

Utility of Catch and Landings Per Unit of Fishing Effort (CPUE and LPUE) in Gulf of Maine and Georges Banks cod Stock Assessments

August 21, 2012
Gloucester, MA

Introduction

The Northeast Fisheries Science Center (NEFSC) convened a workshop among fishermen, fisheries scientists, and managers to determine the utility of including fishery-dependent Catch and Landings per Unit Effort (CPUE and LPUE) in the stock assessment of Gulf of Maine and Georges Bank Atlantic cod stocks. Twenty-nine experts participated in the workshop on August 21, 2012 in Gloucester, Massachusetts. Participants represented commercial fishermen; academic researchers, State and Federal fishery biologists; State and Federal fishery managers, New England Fishery Management Council members and staff, and staff of elected Federal Government representatives. The objectives of the workshop were to determine those factors of fishery-dependent information that confound the use of CPUE/LPUE and recommend new hypotheses of ways to mitigate those factors and potentially incorporate their use in Atlantic cod stock assessments.

Background

Various fisheries assessments around the world use catch rate information (CPUE or LPUE) as a proxy of stock abundance. Generally these proxy abundance estimates are used where fishery independent information is absent or unreliable. A consistent time series must be established to effectively use catch rate information in stock assessments and describe relative abundance over time.

CPUE or LPUE data can often be highly variable or compromised by management or environmental changes through time. Additionally, catch rate data varies considerably across various fishing platforms, seasonal and locational characteristics, fishery methods or evolving technologies employed in fishing operations, and competencies or experience among fishermen.

A debate exists as to the appropriateness of using fishery-dependent catch rate information from the Northeast groundfish fishery in those stock assessments. Self-reported logbook trip data (Vessel Trip Reports-a.k.a. VTR), landings reports from fish dealers, Vessel Monitoring Systems (VMS) and at-sea observer data are the four primary sources of information that could be used in estimating CPUE/LPUE in Northeast Groundfish fisheries.

Terms of Reference (TOR) for the Scientific and Statistical Committee (SSC)

In a meeting of the New England Fishery Management Council's (NEFMC) Science and Statistical Committee (SSC) convened on January 25, 2012, they were asked to identify sources of information, specifically fishery-dependent catch and effort data that may influence the interpretation of the current Gulf of Maine cod assessment results.

The Population Dynamics Branch and the Ecosystems Assessment Program at the NEFSC established 5 major tasks in a work plan to address the SSC mandate:

- 1) Create a standardized CPUE series based on observer reports, perhaps beginning a new time series starting in 1994, consistent with past analytical methods and classification of main effects in generalized linear models. Evaluate development of standardized CPUE including observed discards. Where possible use observer and other applicable data to estimate LPUE by area.
- 2) Update standardized LPUE indices from VTR. Undertake analyses consistent with item (1) above. Evaluate the utility of adding indicator terms to account for additional factors such as rolling closures and trip limits.
- 3) Evaluate the potential use of recreational LPUE from observer data as indicator of relative abundance.
- 4) Examine the relationships among LPUE derived from observer coverage, VTR, and relative abundance estimates (for size classes vulnerable to the commercial fishery) from research vessel surveys.
- 5) Examine sensitivity of assessment results to including these sources of Observer and VTR information.

Basics of CPUE as Stock Abundance Index: How do scientists use abundance indices?

Three presentations were given by NEFSC scientists. Questions and answers ensued after each presentation and in-depth discussions among workshop participants clarified constraints in the use of CPUE/LPUE. Potential options for resolving the issues and constraints of incorporating catch rate information in stock assessments were outlined.

Presentation 1: Changes in Distribution of Fishing Behavior and Concentration of Resources, Michael Palmer

What are the differences in the use of LPUE, CPUE, and discard estimates?

The primary constraint is that at-sea discards are not accounted for in LPUE and there are no reliable VTR data on discards. When observer CPUE is considered, there is low observer coverage in the groundfish fishery before 2005. Thus, it is difficult to see trends in CPUE before that year and difficult to build a long time series relative to current levels of at-sea observer monitoring. In fact, late in the time series, there is no difference in the trends of CPUE and LPUE. This makes interpretation of catch rate data very difficult and compromises its use for stock assessment purposes.

Increased efficiency in the fishery over time also makes it difficult to compare relative catch rates between years with less effective navigational and acoustic fish finding technology to more modern systems that increase fishing efficiency. It is particularly difficult to compare fishing methods prior to the advent of otter trawl to current trawl gear that use devices that increase fishing efficiency such as electronic net monitoring technology.

Another factor that makes interpretation of CPUE/LPUE difficult is the potential culling of inefficient vessels from the fishery that render the time series comparisons near impossible. Thus, comparisons of current CPUE to previous years would require some form of calibration or adjustments to equilibrate the abundance estimates. Because there are so many factors that influence catch rates, equilibrating across years and different fisheries is extremely difficult.

Participants suggested that looking at a few selected vessels with a long history of reliable reporting, selecting them through permit information, could be a way to more effectively monitor catch rates which may be more consistent over time. To do this, however, improvements in those vessels technologies would need to be identified and taken into consideration. Additionally, if analysis were restricted to those vessels reporting over a longer time series (20+ years) there would be a need to eliminate effort in periods of trip limits or during times of closures. This may result in very low sample sizes. Some efforts have in fact been made to do this analysis, but no clear trends have emerged.

Days-at-sea issues also were discussed. Framework 42 to the Groundfish Fishery Management Plan (FMP) resulted in various effects such as trip limits and reduced DAS. At that time several other things happened at once: cod became more valuable and there was a cyclical increase in cod abundance. These increases in cod co-occurred with decreases in flounder concentrations. This may be a result of shifting directed fishing behaviors from more highly regulated stocks to those species that are more abundant, thus resulting in more variability in catch rates of cod during these times. Thus, it remains very difficult to understand and partition out catch rate variability, even when following individual vessels through time.

Participants agreed that we definitely need to account for shifts in management schemes. For example, do flounders withstand increased fishing effort during periods when cod catch are highly regulated? The consensus was that yellowtail flounder do, but gray sole not as much.

Workshop participants considered looking at the NEFSC trawl survey to make comparisons with commercial catch trends over time. The presenter noted that the NEFSC trawl survey is essentially a narrow window in time that affects the estimated catchability relative to commercial catchability. Spring and fall survey cruises do not reflect what is occurring during the summer and winter when the commercial fishery is still operational and cod aggregations occur for feeding or spawning purposes.

One workshop participant who is a commercial fisherman noted that some vessels' fishing efficiency have been relatively constant over time. For these vessels, the CPUE should show

an increase trend in CPUE from 2004-2009. He offered to coordinate acquiring individual vessel “wheel house logbook” or personal skippers notes to help facilitate a more in-depth analysis of this.

Workshop participants recognized that differences in recent cod assessments were primarily driven by a small number of survey vessel tows that had high catch rates. The NEFSC survey hit these fish in 2007 & 2008, which caused the spike in the model. That concentration seems to have gone away in the 2009 and 2010 surveys, but the commercial fleet saw these aggregations on Stellwagen Bank or in Statistical Area 26. Earlier sampling showed an increase in survey and commercial catch rates in that stratum (26), but the random sampling doesn’t always hit on Stellwagen Bank in sufficient sample sizes to track annual variability. We will see in the next presentation how prey species can influence aggregations or dispersions of cod and thus affect both survey and commercial catch rates. It was mentioned that the swept area analysis of the NEFSC trawl survey and the small sample sizes across the entire continental shelf pushes the limits of that data.

The question was asked, “Can you do any standardization by fuel costs?” Answer, no.

Comment: “The NEFSC survey is a multispecies survey – would a cod survey be re-stratified, somewhat like the Gulf of Maine Cod Survey conducted a few years ago by the Massachusetts Division of Marine fisheries? (That would include Stellwagen Bank as a stratum or force more sampling there as well as the cod conservation zone-CCZ?).

Response: The new cod assessment model deals with this relative uncertainty.

Fixed gear such as gillnets were considered. Gillnet CPUE are highly variable as the efforts on the VTRs are very inconsistent, simply based on variations in soak times among fishermen. This adds another layer of uncertainty. One suggestion was that we could try to ‘screen’ the data to group relative soak times of near shore versus off-shore fishing patterns. The near shore soak times are generally in terms of a few hours while off-shore soak times are much longer, in terms of days rather than hours.

A recommendation was made to look at commercial CPUE to fill in area gaps. A participant suggested that, “You should be able to fill in gaps in the differences in catchability by area (for example: Stellwagen vs. other areas) when big swings are evident, go look at commercial CPUE to determine if the fishery shows any trend in catch rates for those areas.

Response: “This is not likely possible without doing an extensive experiment.”

Much of the data on effort/efficiency is based on very broad categories such as ton class, vessel length, longer timeframes such as quarters (3 months), and fishing gear type. Participants recommended the need to identify long-term vessels and gather information on their electronics to see if there were realized enhancements that improved efficiency and thus catch rate. As mentioned above, one fisherman believes that this kind of information exists and could be easily collected through individual vessel’s logbooks or interviews with vessel owners and captains.

There are a limited number of examples where catch rate information is used to “drive the model”, for example-the tilefish industry. There, fleet CPUE and landings explain 70% of variation in the assessment model. Additionally, tilefish are not susceptible to NEFSC bottom trawl gear and therefore very little stock assessment information is derived from fishery independent sources.

For the groundfish industry, use of VTR data and observer data are not likely to be sufficient in explaining significant sources of variation in catch rates. The question of using Study Fleets to gather improved catch and effort data was posed. Improved electronic reporting systems and more real-time data entry (such as data that is immediately entered by fishermen (such as catch and discard information following each tow) and more concise categories describing current fishing gear, would help to improve fishery dependent data. Some form of verification is still needed as this remains “self-reported”, we fall back on the edict of “Trust but verify.”

The NEFSC surveys essentially show us the big picture of continental shelf stocks across years, while the states’ surveys show trends in smaller areas and depending on the survey, shorter periods of time. Some analysis of marine recreational fishery data can show trends in cod abundance north and south of Cape Ann.

Regulatory effects on CPUE/LPUE still remain important and must be accounted for. Chad Demarest presented information on this in during the third presentation, see below.

Discussion also centered on the need to improve the catalog of fleet-specifications relative to fishing power. For example, a suggestion to create enhanced net or gear specifications and categories that are more descriptive of current fishing gear, thus estimating more precise effort by similar gears. Some of this information is in the permits system. A participant recommended that more analysis be put into permit information to improve fishing power definitions. Another participant suggested that the at-sea observer data may have some of this information too and more focus on that data could help improve fishing power categories.

The discussion shifted to inshore fishery independent survey issues. It was suggested that the NEFSC bottom trawl survey does not sample in hard bottom (rocky) areas or where lots of lobster gear or other fixed gear are found. The NEFSC staff described the stratified random survey design and policies that allow sample strategies at stations where fixed gear are encountered.

Participant question: How has CPUE for cod been used in the past? Response: LPUE was used in 2008 assessment, but the data set used only went up to 1994 due to regulatory changes after that. Trip limits and area closures caused LPUE homogenization of landings due to those regulations. The main regulatory effect was to render LPUE the same for all vessels.

The 2010 assessment was modeled with and without an LPUE index. That analysis was not very informative so it was dropped from the assessment modeling.

A participant asked if the GMRI stock structure workshop provided any information that helped develop CPUE and LPUE indices? Response: catchability is a huge confounding issue. This is the primary reason that LPUE data was not updated past 1994. Regulatory changes from 1993-2000 make analysis of CPUE/LPUE almost impossible.

Presentation 2: Effects of Prey Concentration on Resource Distribution-Sand Lance, Dave Richardson

This presentation showed that prey species such as sand lance and Atlantic herring influence aggregations or dispersions of feeding Atlantic cod, thus influencing catch rates. Recent sand lance aggregations have attracted large concentrations of feeding cod. When sand lance abundance is down, cod feed on herring which display a broader dispersion of schooling and movements in larger temporal and spatial characteristics. This tends to disperse cod as well. When sand lance abundance is high in localized areas (such as stratum 26 on Stellwagen Bank) the fishery tends to concentrate in that same area and catch of the fishery is reflected similarly.

Discussion

The lack of inshore cod in recent years (2011&12) has been blamed on lack of baitfish. Question: Is there any evidence for this? Response: No diet data available yet from the most recent surveys. Larval species data from stomach contents of Atlantic cod for 2011 & 12 is preliminary at this time. There does appear to be more sand lance on Stellwagen than on Georges Bank, but sand lance abundance is probably trending downwards. The dominant year class of 2010 Atlantic herring (2 years old), are beginning to show up and that may act to disperse cod in the near future.

Discussion focused on the Survey Vessel S/V Bigelow and the net used in the NEFSC survey has low catchability of sand lance. Additionally, there is no data on sand lance or herring aggregations in a fine scale area resolution.

Stellwagen Sanctuary research has focused on sand lance abundance and life history. This research has utilized some acoustic data on Stellwagen Bank through whale research and some NEFSC bottom trawl information, but currently the data are not fully processed.

The Massachusetts Division of Marine Fisheries conducts near shore fishery independent surveys and that gear is more efficient for sampling sand lance. More research is needed using that data.

NEFSC use fine mesh Bongo net methods in larval fish surveys. These sampling methods are better for sand lance. Other sampling methods were discussed and one participant mentioned that skate survey abundance and catch rate data, using a 'Flatfish' survey net, seems to be more consistent with other abundance indices derived from fishery dependent data.

Question: can this be incorporated into a CPUE index? Response: there may be various ways to look at this. Fishery independent survey stratification is weighted by overall mean and size of strata, influenced by bigger strata that carry more weight. Due to ship time, budget, weather, and now we are doing shorter tows and more tows (about 150 stations in 25,000 square miles of the Gulf of Maine), we do mathematical smoothing based on data points through time. This resulted in an observed sand lance and cod concentration in 2006, which resulted in an LPUE spike in commercial catches and an observed spike in sand lance abundance.

The discussion shifted to how to use LPUE if it changes with the food source? It was pointed out that there would be a need to incorporate alternative scenarios and data sources into the assessment model. It would be a real challenge to quantify prey source and incorporate it into the model.

The NEFSC staff explained that commercial LPUE will not work in the current model because the information is inconsistent with all other information (updated through 2010). The assessment can be run with only 1 set of data at a time (NEFSC, state, CPUE, etc.) to gain maximum scenarios and this can sometimes result in the entire assessment being thrown out.

Question: LPUE – is it calculated for the entire Gulf of Maine or can it be a discrete estimate for a particular area, such as the recreational LPUE which is always concentrated in the Western Gulf of Maine? There are particular issues associated with Marine Recreational Fishery Statistical data that make it hard to expand to entire stock areas or larger marine ecosystems.

Suggestions for additional hypothesis testing

Recreational LPUE: these data should be more spatially consistent as the recreational fishing generally occurs in fairly specific areas, but not temporally (spring closures) and minimum size regulations changed in 2006. Again, another example of regulatory influences on catch and catch rates of fisheries. More research should occur on recreational CPUE.

One area to look at would be to create dummy variables that could be used to identify management regime shifts. There was agreement from fishery scientists and managers in attendance, but it does not always result in a clear outcome, it can be very unbalanced.

A recommendation to consider spawning condition of fish in CPUE/LPUE was suggested. The basis of this is that fish are aggregated when spawning and maybe there is a way to use this as a classification variable (based on time). The response was that we can deal with some of this but doesn't always work in situations where spawning occurs over longer periods of time in different areas or where multiple spawns may occur in a single year for some species. Some evidence suggests that cod in certain areas may actually spawn twice per year.

A participant suggested that it may help to model commercial LPUE information by quarter. That may be beneficial, but rolling closures changed management regime and no maturity information is collected in observer data.

Study Fleet project could potentially gather maturity, age and growth data, but currently there is no time series dating back very far as the study fleet has only been operating for a few years and sampling protocols are evolving.

A participant stated that the Maine/New Hampshire in-shore trawl survey data also should be looked at. The reply came from the survey manager from the Maine Department of Marine Resources. She stated that sand lance is generally not caught in that survey. There are some inshore stations in southern Maine where occasionally sand lance are caught, but sampling has to hit it right and it is highly variable. The cod in that survey are usually feeding on shrimp.

Concluding remarks from this discussion reiterate the previous point: prior to 1994, commercial LPUE tracked survey results better. After that the regulations caused confounding effects and made it harder to track cod abundance through commercial landing and catch rates.

But, there may be value in identifying subset of commercial fishing boats that have fished consistently over time. It was recommended that will be important to track the 'Captain effect', or as a fishermen gains experience, he gets more efficient. How would that quantified or accounted for in LPUE analysis? Factoring in technology was revisited. There are differing opinions on how much the evolution of new technologies has influenced fishing efficiency. It most likely varies greatly by fishery.

Presentation 3: A Brief and Enjoyable Discussion of the Potential Impacts of Regulations on CPUE and LPUE Indices, Chad Demarest

Can we establish a non-biased relationship between CATCH and ABUNDANCE?
What information is lacking?

Regulations that most likely affect catch rate and abundance relationships include:

- Trip limits
- Rolling closures
- Permanently closed areas
- Days at Sea (DAS) limits and differential counting of DAS (such as 1.5 to 1 counting of effort restrictions)
- Changes in net mesh sizes
- Changes in minimum size limits of fish
- Other species' (a.k.a. choke species) regulations and landings limits

It was stated that quota-based fishery management systems can reduce some of the 'wedges' between correlations of CPUE and abundance, if appropriate data are collected and used. There are still determining factors on catch, such as market driven mechanisms or pre-determined amounts to be harvested based on market needs, fish sizes desired, and other consumer driven determinants for targeting of fish.

Discussion focused on what level of observer coverage is needed to establish better CPUE/LPUE? The answer to that depends on objectives of the observer program. In the past the observer coverage was around 20% and was primarily protected species focused. More recently, gear monitoring, catch and discard quantification and total catch became more relevant.

Targeted tows can be a wrench in the works, but also help us better understand fishing effort and catch rates for specific species, particularly now in catch-share quota based fisheries.

Other assessments (such as tilefish) are using CPUE/LPUE, but as stated above, they don't usually have dependable fishery-independent survey information that is reliable enough to model for assessments.

The participants generally agreed that there is low public access to and understanding of CPUE/LPUE data or modeling outcomes. The end result from assessments (for example, recommendations on fishing allocations) is mostly what is seen by the fishing community.

A core question was raised: is the effort and expense worthwhile to improve CPUE/LPUE fishery dependent data use in the assessment? Does improving these data result in significantly better science, more defensible, or more allocation? The purpose of this discussion is to develop more defensible methodologies.

Do wedges presented in this workshop only decrease the estimates of abundance?

- Variable trip limits? – Yes
- Area closures – not sure
- Is CPUE different after rolling closures? Depends of fishery-catch at age is important
 - Commercial fishery – primarily age 3 & 4 fish, some 5 & 6
 - Recreational fishery – mostly age 3 & 4 fish

Workshop Recommendations

The discussions focused on exploring the following tasks:

Additional informational needs and some new hypotheses to explore:

-Need more analysis of fixed gear data – some done but data not as clean (more variable)

- Explore natural or environmental sources of cod mortality-juvenile and adult. Predators – what contribution of predation occurs through dogfish, seals, or sharks?
- Better explore food habits of Atlantic – Gulf of Maine and Georges Bank.
- Explore such things as: as alleged on Cape Cod, the dogfish are ‘taking over’ habitat in some areas and what effects are on cod reproduction.
- Explore the concept that charter vessels are changing targeting behavior.
- Determine if dealer records are in fact not representative of CPUE/LPUE.
- Take a more in-depth look at observer data with a focus on a small amount of ‘best’ data or vessels that are more ‘consistent’ over time in fishing practices.
- Standard Bycatch Reporting Methodology report – try to determine if in most instances, are observer data similar to unobserved trips? There are some indications that this is true but unsubstantiated, we need to look at this.
- Selection bias in observer data, i.e., is selection really random? Are there more day trips vs. trip fishing trips selected by observers?
- Need to generate confidence levels in observer data and use those more when determining discards estimates that will be applied to entire fishery.
- Council directed question. How likely is it that a sector is not abusing/overusing ACE? Is it possible that sector data may not meet needs of assessment?
- Question: How does allocation system change the need to collect and incorporate CPUE/LPUE into stock assessment modeling?
- Fishing decisions change every day based on target species constantly moving and changing market conditions. How can we incorporate such information into catch rate analysis?
- What other information is needed? Such as:
 - Market pricing of purchasing or leasing quota? We are not sure how this information can be used in LPUE models.
 - Non market-based value of quota? For example, what if quota is available to fishermen based on an open trading system between sectors. Not sure where that discussion led.
- All survey gear has catchability issues, how to correlate these catch rates with commercial catch rate data.
- There currently seems to be lots of cod allocation still on the table and no lease market, so maybe this does mean less abundance? Again, how to incorporate market conditions into an economic variable in modeling exercises.
- A final note provided by the fisherman representative: short-term management windows and fluctuations not good for fish or fishermen. We need to create a longer term management orientation so fishermen and the fish populations they harvest can become more stable.

Some other suggestions:

Assemble relevant data bases for the analysis using Vessel Trip Report (VTR), Observer Coverage, and Vessel Monitoring System (VMS) information from specific fishing vessels that may have a more consistent fishing history over a large number of years.

Examine alternative specifications for defining directed cod fishing trips, look at creating more concise categories of fishing gear and modes of deployment that are more similar, and try to analyze these trips.

Examine using temporal factors such as seasonal or monthly time periods as fixed effects in the model using LPUE information.

Comments on Workshop Process

Workshop participants were asked to comment on the overall workshop and this approach in working toward solving stock assessment issues.

Responses included:

- good format and preparation by NEFSC
- Is a day or evening meeting better? Probably doesn't matter, everyone [fishermen] are burned out on meetings anyway.
- This is a more directed way to do outreach and to explain difficult science issues such as the use of fishery dependent CPUE/LPUE information in stock assessments.
- This was a good opportunity for clarification of information and seeking publics' input
- Though, there was one participant who was unsure about utility and format of this kind of meeting. His concern was that they are external to the assessment process. He was concerned that the Stock Assessment Review Committee could throw out any conclusions, and that would undermine the process and trust established during these meetings. His suggestion: **This feedback should be provided to the Council's Science and Statistical Committee.** One participant commented that it is time consuming for NEFSC staff to prepare for and attend these meetings. There was agreement amongst participants: they don't think it could be done for every assessment. One participant asked: 'In the stock assessment process, is there much time for questions and clarifications?' Response: 'It all depends on who is managing the meeting and who is involved in the discussion.'
- this seems beneficial but there are some concerns about the meeting workload for NEFSC and burnout for industry. We need to make sure the fishermen are willing to come to the important meetings (where feedback is provided to the SSC).

Appendices

Announcement and Agenda

Cod CPUE Workshop

August 21, 2012
Endicott College Campus,
Gloucester, MA

Meeting Announcement:

Greetings,

The Population Dynamics Branch in the Northeast Fisheries Science Center (NEFSC) will be hosting a workshop to address the potential use of commercial catch per unit effort information in upcoming Georges Bank and Gulf of Maine Atlantic cod stock assessments in December. The purpose of the meeting is to develop a better understanding of Catch per Unit of Effort (CPUE) and Landings per Unit of Effort (LPUE) as measures of relative stock abundance. Analyses of such data are complicated by changes in the distribution of cod, changes in the spatial distribution of fishing effort over time, and the many changes in fishery management measures that have occurred since the mid 1990's. NEFSC scientists will present an overview of analyses that have been conducted to date. We are soliciting insights from commercial and recreational fisherman to help improve the utility of such information in stock assessments.

This workshop will consider proposals and alternative hypotheses from fishery experts like you. We are expecting that fishermen, fishing industry leaders, state marine fishery biologists, Council members and staff, and NMFS staff will participate in this workshop.

Your contribution is important. Please plan on attending.

We have 'locked-in' the date for this LPUE workshop: **Tuesday August 21, 10 am to 4:30 pm**, at the Endicott College Campus in Gloucester, MA. Address: 33 Commercial Street, Gloucester, MA. (In the Gloucester Chamber of Commerce building. Next to Saint Peter's Square, Pavillion Beach. Free parking available)

If you are unable to attend, please send me a list of industry participants that you recommend be invited. We seek industry members from the commercial and recreational fisheries.

Please RSVP (respond to this e-mail using: earl.meredith@noaa.gov) as soon as possible as space may be limited. Please feel free to contact me if you have questions, concerns or suggestions by calling my cell phone: 508 450-5524.

Many thanks,
Earl Meredith
Northeast Fisheries Science Center

Meeting Agenda:

10:00 Welcome/Introductions –*Earl Meredith, NEFSC and Richard Weissman, Endicott College*

- 10:15** **Basics of CPUE as Stock Assessment index: How do scientists use abundance indices?** –*Loretta O’Brian, NEFSC Population Dynamics Branch*
- 10:25** **Presentation 1: Changes in distribution of fishing behavior and concentration of resources** – *Michael Palmer, NEFSC Population Dynamics Branch*
- 11:05** **Presentation 2: Effects of prey concentration on resource distribution-sand lance** – *Dave Richardson, NEFSC Oceanography Branch*
- 11:20** **Presentation 3: Major changes in regulations and analysis of their effects** – *Chad Demarest, NEFSC Social Sciences Branch*
- 11:40** **Identification and Discussion of Major Topics for Afternoon Session**
- 12:00** **Lunch**
- 1:00** **Discussions with fishermen- What are alternative hypotheses?**
- 3:30** **Break**
- 3:45** **Summary of Major conclusions and recommendations**

GOM Cod LPUE/CPUE Workshop Attendees - August 21, 2012

Name	Affiliation
Fiona Hogan	NEFMC
Bill Gerencer	Portland, ME
Helen Rush-Lloyd	Office of Congressman John Tierney
Jackie Odell	Northeast Seafood Coalition
Dan Goethel	SMAST
Dave Goethel (by proxy)	industry - Hampton, NH
Eric Brazer	CCHCFA
Ben Martens	Maine Coast Fishermen's Assoc.
Richard Allen	R.B Allen Assoc.
Matthew McKenzie	Uconn/NEFMC
Patrick Pagneble (?)	Recreational Advocate
Vito Giacalone	Northeast Seafood Coalition/GFCPF
Jim St Cyr	NERO
Dan Georgianna	SMAST
David Pierce	Mass DMF
Carolyn Woodhead	NEFSC Coop Research
Sally Sherman	Maine DMR
Earl Meredith	NEFSC Coop Research
Michael Lanning	NERO
Mike Palmer	NEFSC
Dave Richardson	NEFSC
Tom Nies	NEFMC
Jay Hermsen	NERO
Megan O'Connor	NEFSC
Paul Nitschke	NEFSC
Mark Terceiro	NEFSC
Katherine Sosebee	NEFSC
Neil Glickstein	Endicott College
Chad Demarest	NEFSC