion

Clarification was sought on the levels of mortality experienced by different life-history stages. Mortality is very high on the larval stages. If lobsters that have settled cannot find suitable habitat, then they experience higher mortality.

It was asked whether there has been a change observed in sexual maturity in the Bay of Fundy. Smaller berried lobster are being observed, but this will be discussed in more detail in the Size at Maturity section.

Seals were identified as a potential predator. There is no strong evidence of lobster predation by seals, but there is anecdotal evidence of seals being observed eating lobster. This may be an increasing concern given the increase in seal abundance. It was felt that lobsters may provide a food source for seals in bays that do not have a lot of fish biomass. Fisher Wayne Green collected grey and harbor seal stomachs from around Grand Manan in the late 1980s and early 1990s as part of a comprehensive study of seal diets in the Maritimes. Seal diet from this area was mostly pollock and squid, with no indication of lobster as prey. However, the diet of seals might have changed over time, or lobsters might be a secondary food source. There are some other older publications relevant to this topic, but they would not reflect any changes that have occurred now that lobster populations have increased and seals have increased. Lobsters are also found in a small number of records in the Maritimes Region stomach database.

Anecdotally, juveniles have been observed aggregating, but the reason why they would do this is unknown. Lobster post-larvae prefer to settle on shelter providing substrates such as cobble. They remain on these kinds of substrate as juveniles. Reasons for aggregation of juveniles are unknown. There is some behavior that we do not understand.

MANAGEMENT UNIT / STOCK STRUCTURE

For definition of lobster stocks, the emphasis is on demographics, growth, and recruitment with some consideration of evolutionary aspects (genetics). It is proposed that LFAs 35-38 be considered as a single unit for stock assessment purposes. LFA 34 is large enough to be considered a separate self-sustaining unit.

The basis for this conclusion includes past morphometric studies, studies of movement patterns, biophysical models of larval drift, genetic studies, and landings patterns. Tagging studies in the Bay of Fundy indicates potential for movement throughout the bay. Kenchington et al. (2009) reports the results of a study done in 2002-2003 in which genetic information was taken from lobster eggs. This showed that, despite large-scale movements, there seems to be more

population structuring in the Gulf of Maine area. Larval drift studies using biophysical models (Incze et al. 2008, 2010) showed that there were typically 1-2 upstream zones that serve as sources for a downstream zone. The Upper Bay of Fundy appears to be the primary source of larvae for the Upper Bay of Fundy. A comparison of landings trends separates the Bay of Fundy (and Maine) from southern Nova Scotia. Lobster node studies will help to refine and elaborate on the above.

Discussion

A question was asked about the amount of migration that might be expected beyond the assessment area (outward flow). It was suggested that this could be in the order of 20-30% and would depend on the oceanography.

Some surprise was expressed about the results of the genetics information. It was suggested that this be looked at more carefully, given comparisons with populations in Newfoundland.

It was suggested that there should be some caution in making associations between LFAs based on landings. When lobster hit the eastern shore, they are observed at all sizes and appear all at once, which seems to suggest that they are coming from somewhere else. However, it was noted that this may be related to simultaneous changes in catchability. There was a small signal in the pre-recruits that indicated that there was an increase in recruitment to the fishery (but it was not as big as expected). It was noted that using landings patterns to distinguish areas identifies small differences in the timing of the changes. While the overall changes are similar, there are small differences that can be observed.

It was asked how sensitive the Bay of Fundy would be to toxicity (given the gyre within the Bay of Fundy) and whether hydrocarbons off the roads in Maine impact the Bay of Fundy. This question would have to be referred to contaminants experts and oceanographers.

It was noted that the Jonah crab fishery sometimes got tagged lobster from Maine. Also, a drifter deployed off the north end of German Bank went into the Bay of Fundy and stayed there. Larval drift was going north from there. It is unclear, however, if there is a gyre that takes larvae out of Lobster Bay. The important point is that each stock area is more likely to be more dependent on the other than expected.

It was noted that lobster larger than 60-70mm CL generally only moult once a year and mature sized lobsters only every 2-3 years). However, evidence is emerging of an earlier moulting in recent years. Lobsters are expected to be hard in the fall, so it has been suggested that soft ones being observed in the fall may be an indication of a second moult or it could just be indication of a more protracted moulting season.

There was a reminder that the lobster management units, which are not biologically based, would remain as they are. It is the biological basis for the stock area that is being discussed here.

For some purposes, it may be useful to consider LFA 34 as a separate stock. It may be useful to monitor the biological indices for this area separately from the other areas. Also, there may be data-related reasons to separate 34 from 35-38. However, movements in an out of LFA 34 still need to be taken into consideration. It was proposed by industry that movement could be tracked by banding lobsters with bands of different colours. Different people use different bands, and metal bands were used one year. Sources of this data and possible analysis could be explored further.

In general, it was felt that the proposed assessment units were appropriate; however, when describing the basis for this, it was felt that more emphasis should be placed on biological

information rather than on the cluster analysis of landings information. Landings information was considered useful to supplement the biological information.

There was concern that having too small an assessment unit would lead to unrealistic expectations about the ability of the fishery (or management) to respond to changes in the Precautionary Approach (PA) reference points for those units. The fishery has indicated that they would want a consistent management response across all the units.

It was agreed that the assessment will present fishery dependent data by LFA but present fishery independent information at a larger scale.

REFERENCE POINTS: CURRENT APPROACH

J. Tremblay presented a summary of work to date on development of PA reference points for lobster in the Maritimes Region, which has now been presented at a peer review meeting (May 2012) and is included in the current lobster Integrated Fisheries Management Plan (IFMP). To date, a Limit Reference Point (LRP) and Upper Stock Reference have been developed, as well as a Removal Reference (RR). No target biological reference point has been proposed. Reference points based on trends in landings have been proposed due to a lack of a working population model for this stock area. There is a lobster model that has been developed in the US, but the Maritimes Region currently does not have the people power to run it. Egg per recruit and other models have been used in the past and still have some application, but they are insensitive to changes in population abundance. In addition, there are no long-term fishery independent surveys conducted throughout LFAs 34-38. Reference Points based on landings are the best option at this time, especially since there is evidence that landings and population abundance are linked (Tremblay et al. 2012). However, other contextual indicators are required as trends in landings alone is not adequate to assess the status of the stock.

The reference period used to set the reference points was 1985-2009 (5 years more than in the 2011 IFMP). This includes a period earlier on with some lower landings. It is suggested that the current status be monitored using a 3-year running mean. Distinct Reference Points have been established for each LFA. Secondary indicators, which provide context for the primary indicator, will be discussed later. Target reference points could be based on higher productivity targets, on optimizing catch, or economics. Industry will have to lead on this.

Estimates of lobster exploitation are quite high compared to finfish fisheries, and they have remained high. This may be due to sound conservation measures and favourable conditions for lobster since the 1980s. There is limited evidence to suggest that the current high levels of exploitation are too high. There may be some concern if exploitation went substantially higher than it is now.

Discussion

Concern was expressed that something is being missed in this approach. It was felt that there has been a decline in lobster in certain inshore grounds in the Bay of Fundy that used to be productive. Fisheries are moving offshore. Every fishery in trouble got into trouble inshore first. Science missed the decline in four inshore fisheries.

It was suggested that a comparison of inshore and offshore landings trends (and between grids) might be helpful. This is possible for LFA 34 but, unfortunately, the current grid system does not capture the inshore/offshore difference in the Bay of Fundy. The grids are too big and are oriented the wrong way. To capture these trends, the grids would need to be redesigned.

It was suggested that an alternative explanation for the apparent reduction in lobster catch inshore was that lobsters were now being caught offshore before they had a chance to move inshore.

Other possible indicators might include lobster abundance from the multispecies Research Vessel (RV) survey. The Individual Transferable Quota (ITQ) survey is pretty short, but there information will be presented that it has some very useful data on lobsters for LFA 34 in particular.

It was asked how the status of the whole assessment area would be summarized using LFA independent reference points. It would be possible to add up all the landings for LFA 35-38 and then provide a reference point for the whole area.

There was concern about the impacts of the Gulf of Maine fishery on Canadian populations. However, it was noted that tagging studies do show that there are some distinctions in populations within the Gulf of Maine. It is possible to include information on the status of the adjacent populations as context for the assessment of LFAs 34-38.

Grand Manan is a special case because it's right on the border.

It was reiterated that what a fishery does in its management unit impacts its own future, and there are actions that can be taken here that can have an impact.

The goal is to never reach the reference points.

Recommendations

Add all of the landings for LFA 35-38 and provide a reference point for the whole area.

Track the status of the adjacent population.

DATA SOURCES

C. Denton presented information on the various data sources available.

Fishery dependent information includes:

- Landings and effort data
- At-sea sampling
- Port sampling

For LFA 34-38, there are historical records (1892-1946) available. Analysis indicated a 2-3% difference between the total weight sold and the estimated weight.

For LFA 34 there are data since 1998 from fishermen logs containing daily landings and effort by grid. In the Bay of Fundy this system came in later. The percentage of licences reporting is currently very high (>90%), and the licenses reporting valid grid locations is also very high.

At-sea sampling of the commercial catch has been conducted from the 1970s to present. In 2008-2010, special sampling was done with Species at Risk funding. In other years, sampling has been lower.

Port-sampling includes area fished, port landed, carapace length, and sex. It does not capture unlanded catch (berried females, etc.).

Fishery independent information includes:

- FSRS recruitment traps
- Scallop survey
- RV survey
- ITQ survey
- Out of season trapping
- Suction sampling

FSRS recruitment traps are being used to study changes in abundance of juvenile lobster. While there are no lobster-specific surveys conducted, other science surveys have been reviewed to determine their usefulness for assessment of lobster. The inshore scallop survey has been conducted since 1981 in the Bay of Fundy and expanded to Lurcher in 1991. Surveys were initiated in SFA 29 in 2001. The multispecies RV survey has been conducted since 1970, and lobster size data have been collected since 1999 (weights and numbers before that). The 4X portion of the July RV survey may be useful for this assessment. The ITQ survey has been conducted since 1996, with lobster sampling added since 2005. It covers more inshore areas than the RV survey.

Out of season trapping has been conducted in the Upper Bay of Fundy from 2009 to present, and in Grand Manan in 1980, 2000-2002, and 2011. Suction sampling via SCUBA diving has been used to measure annual settlement in Beaver Harbour for over 20 years. Lobster settlement collectors were placed in St. Mary's Bay, Lobster Bay, Port La Tour, Sambro, Canso, False Bay starting in 2007. R. Rochette (University of New Brunswick) has deployed collectors in the Bay of Fundy.

Discussion

It was asked why reporting levels are not 100%. It was felt that this may be related to partnerships (e.g. in LFA 38).

It was asked how valid grid numbers were determined. For a grid number to be valid, it only has to exist in the LFA. This does not provide an indication of misreporting within the grids. It is only meant to catch typos, missing numbers, and wrong grid numbers.

It was asked whether at-sea sampling in LFA 34 will continue. Not very much is being conducted now, and the focus is on the port sampling. It is not clear that four trips within an LFA are worth it. However, survey information can be used to support this -- need to ensure that the surveys match with the commercial sampling. There has also been some discussion of focused, rotational sampling (more intense sampling one year in one unit, then move more intense sampling to another unit). It was felt that at-sea sampling is worthwhile if there is funding to support it.

For the size structure of what's caught, get good information from the port sampling. However, do not get information on berried females.

It was asked what part of the ITQ survey the lobster team participates in. C. Denton goes on the ITQ for one day to hit the lobster hot spots. Javatech goes for another portion. The crew does some measurements.

DATA ANALYSIS: DATA FOR THE CATCH RATE (CPUE) ANALYSES

M. Cassista-Da Ros presented information on the FSRS traps and commercial logs, which are being used to prepare a catch per unit effort (CPUE) analysis. FSRS traps, including recruitment traps and commercial traps, are being analyzed from LFA 34 and 35. Catch is by a count of lobsters per trap haul. Effort is the number of fisherman days per week. There is reporting on size class (changed in 2003), whether a lobster is legal or sublegal, and berried females. Commercial logs are being analyzed for LFAs 34, 35, 36 and 38. Commercial catch is in weight per trap hauled. The number of days fished during a fishing season is comparable between FSRS recruit trap data and the commercial log data; however, only a small subset of licenses (<6%) participate in the FSRS data collection (slightly higher in LFA35). In LFA34, grid groups 2A and 2B were determined to be the most reliable to compare the datasets.

Discussion

Reporting of berried females at 20mm was questioned. This is what was reported, but it was not believed to be real.

A question was asked about the number of days per harvester, and why it does not appear to increase again after the closure. It was explained that a more gradual increase is observed.

DATA ANALYSIS: LOGBOOKS VERSUS AT-SEA SAMPLING (CATCH RATE)

J. Gaudette presented a preliminary analysis of the relationship between logbooks and at-sea sampling records for LFA 35. This showed significant correlation between logbooks and at-sea sampling, but at-sea sampling appears to be overestimating the catch rate as compared to the logbooks. This may be related to sample size in the at-sea analysis; however, even periods with good at-sea sampling still show overestimates. There was also correlation between at-sea sampling records and fishermen for one day of fishing. The relationship was better, but it is still overestimating commercial catch rate. Potential bias in at-sea sampling may include: bias towards sampling traps with high catch rates, missing empty traps, assumption that half the lobster in the 82mm size class are legal, and spatial disconnect between at-sea sampling and where most of fishing occurs. Commercial logbooks are pretty good overall (also based on analysis of sales slip versus logbooks). However, estimates of daily landings and number of trap hauled are too broad and/or variable among fishermen. However, it is better than when there is not good at-sea sampling intensity. This type of information is available from LFAs 34 and 35, where the coverage is quite good. The analysis has not been done for LFA 34 yet.

Discussion

It was asked whether it could be determined whether the at-sea sampling was overestimating the catch rate or the logbooks were underestimating the catch rate. It was clarified that statements such as “overestimating” was just in relation to the comparison of the two sources of information. The true value was not known.

One key source of error is how to evaluate whether a lobster is legal or not legal. It was unclear why the legal size was not used (i.e. why 82.5mm). It was noted that at-sea sampling sometimes counts 82.5 as 82mm.

The size at weight relationship is quite good and could be validated. It has not been looked at in a while, and it can vary over the season.

The number of trap hauls is well known.

It was asked what the importance of the boat estimate was in this analysis, recognizing that it’s just an estimate that can be influenced by things such as air temperature. It was clarified that only legal lobsters were used in the estimate. Typically, fishermen just count the number of crates and multiply by 1.3 (or some ratio), but it depends on where you fish. It was suggested that it would be interesting to do a comparison with G. Thompson’s estimates, as he weighs everything. If there was only a 70% correlation, this might provide an indication that something was wrong.

In LFA 34, it is not possible to relate the timing of the catch with the timing of when the catch is sold. It is possible to catch lobster in February and then sell them in March. Sales slips do not relate to fishing activity (in terms of timing).

It was noted that this analysis was based on the more intense Species at Risk sampling, which used a wide variety of samplers. With just DFO sampling, would hope to get a better match. However, the approach still uses length bins.

Recommendation

Suggest re-evaluating the weight-length relationship.

DATA ANALYSIS: FSRS VERSUS AT-SEA SAMPLING (LOBSTER SIZES)

D. Pezzack presented information on sizes of lobster obtained from FSRS traps as compared to at-sea sampling. Grid groups 1 and 2a were investigated for May 2008, December 2009, April 2009, and May 2009. In general, they provided consistent results in the legal size range. There was not such a good match (FSRS sizes shifted to smaller sizes) in May 2009. At smaller sizes, the FSRS traps were good at catching a wider range of undersize lobsters. At-sea sampling captured more lobsters above 110-120mm. Lobster >120mm carapace length (CL) were rarely caught in the FSRS traps and none were caught above 130mm.

Discussion

The out of season trap survey on Grand Manan used three different traps, so it may be possible to compare the catchability of those three traps types. A similar survey is being planned for 2012.

FSRS has fishermen recording daily sizes and sexes in commercial traps in a few areas. In LFA 33, there are three commercial traps being used by each participant.

It was noted that legal lobsters are often caught in the FSRS recruitment traps. However, their primary purpose is to track pre-recruits. It is good to know what is coming into the fishery. The benefit of the FSRS recruitment traps is that they are a standard trap that has not been modified in the last 12 years or so, and that they are fished in the same locations. It is an intended as an index. Recruitment traps do not have the same capacity as the commercial traps.

It was asked whether the FSRS traps were placed at fixed or variable locations. It is supposed to be fixed, and roughly 85% of fishermen place them in the same spot. This is different in the offshore, though. Most of the movement is offshore. Ideally, they stay in the same place. They do report when they move it. They are providing a lot of information that was not available before.

FSRS traps are mostly inshore, so they could be useful for aquaculture studies. They may be a source of data for this.

DATA ANALYSIS: SIZE AT MATURITY STUDIES (LFA 34)

A. Silva presented work to date on lobster size at maturity of relevance to LFA 34. Size at the onset of maturity is important for stock assessment. There is some historical data pre-1990s and 1983, 2008-2011 in Nova Scotia, and 2010-2011 in LFA 34. Size at maturity is a key metric of reproductive capacity, and spatial/temporal changes in size at maturity may indicate changes in environmental conditions or impacts of exploitation. The focus has been on females: mainly whether they are egg bearing, and whether cement glands in the pleopods indicate egg extrusion is imminent. Functional maturity is considered to be when females are berried, and physiological maturity is when the cement gland is at Stage 2.

A total of 4,644 female lobsters were sampled at two locations in Lobster Bay. Sampling took place during the spring to summer period of 2010 and 2011. Preliminary results on the maturity of legal-size and sub-legal size lobsters were as follows:

- Maturity of Legal Size lobsters
  - 27-34% were mature for Outer area
  - 16-22% were mature for Inner area

  - Cement gland (211) versus berried (229)
  - July 2011 some hatched eggs
  - August 2011 appearance of newly spawned eggs
- Maturity of sub-legal size lobsters:
  - 1-2% mature in Outer Area1-3% mature in Inner Area Cement gland (43) versus berried (3)

These results were then compared with other areas: Canso, Tangier, Port Mouton. Lobster Bay maturity was most similar to Port Mouton site.

Research plans are to verify cement gland results with ovaries or presence of sperm plug.

Discussion

Clarification was sought on why size at maturity was being reviewed. A size at maturity of 95mm (50% of females have reached maturity by the size) has been used for many years; however, it was unclear whether this had changed over time. Some areas did not have size at maturity estimates (like Lobster Bay). Also, more accurate estimates of size at maturity may be useful for an egg production index.

For a sustainable fishery, knowledge of the size (and ultimately age) of maturity is needed. Fishing pressure should be low enough to allow for individuals to reproduce before capture by the fishery. However, it would seem that the fishery is leaving a sufficient number of mature females or there would have been a crash in the population.

It was asked how, if you're using a different staging, the current maturity studies can be compared with those from before. It was clarified that the staging in not vastly different. Stage 3 is just a few weeks later than Stage 2.

It is believed that lobsters are maturing at a smaller size in response to change in temperature. There has been no long-term monitoring of this, but perhaps this should be a recommendation. It is possible that this may also be a fishing effect.

The biological, ecological and management implications of lobsters maturing earlier are not known. This is an additional research requirement.

There are at least two possible approaches to making use of this information in a management context: either make sure there is a gap between the legal size and the size at maturity, or use this within an egg production index to determine whether changes are warranted.

DATA ANALYSIS: SIZE AT MATURITY STUDIES (LFA 35-38)

J. Gaudette provided a summary of size at maturity studies for LFAs 35-38. Previous estimates:

- Grand Manan: 108mm CL (1982)
- Alma: 101mm CL (2001)
- FRCC: average of the two of 104.5mm CL (2007)
- Bay of Fundy estimate different from other LFAs

There was occurrence of sublegal berried female. The size at maturity (SOM) predicts that 0% of females at the minimum legal size (MLS) are mature. Has the SOM50% has changed over time.

Cement gland approach is good because you do not have to kill the animals (Campbell and Robinson 1982; Waddy's data from 1978-79, and 2011), but study of ovary condition is more reliable (Waddy unpublished data 1978-79).

Waddy 1978-79: SOM50% estimate = 99.9mm. There is a factor that is driving the shape of the ogive – very large lobsters that are not mature based on cement gland analysis. Do not believe these are really immature. An issue with false immature using the cement gland approach (28%). When excluding large immature lobsters in the analysis, ogives based on cement gland match well with the ovary ogives. With the corrected data, size-at-maturity estimates were much lower than Campbell and Robinson 1982. Differences in the time period (May June versus July-August), location (North Head versus Grand Manan vicinity) and cement gland development maturity (Stage-2 versus Stage-3) may have caused the discrepancy between the two estimates

Reasons for false immature females:

1) Different spawning cycles: biennial sampling, consecutive spawning, alternative-year spawning. Will affect sampling/results using the cement gland method. Not clear what proportion on the alternative year cycle.
2) Nemertean infestation can destroy an entire clutch.
3) Mating failure and sperm limitation: eggs from unmated mature females will detach. Will have no cement gland.

No matter if large immature are included in the size-at-maturity analysis or not, it seems like there has been a shift in size-at-maturity, as there has been a decrease of SOM50% from 99.6 to 92.5mm CL. The cause of the shift is not yet known.

Other regions where there are large immature females affecting the size-at-maturity ogive include: Passamaquoddy Bay (SOM50%: 119.3mm to 92mm), Deer Island (99.9 to 97.9mm), and Lobster Bay (100.4 to 97.5mm only excluding 3 of 1804 lobster).

There is evidence of mating failure. In Passamaquoddy, >102.5mm were all mated but in the 92.5-102.5mm range, 36% were not mated. In Deer island, a greater percentage (10%) of >102.5mm lobster were unmated. This will impact variability in the SOM estimates among regions. Sample size may also impact this variability. Temperature not considered to be a major factor in the variability.

Preliminary results indicate that size at maturity has decreased over the past three decades. The cause of the shift in SOM and mating rate is not known. Sperm limitation should be considered a possible constraint to egg production, and there is a need to keep an eye on the egg parasite and clutch quality.

Discussion

There was concern that changes in size structure might impact the SOM50% estimate. However, the method used should take this into account. There are problems with the results that are linked to this, but it is not directly related to the size structure.

The majority of lobsters in 1982 were from North Head.

It was asked why 102.5mm CL lobster were excluded from the analysis when the ogive predicts that there would still be 20% no mature at this size. The response was that the ogive is based on the full data set. They have too much of an impact to include them. It was clarified that only the immature ones were excluded.

One participant indicated that he'd heard reports of egg parasites this year ("small worms"). However, it was noted that the "glue" sometimes looks like worms if you do not know what to look for. Fishermen could be mistaking Stage 4 egg-development lobsters for worms.

A lot is still unknown about mating dynamic.

Some surprised was expressed about the indications that mating failure is high. It was noted that the sample size is low, and that additional information is now being collected from at-sea sampling.

INDICATORS: FISHERIES PERFORMANCE

Fishery performance is assessed in terms of trends in:

- Landings
- Effort
- Days fished
- Uncorrected CPUE

Landings in the lobster fishery are currently in an exceptional state, and small downturns are not considered to be cause for concern. Landings started to increase earlier in LFA 34 than in the Bay of Fundy/Gulf of Maine. Maine is more in sync with the Bay of Fundy than LFA 34.

For LFAs 35-38, trap hauls have reached a plateau since 2007/08. CPUE has been increasing gradually in the Bay of Fundy, with greater increase in LFA 35 (Upper Bay).

For LFA 34, landings increased dramatically over the 1980-2002 period from 3,500t to 19,000t. Landings leveled off and declined slightly 2002-2007 (16,500t 2006-07) then rose sharply 2009-10 to 19,700t and 22,800 t in 2011-12. Data for trap hauls and CPUE is only available since 1998 and they show trap hauls varying without trend and CPUE trending similar to landings, peaking in 2001-02 declining 2004-05 and increasing again 2007 through 2012.

Grid groupings have been grouped into nearshore, midshore and offshore, as well as the Bay of Fundy portion of LFA 34. The nearshore has had stable landings, effort has decreasing slightly, and there has been stable CPUE (with an increase in the past few years). The midshore is seeing increasing landings, slightly increasing trap hauls, and increasing CPUE. The offshore is seeing stable landings and trap hauls with increasing CPUE.

Lobster landings and trap hauls have been declining in Lobster Bay (2A), but CPUE is more constant. There may have been some movement of fishing effort to the mid and offshore areas. There is an increase in landings and effort in German Bank (4a). Results for the offshore are more variable, as there are fewer fishermen and lots of fluctuation.

Discussion

It would be interesting to look at grids 63-64 off Grand Manan to see what happened after the lobster kill in 2009. The catch rate is now about 30% of what it was.

It was thought that there might be a relationship between the price of fuel and lobster landings. In LFA 34, fishermen are not coming home at night and are doing 3 day trips to deal with fuel costs. They may also be using larger traps and longer soak times.

INDICATORS: ABUNDANCE – FISHERY DEPENDENT

FSRS CPUE

M. Cassista-Da Ros presented progress to date on development of a CPUE index to account for both area fished and fishermen. Based on experience from the LFA 27-33 framework, the following were incorporated: zeros, seasonal variation, grid group variation, Poisson distribution, and catch rather than effort was modeled. A Generalized Additive Mixed Model (GAMM) was proposed. The GAMM fit better for 2A with less variability (similar to unstandardized). It should be applied to legals and by subarea.

Discussion

It was asked why data greater than 5 days were excluded. The response was that this was what was done in the previous analysis. Some analysis was conducted, but it was somewhat arbitrary. Soak time does have an impact.

It was clarified that 'soak days' is not a parameter in the model.

It was clarified that no attempt has been made to date to look at outliers. This will be done later.

It was clarified that Week 0 is last week of November. For all years of data, there are no records for Week 12.

It was asked how one would incorporate environmental variables and whether these effects (like winter conditions) would pull the estimate down. It was felt that this is accounted for, since the traps are in the water. If that low period is removed, or a standardized time period was determined, the results from such an analysis could be compared to the annual average. It was felt that the pattern of seasonal effort is accounted for.

If one compares the standardized and unstandardized indices, they are pretty similar. So, the question was asked whether it was worth doing the standardization without incorporating environmental variables, as this may not be adding much. It was clarified that neither approach accounts for environmental variability.

Tides, wind, weather all play a role. In order to assess their influence, however, they would need to be reported consistently in the logbooks. Rough weather will reduce the movement of the soft lobster. Something like the moulting cycle will be replicated each year, so the influence of this should average out unless there are changes in moult cycle timing.

This is why there are other indicators that are assessed.

When aggregating data by week, it is not possible to investigate the effect of the tide. This could potentially be investigated through the commercial logs. Effects may not be as noticeable with current high catches. Tides are predictable, so they should not change over the years. However, if tides are doing something different at the beginning of the season, this might have an impact.

It was asked whether the effects of soak time were investigated. The response was that it was difficult to bring this into the model. It cannot be done with the FSRS data. The sample numbers are too low, so they need to be combined.

If the catch rates are good, the FSRS traps may be skipped. Also, if the longer soak days are discarded, these would mostly be in the winter. The FSRS traps are not within the fishing grounds, so people might not get to them.

Commercial CPUE

M. Cassista-Da Ros presented progress to date on development of the Commercial CPUE index. LFA 34 contains 850,211 records. Discarded 10% of data (e.g. entry mistakes; no information on effort and/or location). Also discarded greater than 25 kg/daily rate.

CPUE~Season year, seasonday, and fishermen.

Catch.Kg~Season year, seasonday, fishermen, and effort offset

Run using a Gamma distribution (instead of Poisson). Dataset is too large to run; this presents a major obstacle to modeling commercial CPUE in LFA 34.

Could try GLM with CPUE as a function of seasonday, year and fishermen.

Could also try: Tweedie distribution (might be better fit), better evaluate model fits, aggregate by week, model FSRS 35 data and LFA 35-38 commercial log, and integrate grid groups.

Discussion

Should be fewer mistakes in the future, as they are getting pickier.

What is a reasonable daily catch rate? 25kg / 50 pounds per day? Can vary spatially based on trap design, bait, etc.

Not allowed to set traps with >25 knots of wind. If cant fish the 50 mile line, will go there in week 2 and will get really high catches.

Could try a more random and smaller subsample. Or a random sample of fishermen (just model Ashton). Could pick some index fishermen that were reflective of the LFA. Have to pick people who stay in an area the whole year. Aggregate by week. What do you lose? Stephen Smith suggests finest level resolution possible – especially if you want to bring in temperature or other effects.

When have had problems running something in R, have tried SAS and it has converged.

Temperature Corrected CPUE

J. Tremblay presented work on a temperature corrected CPUE index based on work by Allard and Claytor (Allard et al. 2012) This only works for sublegal animals (76 to 80mm), as there is a problem with legals declining due to removals at the same time that temperature is declining. This approach assumes that the target class is locally closed in the sense that migration, moulting, and mortality are negligible at each sampling location. It also assumes a temperature catchability relationship that does not change across fishing seasons. FSRS data is used, where each trap has a temperature log. This approach tries to standardize for temperature. Earlier studies are referenced in which catch rates were investigated in relation to temperature (Allard et al. 2012).

Work to date for this assessment has been on LFA 34, but what was done for LFA 33 was presented as an example. The temperature corrected index for LFA 33 shows an even greater increase in abundance. Temperatures have been decreasing in this area. For the assessment, a temperature corrected CPUE can be prepared for LFA 34. It may be possible to depict the values of this indicator and other indicators using a traffic light approach whereby values of the index are coloured according to whether they are below the 25th percentile (i.e. the value is in the lowest 25% of values observed), between the 25th and 75th percentile, or greater than the 75th percentile.

Discussion

Is there a similar relationship between temperature and catch rate for legals and sublegals? At low temperatures, will get sublegals and not legals. Does show you what is going on with sublegals. Temperature effect may have even more of an impact on legals.

How does temperature vary on the bottom? Get quite a lot of variation. Ranges of 6 degrees over the season. Depends on the area (wind and upwelling, in the fall).

Do not believe that temperature impacts lobster. Is it worth it? Takes a lot of work to do.

Would it detect changes in condition sooner? There may be a change/warming in the past few year. Catch rates went up earlier this year. Would this be an early warning indicator?

Is it possible to talk to FSRS about trap location?

INDICATORS: ABUNDANCE – FISHERY INDEPENDENT

RV, ITQ and Scallop Survey Indices

D. Pezzack presented work on the RV, ITQ and scallop surveys as sources of information for lobster abundance indices. The RV trawl surveys were not used in the past because only total weight and number of lobster were recorded. However, sex and size information on lobster have been recorded since 1999, so there is now a long enough time series to assess. ITQ survey goes closer inshore using rockhopper foot gear. Strata used include the Bay of Fundy (strata 490-495) and Eastern Gulf of Maine (Strata 480-495). A broader area could be used to better capture the overall lobster picture. There are currently two index ideas being considered: 1) proportion of sets with lobster, and 2) mean number of lobsters per tow.

The RV Survey results provide information for the Bay of Fundy and offshore regions of Browns Bank and the Gulf of Maine (LFA 41) but not for LFA 34.

Results for RV survey show a similar relationship between the two potential indices. The RV survey and BOF landings show similar trends. These indices show good correspondence with recent trends in LFA 34 but not with the increases in landings observed in the 1980's when landings increased with no increase observed in the RV Survey. Something might have been happening in near shore areas not surveyed that was not occurring in the Bay of Fundy or Gulf of Maine, or the shift in the fishery from nearshore to more offshore areas was greater than estimated. In an investigation of sex ratio, the impact of exploitation is seen more clearly in the ITQ survey than in the RV survey due to the large numbers and coverage in the nearshore areas. In terms of median size, there appears to be a wider size range in the deeper strata. Proportion of large lobster were also investigated, which appears to be stable for >147mm.

Results for ITQ survey show a good correspondence between landings and the offshore ITQ survey in the midshore, offshore and Bay of Fundy portion of LFA 34. It does not perform as well for the nearshore where landings have declines slightly while the survey catches have increase dramatically. The ITQ survey may be giving a better picture of abundance as the decline in nearshore landings is in part a result of decreased fishing effort.

Next steps include correcting database errors, analysis of Bay of Fundy ITQ data, comparison of areas where the ITQ and RV surveys overlap, comparison of size/sex data with at-sea samples, and expansion of data collection for lobster.

The scallop survey has the potential to supplement other surveys, and provides data using different gear and timing.

Discussion

The RV survey is conducted in July, which is after the fishery and before the moult. Would consider this a positive thing.

Why does not the RV survey trawl closer inshore? Untrawlable bottom or just do not know where to trawl? Have tried - more an issue with the vessel being large.

A vessel correction factors (for use of the Templeman versus the Teleost) is not applied in groundfish assessments.

Do you report lobster condition from the RV survey? No. Do for ITQ survey. Everything is returned to the water. It represents a small proportion of lobster catch compared to fishery. There is greater concern about the frequency of the trawling or the number of sites.

Only in the past 3 years has there been occurrence of soft lobster. Mostly offshore tows – do not see as many soft ones.

Could you also consider a relative F (total landings versus survey catch)?

Happy to see abundance indicator that's not related to bait. These surveys see a part of the population not observed by the traps.

Have not considered the sculpin fishery as a set of data on lobster. It occurs within a small area.

The offshore not going to show as much lobster in LFA 34 in July.

Other possible surveys include: the Georges Bank survey; the NOAA and Maine surveys (might be interesting to compare). The timing of when the increase started in the various surveys might be interesting to look at. Might want to look at size composition earlier on versus later. Can also look at mean weight.

Not collecting individual weights. If you took weights for whole animals, could you use that to look at length weight relationship?

How can you use these to investigate recruitment or mortality/exploitation? Does it improve predictive ability? US has been tracking recruitment using the RV survey. Would like to be able to follow recruitment – probably not predictive.

Want to use settlement traps or FSRS recruitment traps for prediction. RV can validate whether these signals are showing up. If you see a peak in the recruitment trap, might see this show up 7 years in the future.

Consider optimal versus suboptimal habitat – RV survey tracks suboptimal habitat. Might give early warning if declines here before optimal habitat. This is just speculation.

The lobster model from Maine used an RV survey index. This model did not produce projections before, but it might now (in a more recent version).

The RV survey also provides some good secondary indicators. These might help to explain why abundance is changing. Need to be able to have understanding to make corrections: recruitment failure, loss of females.

Have you looked at effects of SFA 29? Could do this if a priority. Does trawl survey show differences in adjacent areas from the scallop fishery? Does scallop fishery prevent lobsters from moving inshore? Positive or negative impacts.

Recommendation

Determine if it would be possible to record condition of lobster on the RV survey.

Use a three year geometric mean instead of arithmetic mean.

Lobster Settlement Index

J. Tremblay presented work on a lobster settlement index. In Australia, a comparable index makes very good predictions of landings based on the long-term relationship between the numbers of postlarvae and the size of the commercial catch four years later. This is also being looked at for the American lobster and in some areas there are more than 20 years of data, including Beaver Harbour in the Bay of Fundy. Rick Wahle of the University of Maine is leading a collaborative project that produces an American lobster settlement index for a wide range of areas. This year, Lobster Bay is included in the report.

In Canada, there are various locations of collectors and/or suction sampling. Lobster Bay and Beaver Harbour have both. Suction and collectors give similar trends.

One of the longest time series is in mid-coast Maine. There was a downturn in 2001, but it was up again after that and is now stable. Rhode Island has seen a dramatic decline in settlement.

There is a short time series for Lobster Bay, which shows a decline. Beaver Harbour increased to 2005, with a decline since then, but it is still at levels comparable to the 1990s.

This does provide an indicator of settlement strength, but the short time series does need to be taken into account. Continued low levels may be cause for concern. The predictive power of this index needs more evaluation. To keep this index going funds external to DFO will be needed.

Discussion

How many collectors are deployed in Lobster Bay? One issue with this method is that the locations are not randomly allocated. There is a random component in the design in that dropping it on the bottom from a vessel means its exact location in relation to habitat cannot be controlled. Remy Rochette's group at UNB is being more precise and looking at habitat impact. We are going within a few hundred meters and try to avoid mud and sand - rough bottom is preferred. This is the same approach as is used in the US. Ideally, we would get to a random stratified design.

Would you lose any lobsters on retrieval? There is a mesh all around and we try to bring the collectors straight up. We have not evaluated loss directly but studies in the US indicate (bagged versus unbagged collectors) there are no losses. In addition we have compared suction sampling estimates with collector estimates and found them to be very close.

If it is an attractor, would it change the densities? This is why we compare the results to suction sampling. Seem surprisingly close. Indication of larval supply – competent ready to settle. Good indication of settlement if adequate substrate is available.

A little bit of skill is required.

INDICATORS: REPRODUCTION

Spawner and Egg Production Indicators

J. Gaudette presented work to date on spawner and egg production indicators. The importance of having a healthy brood stock, which is crucial to ensure sustainability and greater potential for recovery, was stressed. This should be monitored carefully.

Potential indicators include:

- Abundance and size structure of berried females
- Size structure of brood stock and sex ratio (do not know what is healthy)
- Egg production indices (potential and observed)
- Mating success rates (TBD)

Egg production potential:

- Fecundity: Campbell and Robinson (1983)
- Size at maturity (previous presentation)
- Female size structure (port sampling LFA 34; at sea sampling spring or RV survey)
- Abundance estimate : CPUE logbook, CPUE sea sampling, RV survey or landings)
- Mating success rate

It would be useful to start with area that has lots of data (e.g. North Head). The most appropriate spatial scale of analysis needs more development. Then, an appropriate time scale (e.g. 1980s, mid-1990s, or past 5 years) would have to be determined. One problem is that there are only two maturity ogives – 1980 and last year – and do not know how this transitioned.

Comparing 1980 egg production to 2011, see a shift in the contribution from smaller lobster.

Relative egg production combined with abundance should give absolute egg production.

In a comparison of potential versus observed egg production, observed egg production did not show as great an increase as the potential egg production.

There is a need to determine how to scale this index up to the entire LFA 35-38. It does integrate a number of biological information and could provide insight into how to maximize reproductive performance, e.g. window size for males or females.

Discussion

When you catch a large female, often find a male of the same size in the trap. With at-sea sampling, is it significant that the size of females and males is comparable, especially berried females?

There does seem to be a lot of males in the at-sea sampling. However, there is potential for sperm limitation. If only females are protected, there is the potential to get limitations in males. Surprised to see so much variation in the mating success. Males might be more selective in the females they mate with. Looking at just sex ratio might be too simplistic.

Has a lot of merit. Would like to see how it evolves.

Tried something in 31A. Brought in a window size (female only), but now egg production is coming from sublegals. Window size is now doing nothing.

Need to incorporate abundance somehow. Could you use the egg per recruit model and scale for abundance and might come up with something similar. Maine model will give estimate of the absolute spawners. Does not account for mating success or parasites. It was a detailed model.

Might be interesting to compare theoretical size structure with measured size structure.

Doug has a working egg per recruit model. Do need to go to Maine model.

Information on growth and fecundity are 30-years old. Need to update this information so model estimates on reproductive status is more meaningful.

Will have an egg production index for LFA 34 and LFA 35-38 – relative and absolute.

INDICATORS: FISHING PRESSURE

J. Tremblay presented work to date on fishing pressure indicators. Fishing pressure will be evaluated with two approaches:

- Direct measures of fishing effort
  - Fishing effort such as trap hauls, days fished etc.
- Indicators of exploitation rate
  - Size composition (% in molt group 1)
  - Length composition analysis
  - Days to catch XX% of catch
  - Continuous change in ratio methods
  - Exploitation

Size composition (% in molt group 1) requires assumptions that are generally not met. It would be possible to do length composition analysis for females, the whole LFA, and possibly grid groups. For days to catch some percent of catch, 50% of catch might be used.

The continuous change in ratio method (Claytor and Allard 2003) looks at the ratio between legal and sublegal lobster from FSRS data. Lobsters 82.5-90mm are compared to males 76-82.5mm. Get a cumulative exploitation rate over the season. It assumes populations are closed, which is reasonable for a 9 week season but more of an issue for the fall-winter-spring seasons. It also assumes the ratio of catchability between the classes is constant through the season for all traps, and assumes the ratio of catchability by the monitoring traps and by commercial traps is constant over the season for all classes (reasonable assumption but not tested).

For LFA 34, can estimate 1999-2000 to 2010-2011 [2011-2012 to be added] as a relative index of exploitation. This analysis indicates an exploitation rate above 88%. These estimates should be regarded as an index that is biased high; we know that it does not include berried females, for example. The values produced are not of as much interest as the trend. If you compare LFA 34 with other areas, it does appear to have higher exploitation than other areas. LFA 35 appears to be lower, possibly due to more movement. Similar to size composition in the trawls and trap surveys.

A range of methods will be presented in the assessment. Relative F will have to be investigated at a larger scale.

Discussion

How are individual estimates combined for the whole year? End point of the cumulative estimate.

There is potential for individuals to move out of the population. In the fall, mostly catch 2 pounds and less. Spring, catch >2.5 pounds. Where are the big animals coming from?

Showing exploitation for nearshore area where exploitation is higher, as this is where the FSRS traps are. Snapshot of 20% of the industry? Nearshore is higher than this.

LFA 33 is not a good representation of LFA 34. LFA 33 is keeping track of their commercial traps.

Need to interpret how representative this is of the fishery as a whole. Used this in the last assessment. This index will be higher than the others.

Reference points? Would likely just present the quantiles. To do a change in trend (%) would have to be relative to some start year.

Either we're missing something, or lobsters are resilient to high exploitation rates.

When you get stats from LFA 34 this year, will see dramatic changes in landings. Will see lower landings in "red" area in the graph.

If we do the length composition analysis, and it still shows that there is a big drop between legals and sublegals in LFA 34, would you agree that exploitation LFA 34 is higher? Production is there. But are also catching a lot and exploitation is high. Recruitment is high.

Concerned that when the decline comes, it will be steep instead of gradual. It will take some time for a management change to take effect.

Could have an effect on making what's there last longer.

The way fishermen bait their traps can determine the size composition of the catch. It is hoped that there is enough port sampling to see a broader spectrum (average). It might be better to use the size composition from the RV survey. Amazingly similar size compositions are observed from year to year. Could compare traps with RV surveys.

Decline in groundfish is one of the possible reasons for the increase in lobster.

This method was also applied to historical data, and high exploitation rates were still indicated. Could bring this out again. Localized depletion effect?

Have strength in the number of different metrics that you have and how they compare. Would not worry too much about the problems with the individual methods if they all converge.

Size distribution and exploitation are pretty shocking. Have thought about this a bit. With this size selective fishery, even if you're half right on exploitation, it is still problematic. Being a bit complacent about some indicators given the high abundance of lobster. The change in the size at maturity indicates that we may be seeing effects of a strong incentive to mature early. These kinds of changes have had a big impact on other fisheries.

However, data from 1940s, size structure was very similar but they were not fishing offshore. Might have had a refuge. What was in the first moult group? Similar. Might be more related to change in fishing pattern. Just seem to be in a different regime. If it shifts, this change in size at maturity will have a bigger impact on the population's ability to recover.

APPLICATION OF INDICATORS IN THE ASSESSMENT AND POTENTIAL REFERENCE POINTS

J. Tremblay identified key indicators to consider for determination of reference points:

- Commercial abundance or biomass
  - Landings
  - Trawl surveys
  - CPUE from commercial size
- Pre-recruit abundance or biomass
  - Abundance of spawners/index of reproduction (index but no reference point)

Based on DFO guidance on the PA approach, as long a time series as possible should be used to set reference points:

- Landings 1985-2009
- RV survey: 1985-2009
- ITQ survey: 1995-2009 (or assume catch rate from 1985-1994 is same as 1995)
- Trap catch rate: 1998-2009

A running average will be used to smooth out annual variation, particularly in the trawl surveys. For commercial catch rate, the lowest CPUE from the 1998-2009 period is proposed as the USR. A drop in any one of these could trigger action:

Commercial sizes:

- 3-year running mean of landings
- 3-year running mean of RV survey
- 3-year running mean of ITQ survey
- 3-year running mean of CPUE < 1999 value

Sublegal sizes:

- 3-year running mean of FSRS sublegal CPUE < 1999 value (LFA 34)
- Summer trawl and ITQ as above but sublegal sizes

Discussion

There was a sustained period of productivity from 2000-2008. Use this as a BMSY proxy. Take 80% and 40% of this as the USR and LRP.

Has there been a regime shift? What productivity are we talking about? For the foreseeable future, expect that it will continue at current levels. Shrimp in the Gulf of St. Lawrence may be a useful model.

Could use start of the ITQ survey (1995).

USR needs to be higher because it will take a long time to take action. Be conservative.

Total stratified biomass. Then look at lowest level from which there has been recovery.

Do not have much response time in the inshore between USR and LRP.

Change the color of the line to indicate when the reporting changes occurred.

Dealing with cash sales now. Slips that went to the dealers would not reflect the cash sales. How to deal with misreporting. Some officers gave an estimate of the cash sales but not consistently.

Could overlap RV and ITQ to determine how they compare.

Why keep CPUE there? Would it be used as a counter argument? Has been used as an argument in other fisheries. CPUE can be hyperstable. Move when you reach a certain catch rate (e.g. move if less than 10 pounds a trap). CPUE can also be affected by environmental conditions.

Is it ok to have a different timeframe for the landings versus ITQ/RV surveys? It is ok as long as there is a rationale. The Bay of Fundy did not show an increase in lobster abundance until the 1990s. If you looked at all the LFAs, do not know what you'd pick. 1985 works for LFA 34. 1995 might work better for LFA 35-38. However, there is a desire to be consistent across all LFAs for landings. The RV and ITQ indices are for a specific area, so do not need to be consistent across all areas.

Could look at 3 versus 5 year smoother again. Did not see much difference. Use a three-year geometric mean. This would dampen the annual change.

How to deal with LFA 35-38 in terms of reference points? Either look at the average or 3 of 4 drop below.

Separate ITQ survey for LFA 34 versus LFA 35-38? Dramatically different numbers.

Would sublegal index be an OR? Yes. Sublegal index more predictive.

Recommendation

Use 1995-2009 as the timeframe for trawl surveys. Use a number of arguments to set the USR higher. About 13 mean number per tow. Do not set a LRP or be arbitrary at 40%

Use the ITQ survey for the LFA 34 reference and the RV survey for the Bay of Fundy.

Do not include CPUE in the Harvest Control Rule.

Go with simplicity (average LFA landings – make a reference point based on this).

ECOSYSTEM CONSIDERATIONS

Incidental Catch

D. Pezzack presented work to date on analysis of incidental catch in the lobster fishery.

The Species at Risk program provided funding for additional sampling in 2009 (did not match with season). This program was interested in determining whether there was incidental catch of

a range of SARA-listed and COSEWIC species. The Bay of Fundy had some bycatch sampling conducted but no SARA logs, so results from that area is provided in a different format than the other areas. It will be analyzed for the February assessment.

For LFA 34, 288 trips were observed with 64,570 kg of kept lobster and 51,250 kg of discards. The ratio estimator method from Gavaris et al. (2010) was used to estimate bycatch, i.e. lobster landings x (observed catch/observed kept lobster). Weight by landings was used rather than effort, as landings are more complete and are considered to be more reliable.

Sources of uncertainty include that the SARA sampling was not that spatially representative of the fishery; there were many different observers used, so the same sampling protocols may not have been used on all trips; there were multiple trips from the same vessel or on subsequent days; and there may have been changes in fishing practice when there was an observer onboard. There was also inconsistent sampling of subunits, with areas 1, 2a, 3, 4b, and 7 more highly sampled than 2b, 4a, 5. However, there was still low sampling overall. More sampling was conducted in spring, with less sampling in fall and winter. This may have been related to observers (students) going back to school in the fall. To account for this, bycatch was weighted by season.

This is the first time that bycatch analysis has been attempted for the lobster fishery. It does provide a reasonable snapshot, and some lessons have been learned from doing this work. The highest bycatch was of Jonah crab, rock crab, hermit crab, sculpin, whelk, sea raven, cusk, and cod. Area and season effects can be investigated. A lot of cunners were caught in LFA 27 (to be used for bait).

There is a hope that this type of sampling would be conducted every 5-6 years, as it would not be conducted annually. To provide annual estimates of bycatch, current rates would have to be applied to subsequent year's catch.

There appear to be high levels of discards of lobster in LFA 27 and LFAs 34-35, which includes berried females, sublegals, V-notched, window, and maximum size. These are required discards. Analysis of the data indicates that most of the discards were sublegal lobsters. Smaller amount of berried females were discarded, except in LFA 32 (where there is a large v-notch program) and LFA 41. It may be possible to use at-sea samples from the Bay of Fundy to estimate these discards, i.e. to look at changes over time. Could look at at-sea sampling for 2008-2011. This type of sampling should be done periodically, especially if it becomes a Marine Stewardship Council requirement. However, it is expensive. It may be possible to design something smaller scale to give better data.

Discussion

Ratio calculated for each trip? Yes. Sum of that to get the total.

300 trips sampled out of 60,000 possible trips. A low percentage.

Management could be concerned about cusk and cod. 300 t of cod is about 20% of the TAC. D. Clark did some tagging to look at mortality of cod after discarding. Cusk had been evaluated previously – it came out similarly.

Were shad in the table? No.

Could display the results for SARA species better, as they are currently hard to identify. Include table with values.

Could use a stacked bar to see what proportion of the sublegals were berried.

Can you compare the at-sea discard ratios with the SARA sampling ratios? There are a few years that could be investigated. It would be interesting to see the cod and cusk discards. There did not used to be recording of bycatch. It is only done now.

Should calculate ratio estimators with error.

Did you check the comments field for reports of entanglements of turtles? Do get reports of entanglements to the Volunteer Strandings Network.

It would be better to use trap hauls rather than landings. Use a measure of effort, if you have it. If groundfish return, there could be a dramatic increases in bycatch.

Should all of this be presented at the assessment, or just a portion of it? What is the message? Is there something we should think about before the assessment to respond to concerns that arise? Fishermen want to reduce discard rate.

Do you have shell condition? What proportion are post-moult? It is recorded.

There was a National workshop on bycatch, and the Science Advisory Report from this meeting is out now. It may be possible to get a rough estimate of mortality from the tagging work. Match with exploitation rates. May also be concerned about egg loss from berried females. Can be recaptured many times.

Fishery Footprint
Discussion

One of the objectives/strategies in the Maritimes Ecosystem Approach to Management framework is to manage the area of disturbed of habitat. The Marine Stewardship Council has also asked to show evidence of no habitat impact from fisheries.

Ways of estimating the fishery footprint were discussed. One thing that could be done is to attempt to estimate the spatial coverage of the traps. The number of lobster trap hauls would be available, and a trap size could be assumed in order to calculate a rough estimate of the fishery footprint. Work has also been done to estimate the line distance. It would be interesting to see what the percentage of bottom impacted might be – not taking into account bottom type. Could then do a fishing density map by grid cell. The size of each grid is known, as is the average water depth. The percentage of available bottom versus fishable bottom could potentially be estimated. Presume higher percentage in fishable bottom. However, aerial or buoy surveys would be required to get better spatial resolution.

It would also be useful to have underwater video showing actual habitat impact, if any. If a lot of traps are hauled together, there can be some dragging. If done properly, there may be less/no dragging.

Other Ecosystem Interactions

J. Tremblay reviewed other potential ecosystem interactions that may be useful to consider. These include:

- Temperature (effect on other processes, growth, reproduction, timing of life-history)
- Ocean currents
- Predation
- Food availability
- Disease
- Anthropogenic impacts, e.g. aquaculture

Further discussion is required with oceanographers on how to present physical oceanographic indicators, such as 4X bottom temp. The snow crab assessment currently summarizes this type of information for the Scotian Shelf. The North Atlantic Oscillation (NAO) may be an important environmental index. A positive NAO results in warmed than usual conditions for the western Scotian Shelf and in the Gulf of Maine, but colder conditions on the Eastern Scotian Shelf. Boudreau (unpublished study) shows a weak relationship between the NAO and lobster abundance, with a 5-8 year lag. Indices of lobster predators, such as cod, sculpin, haddock and thorny skate may also be useful indicators of natural mortality.

Discussion

The effect of the NAO on the nearshore is uncertain.

Would it be possible to link the Maritimes stomach database information to a predation index?

What about disease? Shell condition (shell disease) is starting to be recorded on the ITQ survey. The vet college has been doing some collections of data. However, it was suggested that there should be some caution in publishing this type of information, as it might impact lobster marketing.

Some potential predators, such as cod, cusk, monkfish, could be selected. A. Cook could be asked to provide the top 5 finfish species that eat lobster (for a selected time period).

Need to determine what a useful product might be from the oceanographers. Are there life-history stages or times that are most important for lobster? For shrimp, it's the spring bloom. It was noted that C. Johnson (DFO Maritimes Science) has taken over the Atlantic Zonal Monitoring Program (AZMP), so she might be a good person to talk to about this.

OTHER CONSIDERATIONS

ANNUAL REPORTING

Primary indicators (in relation to reference points) are to be updated and reported annually. Other indicators may be tracked but not reported. There will still be the ability to analyze these secondary indicators if something problematic is seen in the primary indicators. Full assessments will be conducted every 5 years (2013, 2018). Exceptional events could trigger an early assessment.

Recommendations

Disease, significant change in management, and change in surveys could be considered as exceptional circumstances. These would trigger an assessment or review of the issue.

RESEARCH RECOMMENDATIONS

Genetic work will arrive rapidly. Data is to be generated this year.

Lobster Node. Will this work change the perception of the stock? Next couple of years may generate information on berried females (abundance and size in Atlantic Canada), as well as clutch quality. Sources of larvae for the biophysical model.

Settlement studies.

Modeling work will speak to connectivity and assessment unit, as well as tracking of movement. Looking at nearshore, midshore and offshore connectivity. Brian Morse (Ph.D. candidate at UNB) is looking at the movement of smaller lobsters in relation to spatial patterns of

temperature. Ultrasonic tags have been used in this project. There are still 3 years of funding for that project.

There is to be a half day meeting in Grand Manan in October to talk about lobster science and aquaculture.

MESSAGE FROM G. THOMPSON ON LOBSTER SCIENCE

G. Thompson has been representing industry for 30 years. There was a time when the scallop industry did not accept the scallop science, but they do now. Lobster is different in that they move around. It does not seem that harvesters are willing to accept the science findings. It appears from the presentations that have been made at this meeting that more effort is going into developing predictability, but it is not clear that we can get there. Landings information is up to date. Secondary information is not getting the emphasis it requires. Spatial patterns are very important. Other species have shown declines in spatial distribution first. The RV survey can get us partly there. However, there may be a need to change the grid reporting system. There appears to be a move to get fishery independent information, which is great, but it depends on funding from a non-industry source. If that funding stops, then time has been wasted. Given that, is there any way to ensure against getting caught without a good indicator? DFO seems to be moving towards electronic logs or downloadable logs in 2014. Somebody is designing a system, and people who need the information cannot get what they want. It took some time to get trap hauls added to the logs. If there is going to be a different system of reporting, some effort should go into what information needs to be there. If there a few extra things that can be added to make the information better, it should be added now. Hopefully there is buy-in from the industry.

Discussion

Fishery information is getting better.

Started a pilot project in Southern Gulf, but funding ended. Was never implemented fully. Have switched to another E-log. Also has put aside because there are other pressures. No log book info now – just sales slip. Will go to logbooks at some point. There is pressure to standardize log books.

Trying to determine nationally if we need 80 different logs. Do not know if they will try to change the lobster log. Science and FAM is supposed to review any proposed changes before they would be implemented. Would want to make sure that grid system is input. Include a map.

Concern about grouping logs by gear-type.

Our needs for the logbook will change over time. Need flexibility to make updates.

How would it work for FN for communal licences? Some reporting, but not through a commercial log.

SUMMARY AND CONCLUSIONS

SUMMARY OF DAY ONE

T. Worcester presented the objectives and format of the meeting. An industry participant asked whether other (non-fisheries) sources of lobster mortality would be addressed, such as aquaculture. It was suggested that that there would be an effort to determine what information might be available that would inform this (higher resolution) type of analysis. Later in the day, a

suggestion was made to look at the catch rates in Grids 63 and 64 to determine whether any impact of lobster kills could be detected at that scale.

D. Pezzack presented some background biological information, including preliminary discussion of changes to biological parameters (moulting, maturity, growth), and talked about lobster movement and ecosystem interactions. There were some questions on mortality (larval versus settled), and potential changes in the predation on lobster by seals. It was felt that studies conducted in the past may not be representative of current conditions. It has suggested that information might be available in the Maritimes Region stomach database on finfish predation. Later on in the day, there were questions about the aggregations of juveniles, with a recognition that there is still much that is not understood about lobster behavior. It was suggested that the length/weight relationship in lobster might need to be reviewed, as it has not been checked in a while.

Next, there was a presentation and discussion of what is known about lobster stock structure and the basis for the assessment unit. A proposal was made to provide an assessment of LFA 34 separate from LFAs 35-38. Information available for assessment of stock structure includes morphometrics, genetics, tagging, and larval drift studies, which are supported by information on landings trends. There was recognition that LFA 34 will have movement (adults and larvae) in and out of the unit, but it does appear to show different trends than the Gulf of Maine and Bay of Fundy. It was suggested that additional biological information (similarities in biological parameters) could be included as evidence of stock structure (better argument than reliance on landings trends). There seems to be a tension between wanting to understand processes at a fine scale resolution, i.e. the scale of an aquaculture site and to separate inshore/offshore differences, while wanting management response to be more consistent across all areas. Also, there needs to be a balance between recognizing the interconnectedness of the areas while recognizing the importance that local management measures can have on local stock health. Later in the day, it was noted that environmental changes (changes in the timing of processes) are complicating the interpretation of spatial patterns and also limiting the usefulness of historical information in describing current dynamics.

J. Tremblay described the current landings-based approach to reference points. While there is agreement that this approach may not be ideal, it is an appropriate interim solution to meet the current DFO guidelines on the precautionary approach (PA). There are other conservation measures in place to help ensure a precautionary approach above and beyond a simple PA reference point. At current lobster levels, discussion of a target reference point is more meaningful than discussions of a limit reference point or even an upper stock reference. J. Tremblay explained how the removal reference is not helpful under current conditions (no clear relationship between exploitation rate and changes in abundance). Concern was expressed that landings-based reference points (even the LFA ones, not combined to the assessment unit level) might not be sensitive enough to detect early warning signs of changes in stock health. Hopefully, discussion of secondary indicators will speak to this concern. It was agreed that there would be some further discussion on how to report on the status of the assessment unit as a whole (if it is agreed to make LFA 35-38 one assessment unit).

Next, the various sources of data for this assessment were discussed.

Landings	**Pros**	**Cons**
Historical records	1892-1946; LFAs 34-38	Landings only Position by country Yearly total Reliability is more uncertain
Sales slips from buyers	1947-1995; LFAs 34-38	Landings only Position information by

Landings	Pros	Cons
		statistical district Missing catch
Self-reporting logbooks	1995-1998: LFA 34 1995-2003: LFAs 35-38 Includes date of landing	Landings only Position by port No analysis of completeness or accuracy
Lobster catch and settlement report (slip vs. log)	1998-present: LFA 34 2003-present: LFAs 35-38 More information collected: effort and daily catch Reported by grid High reporting rates Log catch estimate seems to correspond well with sales records on average over season.	Short time series Log - estimate of catch Slip – no associated date/location of catch

There was some discussion of discard mortality from other fisheries or other potential sources of mortality, which might be useful for development of indices for stock health and/or fishery performance but not necessarily for estimating total removals. It would be possible to reference work that has been done on bycatch in other fisheries, such as making reference to the Gavaris et al. (2010) report, as well as Bay of Fundy Scallop, Scallop Fishing Area 29, and groundfish assessments. Bycatch of lobster in the sculpin fishery was mentioned. It was noted that a priority fishery would be the redfish fishery.

There was some discussion of how to account for the discard of lobster in the lobster fishery. Mortality of soft lobsters in LFA 35 was considered to be high unless they are well cared for. This should be recorded in the log, though likely due to concern with lost revenue. Estimates of discard mortality in the range of 15% have been reported, but this may include post-landings mortality.

Effort	Pros	Cons
Lobster catch and settlement report	1998-present: LFA 34 2003-present: LFAs 35-38 Effort information (trap hauls) currently well estimated.	Short time series

Catch Composition / CPUE	Pros	Cons
At sea sampling 1976-present	Long time series All LFAs Can sample entire catch, including bycatch/discards More accurate positional information Includes info on: CL, sex, shell hardness, egg presence and stage, culls, v-notch, location and depth Potential use for catch rate (similar to commercial CPUE)	Relatively costly / funding dependent Lower sample size / less representative Not good spatial overlap with fishery Inconsistent level of sampling (some good years) Weather dependent
Port sampling	Less costly, more likely to continue Higher level of sampling / more representative Consistency Location: port or area fished (?) Includes info on: CL, sex	Only LFA 34 Only sample landings (not berried females, etc.) Subsample of catch
FSRS recruitment traps	Sampled over the whole fishing season Wide distribution along coast Includes depth, temperature information Includes bycatch Use for CPUE	Fewer number of traps Primarily inshore (not as many offshore) Not so good at sampling large lobster Binned sizes
FSRS commercial traps	Sampled over the whole fishing season Wide distribution along coast Includes depth, temperature information Includes bycatch	Small number of traps Primarily inshore (not as many offshore)

Concerns were expressed about ability to continue at-sea sampling. There was a suggestion to conduct focused (rotational) sampling to fill gaps and do periodic checks.

Population Information	Pros	Cons
Scallop survey - BOF since 1981 - Lurcher since 1991	Fishery independent Moderate time series Includes information on size Accurate locations (distribution)	Does not cover whole assessment area
RV survey - 4X since 1970 (size info since 1999)	Fishery independent – independent of trap selectivity and fishing patterns Long time series Includes information on weights, numbers, size Standard gear Covers wide area (can link with GOM and Maine) Oceanographic and other species information collected Done in July – testing after the fishery and before the moult	Does not cover whole assessment area More focused on offshore >40m Selectivity of gear not known Restricted to trawlable bottom Done in July – limited time period
ITQ survey - 2005-present	Fishery independent Fixed station Better inshore coverage than RV survey	
Out of season trapping		Sporadic for Grand Manan Short times series for Upper Bay of Fundy (2009-present) Not analyzed
Suction sampling	>20 years for Beaver Harbour 6 years for Lobster Bay Collects information on newly settled lobster	Site specific / few locations
Settlement collectors - Since 2007	2 locations in LFA 34 Collects information on newly settled lobster	Site specific / few locations Short time series

It was suggested that the overlap in coverage in the three surveys (scallop, RV, ITQ) would be useful to see.

Size at maturity was then described by A. Silva and J. Gaudette. Size at maturity is an important biological parameter that may be used to estimate reproductive capacity. It is also an indicator of environmental change or fishery pressure that appears to have changed over the past three decades. There was lots of discussion on the problems with using the cement gland approach (can overestimate maturity), with resulting impacts on the shape of the maturity ogive, though there is a clever fix of assuming maturity over a certain size. Ovary condition is suggested as a more accurate measure, although this is not practical for large scale studies as the animals must be sacrificed. Considerations of differences in size at maturity between areas based on cement gland development should consider the potential occurrence of false immature females (mating failure, parasite infestation) and if so, validation with ovary condition should be

conducted. should include the methods used but in general most studies have used the cement gland method backed up to varying degrees by examination of ovaries in a subset of animals. Mating failure was prevalent in many regions of the Bay of Fundy. There is a need to watch for clutch quality, parasites, and mating success.

The day ended with presentation of fishery performance indicators. There appears to be good information on the major trends in landings, effort and CPUE, but there are some differences in trends at smaller scales (with potential shifts in the fishery). There is similar information available on adjacent fishing areas (e.g. Maine). There was a suggestion to look at the correlation between lobster landings and fuel price.

SUMMARY OF DAY TWO

Day Two started with presentation and discussion of fishery dependent indicators:

1) An FSRS CPUE index was proposed as an indicator of recruitment. Recommendations included: looking at outliers, look at a consistent period (i.e., do not include winter), and incorporation of environmental information. Without incorporation of environmental variables, it was not clear that standardizing is worth the effort. Sources of uncertainty: annual differences in temperature, tide effects, changes in moult timing, bias in when FSRS traps were checked.
2) A standardized Commercial CPUE index is not available yet because of insufficient computing power to model the large data set. Recommendations were to try a smaller subsample (subset of fishermen, aggregate by week), and to run in SAS.
3) A temperature corrected CPUE index for sublegal lobsters was presented for LFA 34 only. A traffic light approach (color coded) to reporting on this indicator was proposed. There were more questions about whether this indicator was worth the work involved.

Next, fishery independent indicators were reviewed:

1) The RV survey was considered to be more reflective of offshore (as compared to nearshore) trends. It appears to indicate a fishery impact on sex ratio, but not as much as the ITQ survey does. The size range of lobster increases in deeper water. The proportion of large lobster appears to be stable. It was recognized that there is a need to compare the RV survey results with at-sea sampling in the same area. It was suggested that a 3 year geometric mean be used instead of an arithmetic running mean. Suggestions were made to report lobster condition in the RV survey, to attempt to determine relative F from RV survey, and to make comparisons with adjacent survey trends. It was also suggested that the weight/length relationship could be used from the RV survey, and the RV survey could be used to validate the recruitment indices. However, it was noted that the RV survey occurs (and may be tracking trends in) sub-optimal habitat. There was a suggestion to look at the impacts of SFA 29, if time was available.
2) The ITQ survey appears to be better suited for detecting trends in the nearshore of LFA 34. Results for the Bay of Fundy have been not been analyzed yet.
3) The scallop survey may provide supplemental information but would likely play a minor role.

The lobster settlement index was considered too short a time series to be useful now, but it would be a useful development to support the assessment's predictive ability.

Next, potential reproductive indicators were presented, including relative and absolute egg production potential (need updated fecundity information), and mating success (under development). Recommendations included: compare theoretical with measured size structure,

and compare results of egg production index with egg per recruit model (if coupled with an abundance index).

Next, fishing pressure indicators were reviewed. High exploitation rates continue to be indicated by the methods used. Measures will be provided based on fishing effort, size (not good assumptions) composition, length composition (females), days to catch some percentage of catch (possibly 50%), and change in ratio (needs more work or a better explanation of what this represents, e.g., nearshore, not including berried females). More discussion is required on the scale of the proposed relative F index.

It was agreed that there is a need for a predation index [and possibly a habitat (such as temperature) index]. The apparent change in size at maturity may be an early warning sign.

Possible reference points were discussed for commercial sized and sublegal lobster.

Commercial size reference points could be based on:

- 3-year running mean of landings for LFA 34 and 35-38 from 1985-2009 as the USR, with 40% as LRP.
- 3-year (geometric?) mean of RV survey for the Eastern Gulf of Maine as an indicator for both LFA 34 and 35-38 from 1995-2009 as the USR. LRP?
- 3-year (geometric?) mean of ITQ survey for LFA 34 and LFAs 35-38 from 1995-2009 as USR. LRP?

Sublegal reference points could be based on:

- 3-year mean of FSRS CPUE.
- 3-year (geometric?) mean of RV survey and ITQ survey for sublegals.

There was general support for using a higher productivity period to set reference points for lobster, as it would be hard to argue there has not been a change in lobster productivity (regime shift?) in the recent period. While there may be a return to previous productivity levels in the future, there is an expectation that reference points would be revised to reflect that change (should it occur). There was a suggestion to separate the USR further from the LRP to allow time for management response, as there is currently limited opportunity for response between the 40% and 80% reference levels.

Some comments were made by G. Thompson about the importance of spatial patterns, focussing on secondary indicators to increase confidence in results, best use of commercial data as a constant source of information, concern about ability to collect fishery independent information. He expressed support for changing the reporting requirements or scheme (grids) if need be to get to the heart of the matter. There was some discussion of electronic logs and how quickly DFO may, or may not, be moving towards them. Some careful thought should be given to their implementation. There is a need for flexibility to make modifications.

SUMMARY OF DAY THREE

Day Three began with a discussion of ecosystem considerations, including incidental catch, fishery footprint and potential impacts to benthic habitat.

D. Pezzack presented work to date on analysis of incidental catch in the lobster fishery. A number of concerns and caveats were identified with the SARA-funded sampling that had been used to estimate incidental mortality in the lobster fishery; however, it was still felt to have provided some useful information. Preliminary analysis indicated that the highest bycatch was of Jonah crab, rock crab, hermit crab, sculpin, whelk, sea raven, cusk, and cod. Discard rates for lobster, primarily sublegal lobster, were identified as being quite high in LFAs 34-35. It was suggested that results for SARA-listed species should be highlighted in the analysis. Also,

stacked bar plots could be used for lobster discards to help interpret results better (e.g. to see proportion of berried sublegals).

Ways of estimating the fishery footprint were discussed. Use of the number of trap hauls and an estimate of trap size was suggested. Creating a density map from this information, with an indication of water depth (fishable area) might also be possible. It was acknowledge that, while this may provide a very rough estimate of footprint, it would not provide a good understanding of potential impact to benthic habitat.

Other potential ecosystem indicators of interest include temperature, currents, predation, food availability, disease and anthropogenic impact. There may be oceanographic indicators that are readily available from other sources, but further discussion with oceanographers is required and some consideration should be given to what linkages between these indicators and lobster might be. It was suggested that finfish and seal predation be explored further. Caution was suggested in reporting of disease.

Guidance on annual reporting and research recommendations were discussed.

PROPOSED STRUCTURE OF THE LFA 34 AND LFA 35-38 ASSESSMENTS

Fishery Information

- Landings trends
- Effort trends (days fished and trap hauls)
- Catch composition (at sea sampling)
- Unstandardized CPUE?
- Discards? Comment on discard mortality. Other sources of mortality (if possible).
- Fishery Footprint

Stock Status

Fishable biomass

- 3-year mean of landings, reference point
- 3-year (geometric) mean of RV survey for Eastern GOM
- 3-year (geometric) mean of ITQ survey in LFA 34 (have to look at LFA 35-38)
- Commercial logbook CPUE

Sublegals

- 3-year mean of FSRS CPUE from 1999 (reference point?)
- 3-year (geometric) mean of RV survey for sublegals from 1995 (reference point?)
- 3-year (geometric) mean of ITQ survey for sublegals from 1995 (reference point?)
- Temperature corrected CPUE trend

Recruitment

- Settlement index (no reference point for now)

Reproduction

- Abundance and size structure of berried females
- Size structure of brood stock and sex ratio
- Egg production, potential and observed (no reference point for now)
- Mating success rate
- Combination of all of the above into a reproductive index where data allow

Exploitation / Fishing Pressure

- Days to catch 50% of catch
- Length composition analysis (females)
- Continuous change in ratio method
- Relative F

Ecosystem Indicators

- Predation index
- Habitat index? Sea surface temperature. – Jessica Sameoto. Can do this in SQL as well (define a polygon).
- Bycatch
- "Area of Occupancy"

Management Considerations

- Trends in adjacent areas (Maine / GOM)

Discussion

What data will you use? Will include 2011-2012 fishing season and data from surveys in 2012(may be preliminary).

Need to evaluate the BOF ITQ results still.

NEXT STEPS

The LFA 34-38 Assessment will be conducted in February 2013. Resource Management (C MacDonald) will send out the date to fishermen. It was noted that R. Rochette is busy on Tuesdays.

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APPENDIX 1. 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: Feb 12-14, 2013 (Dartmouth, NS)

Chairperson: Tana Worcester

TERMS OF REFERENCE

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

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APPENDIX 2. LISTS OF PARTICIPANTS

Review of Framework and Assessment for LFA 34-38 Lobster Stocks:
Part 1 - Framework Review

10-12 July 2012

Carl Thomas Room, Fundy Complex
Digby, Nova Scotia

Chair: Tana Worcester

ATTENDEES

Participant	Affiliation
Cassista-Da Ros, Manon	DFO Maritimes / Population Ecology
Cook, Laurence	LFA 38, Grand Manan Fishermen's Association (GMFA)
Cronk, Ron	NB Dept. Agriculture, Aquaculture & Fisheries (NBDAAF)
Denton, Cheryl	DFO Maritimes / Population Ecology
Dunn, David	APCFNC Secretariat
Finley, Monica	Fishermen and Scientists Research Society (FSRS)
Gaudette, Julien	DFO Maritimes / Population Ecology (SABS)
Guptill, Brian	Grand Manan Fishermen's Assn. (GMFA)
Hardie, David	DFO Maritimes / Population Ecology
London, Evelyn	Oromocto First Nation (Wolamuktuk)
MacDonald, Carl	DFO Maritimes / Resource Management
Paul, Jeremy	St. Mary's First Nation
Pezzack, Doug	DFO Maritimes / Population Ecology
Rochette, Remy	UNBSJ / Dept. of Biology
Rondeau, Amélie	DFO Gulf
Scott-Tibbetts, Shannon	Fishermen and Scientists Research Society (FSRS)
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
Thompson, Greg	Fundy North Fishermen's Association (FNFA)
Toney, Gerald	Annapolis Valley First Nation
Tremblay, John	DFO Maritimes / Population Ecology
Worcester, Tana	DFO Maritimes / Centre for Science Advice

APPENDIX 3. AGENDA

Review of Framework and Assessment for LFA 34-38 Lobster Stocks:
Part 1 - Framework Review

10-12 July 2012

Carl Thomas Room, Fundy Complex
Digby, Nova Scotia

Chair: Tana Worcester

DRAFT AGENDA

10 July 2012 – Tuesday

10:00-10:45 Introduction and Background

- Context
- Life history and relevant biological information
- Reference points – current approach

10:45-11:15 Stock Structure and Management Unit

11:15-12:30 Description of Data Sources

- Commercial logs, port and at-sea samples, observer data, FSRS data
- Fishery-independent data from surveys, young-of-the-year sampling
- CPUE and size structure from different data sources

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

1:30-2:30 Description of Data Sources (con.)

2:30-3:15 Size at Maturity Studies to Date

- LFA 34
- LFAs 35-38

3:15-3:30 Break

3:30-5:00 Fishery Performance Indicators

- Landings, effort

11 July 2012 – Wednesday

9:00-9:15 Review of Previous Day

9:15-10:30 Abundance Indicators – Fishery Dependent

- Standardized CPUE (commercial logs, FSRS)
- Temperature-corrected CPUE (FSRS, LFA 34 only)

10:30-10:45 Break

10:45-12:30 Abundance Indicators – Fishery Independent

- ITQ survey; summer trawl survey; scallop survey
- Settlement time series

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

1:30-2:30 Reproduction – Spawner and Egg Production Indicators

2:30-3:15 Fishing Pressure

- Indicators from logs
- Size-based measures
- Change-in ratio

3:15-3:30 Break

3:30-5:00 Application of indicators in the assessment, and potential reference points

12 July 2012 – Thursday

9:00-9:15 Review of Previous Days

9:15-10:00 Ecosystem Considerations

- Incidental catch
- Fishery footprint

10:00-10:30 Reference Points – Further Considerations

10:30-10:45 Break

10:45-12:00 Reference Points – Plans for Assessment

12:00-1:00 Assessment Schedule