MAINE DEPARTMENT OF MARINE RESOURCES

COASTAL FISHERY RESEARCH PRIORITIES

LOBSTER

(Homarus americanus)

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for

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Contents

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Preface

The 2010 research priority setting workshops follow a decade of research since the Maine Department of Marine Resources held the last series of workshops in 2000. There has been a great deal of information gathered and new insights gained over these ten years. Most importantly, Maine fishermen have become full partners in establishing the research questions and pursuing the answers to those questions through collaborative research. Maine has been a leader in the region for engaging fishermen, scientists, and managers in the quest for better information on which to manage its fisheries. While there has been great progress, there remain many unanswered questions and further work to be done. Through this collaborative approach to research, drawing upon Maine's creative and innovative spirit, we are optimistic that the most pressing questions will continue to be addressed in the next decade.

I. Lobster Background

The American lobster (*Homarus americanus*) fishery is Maine's iconic fishery and dominates over all other fisheries in the state in terms of numbers of participants and economic value. In 2009, there was a record 78 million pounds landed and the dockside value of the catch was $228 million. There were 5380 Maine commercial lobster licenses sold in 2009.

Lobster abundance, landings and value have steadily increased since the late 1980s. Prior to that, the long-term average landings had been approximately 20 million pounds since 1950. Despite predictions that lobster landings have been at unsustainably high levels, the Maine lobster fishery continues to appear robust and landings have remained above 50 million pounds since 2002. However, it is worth noting that the Maine Department of Marine Resources (DMR) increased their effort to collect voluntary landings data from some dealers in 2002 and 2003 and lobster reporting became mandatory for all Maine dealers buying directly from harvesters in 2004. Therefore, comparisons with earlier landings data may be less accurate. Lobster landings in Southern New England peaked in the early 1990's and have fallen significantly since then.

While lobster landings have been increasing, other Maine fisheries such as groundfish and scallops have been declining. The relative health of the lobster fishery has allowed the industry to absorb an influx of harvesters displaced from other fisheries experiencing declining stocks. Meanwhile, access to other fisheries in the region has become tightly controlled. It is believed that many fishermen who previously targeted lobsters only part time or not at all are now exclusively dependent on the lobster resource. Many rural coastal towns now depend almost entirely on lobstering to support the local economy.

The Atlantic States Marine Fisheries Commission (ASMFC) has primary management responsibility for the lobster fishery through state regulatory and statutory actions. The National Marine Fisheries Service (NMFS) develops complementary management actions affecting federal waters. ASMFC decisions must be implemented in Maine through state action; however ASMFC has the power to find Maine out of compliance and the Secretary of Commerce may declare a moratorium on lobster fishing in the state if Maine does not comply. Maine regulates the fishery through both legislative actions and DMR regulatory actions.

Since 1996, Maine has implemented a unique co-management approach to lobster management. The coast is divided into seven lobster management zones, each of which is divided into voting districts of approximately 100 fishermen. Lobstermen elect representatives to a zone council that can set referendum questions. The zone councils work with the Maine Lobster Advisory Council and the Commissioner of DMR to enact management tailored to local conditions. Zones run from east (Zone A) to west (Zone G). More information about the zone councils can be found at the DMR website at www.maine.gov/dmr/council/lobsterzonecouncils/index.htm.

Entry to the lobster fishery is controlled through a two-year, on-board apprenticeship requirement. In addition, each lobster zone has the option to limit entry in the zone through an entry/exit ratio and all but one zone has elected to establish a limited entry ratio. Lobster fishing in Maine State waters and by Maine license holders is a trap-only fishery and each trap requires a trap tag. There is a statewide trap cap of 800 traps per boat, but each zone has the authority to consider a referendum on a more restrictive trap limit. Maine lobster traps are required to have a

vent to release undersize lobsters and the trap dimensions are also regulated. More details are available at www.maine.gov/dmr/rm/lobster/index.htm.

Maine lobstermen take pride in the lobster regulations to protect both juveniles and large lobsters through a dual gauge that includes a 3 1/4" minimum measure and a 5" maximum measure. In addition, lobstermen protect reproductive female lobster through a requirement to cut a v-notch in the tail flipper of an egged-out female to mark it. A v-notched lobster is not legal to catch until the notch disappears through successive sheds, usually after several years.

The most significant change in lobster management during the past decade has been the impact of the federal Marine Mammal Protection Act and the Endangered Species Act on the fishery. Maine launched an Atlantic Large Whale Take Reduction Plan in 2001 in response to proposed federal regulations to protect the endangered North Atlantic right whale. Management measures have included gear modifications and a dynamic area management (DAM) program. Beginning on April 5, 2009, the DAM program was eliminated and replaced with a broad-based sinking groundline requirement for the lobster fishery. Further management measures to address vertical lines are under consideration. Visit www.maine.gov/dmr/rm/whale/whale.html for more information.

II. Research Priority Meetings

The Maine Department of Marine Resources (DMR), in collaboration with the Gulf of Maine Research Institute and Maine Sea Grant, conducted a series of meetings in November and December 2010 to develop research priorities for scallops, herring, and lobsters. For scallops and lobsters, these meetings provided an opportunity to update the DMR Research Priorities established through a similar initiative in 2000 for five on Maine's major commercial species (soft-shell clams, lobsters, scallops, sea urchins, and shrimp; see http://www.maine.gov/dmr/research/table_of_contents.htm).

Fishermen, academic scientists, government scientists, fisheries managers, and others interested in fisheries issues gathered together in a non-regulatory, open discussion about the scientific questions they had about each species. The meetings were not structured to address management questions or to decide how to use scallop or lobster research funding. Rather, the result of these meetings is a prioritized list of research questions that can be used to stimulate new research by the marine science community and to help ensure that fishery management decisions are made on the best information.

These meetings followed the formats of the 2000 initiative and a recent rockweed symposium (see http://www.maine.gov/dmr/rm/rockweed/symposium2010/index.htm). Scientists with expertise on each species were invited to give brief presentations on specific topics along with their ideas for major scientific gaps and potential research questions. The presentations were followed by a facilitated discussion that provided an opportunity for exchanging ideas and observations. These ideas formed the basis for a list of research questions. Meeting participants were asked to prioritize among the research questions at the end of the meeting in two ways; first with regard to overall priority and second with regard to the most important research questions to address initially.

III. Report Format

The lobster meeting was divided into four segments: Life History, Stock Assessment, Marine Mammal Interactions and Socioeconomics. A brief overview of each presentation is given in Section IV followed by the priority research questions. Where appropriate, additional topics have been added to reflect the questions and concerns articulated at the meeting, not necessarily how the meeting was structured.

The priority research needs were generated throughout the day and are arranged below under the topic area that is most appropriate, not necessarily the segment where they were discussed. The research needs are listed in priority order within each section.

A detailed, categorized list of questions, observations, and opinions articulated during the meeting is presented in Section V.

IV. Priority Research Questions

Lobster Priority 1: Stock Assessment

Carl Wilson from the Maine DMR presented information on the lobster stock assessment. A summary of his presentation and the discussion is below. The full Powerpoint presentation can be found at www.maine.gov/dmr/research/priorties10/lobster/cwilson.pdf.

Maine has done a good job in the last ten years addressing lobster assessment concerns. Ten years ago, landings were around 40 million pounds, and predictions were that lobsters had peeked and federal scientists declared the resource overfished with overfishing occurring. However, this conflicted with what fishermen were seeing on the water and, in reality, the landings have doubled in the past decade.

The lobster assessment is driven by ASMFC, which divides the resource into three stock areas - Gulf of Maine, Georges Bank, and Southern New England. The lobster assessment has gone through significant changes. Yong Chen at the University of Maine developed a new assessment model between 2001 and 2004. This new model is a length-based model and it has been endorsed by ASMFC and was used for the 2006 and 2009 lobster assessments.

The ASMFC lobster stock assessment uses stock indicators to corroborate model results and provide additional information about the overall health of each stock. The health of the lobster resource is evaluated using a reference period from 1982-2003 and determining if the indicators lie above or below the reference point. The reference period is assumed to be the "normal" status of the stock and the assessment looks at the overall trend (i.e., trend based reference point). A recent peer review rejected the current reference points as too risk prone and new interim reference points are being developed. The ASMFC is moving toward biologically based reference points as these provide a more objective evaluation of the health of the fishery. The Maine lobster fishery is also undergoing the Marine Stewardship Council (MSC) assessment process and the demands of this process may further drive changes to the stock assessment process.

Regardless of the reference points used, the Southern New England (SNE) lobster resource is severely depleted and there is evidence of recruitment failure. The scientific recommendation has been for a 5-year moratorium on harvesting. It is not clear how the collapse of the SNE lobster fishery will impact Maine. Environmental conditions that impact changes of growth should be tracked and incorporated into the assessment models.

The fishing industry expressed concern about trends in the size distribution of lobsters offshore. In the past six years, some lobstermen have seen a decline in larger sized lobsters compared to the previous 10-15 years. There has been evidence from the NMFS offshore trawl survey that larger lobsters are becoming less prevalent and there is an increase in smaller lobsters.

Priority Research Needs:

1. *Evaluating the appropriate time period to use as a baseline for the lobster stock recruitment relationship.*
2. *Examine what environmental factors might correlate to lobster abundance (e.g., water quality, habitat, oceanography, temp, pH), how to measure these factors and determine if they should be integrated into stock assessment models.*
3. *Establish the key factors that industry can assist with in stock assessments (e.g., sea samplers, collecting stomach contents, etc.).*
4. *Explore the aggregate potential impact of lobster traps and fishing practices on habitat.*
5. *Conduct a survey to target larger lobsters.*

Lobster Priority 2: Life History

Rick Wahle from the University of Maine provided an overview of lobster life history, the summary of which can be found below. The full Powerpoint presentation is available at www.maine.gov/dmr/research/priorities10/lobster/wahle.pdf.

The lobster life cycle includes a pelagic stage of 5-9 weeks when lobsters are tiny larvae floating in the water column until they metamorphose to a postlarva which settles to the sea bed and begins the benthic phase. Lobsters reach adulthood after 5-9 years, less time in southern, warmer parts of the range, and more where temperatures are cooler. Since the late 1970s trawl surveys have provided a fishery-independent index of the abundance of relatively large lobsters just above and below the size that recruits to the fishery. In 1989, a diver-based suction sampling program initiated a lobster "settlement index" that monitors the earliest benthic life stages that populate rocky nurseries from the planktonic larval stage. The two parallel data sets are being used to evaluate whether the settlement index can be used to forecast subsequent time trends in recruitment to the fishery. Passive postlarval collectors are also used for places offshore and in places that are inaccessible to diving. Intertidal monitoring is also conducted to monitor the population of juvenile lobsters.

The connectivity between the source of larvae and larval settlement has been modeled with a bio-physical larval transport model to link hatching hot spots with egg production along the coast. The settlement index has confirmed the location of settlement hot spots predicted by this model. The larval transport model further suggests that a large proportion of larvae settle in the

neighborhood where they hatched, but that the further they hatch from shore the more likely they are to be transported away from their natal grounds.

The geographic range of the American lobster, from Newfoundland to the Mid-Atlantic States, spans the steepest gradient in sea surface temperature in the world. The thermal gradient is accompanied by biogeographic shifts in the biota with which lobsters interact - from changes in the intensity of fish predation, to competition with crabs, to their vulnerability to disease. In turn, the processes influencing rates of growth, mortality, and reproduction differ from one end of the range to the other. There have been changes in time as well. Most notable has been a decrease in the groundfish population over the past few decades, likely from over-harvesting, that many scientists view as the reason for the dramatic increase lobster populations in the Gulf of Maine over the same period. On the other hand, lobster populations in southern New England have declined precipitously since the onset of shell disease in the late 1990s. This geographic variability calls for the need to develop regionally customized forecasting models, and for variable approaches to lobster fishery management in different regions.

Priority Research Needs:

1. *Determine the impacts from the increasing use of alternative/artificial baits (e.g., disease, invasive species, etc.).*
2. *Establish better accounting of natural mortality rates (M) and the predator/prey relationships between lobster and other species (e.g., crabs and groundfish).*
3. *Determine if the settlement index is sufficient for tracking time trends or if a random, stratified sampling approach for abundance estimates should be used.*
4. *Examine the epidemiology of lobster diseases (e.g., shell diseases such as Gaffkemia).*
5. *Collect molt increment data for larger lobsters for growth models.*

Lobster Priority 3: Socioeconomics

Jim Wilson from the University of Maine provided some thoughts about the socioecoomics of the Maine lobster industry and its governance structure. The Powerpoint presentation can be found at www.maine.gov/dmr/research/priorities10/lobster/jwilson.pdf.

Prior to implementation of the lobster zones, there were 25 years of discussion and debate at the federal level regarding the "one-size-fits-all" management approach from Maine to Cape Hatteras. Good management of any complex system requires multiple levels of governance (e.g., local, state, federal, etc.). The United States has worked out what scale different governance actions should happen (i.e. decisions regarding road maintenance are left to local versus state government entities). To be most effective, responsibility and authority should go to the lowest level unit possible. Experimentation and learning is much more likely at local levels as there are fewer interests to satisfy. Maine may want to consider giving the zone councils more resources and more independence from DMR, and/or giving local districts (or some local areas) some responsibility appropriate to their scale to better address management problems.

A DMR survey on lobster effort conducted in 2008 indicated that ~60% of lobster license holders think there are too many traps in the water, but less than ~40% favor a trap limit. Some areas along the coast are very heterogeneous with distributional disagreement, but there are 13

zone districts that indicated they were very worried about the number of traps and they expressed interest in reducing the number of traps in their area (see http://www.maine.gov/dmr/rm/lobster/effortquest7-17-08.pdf). Understanding some of the zone and district differences may help decide if there are finer scale issues and finer scale solutions.

In 1981 the price of lobster was $2.19/lb or, adjusting for inflation, the price was the equivalent of $5.95/lb in 2007 dollars. In 2007, the price was $4.76/lb, or down about 20% while lobster landings rose from 22.6 million lbs to 69.9 million lbs during the same period. In 2010 landings may reach 100 million lbs with an estimated price holding around $4.00/lb while the US is in a recession. This is a remarkable market history for a product that was assumed to have a very inelastic (or nearly fixed) demand. Documenting and understanding this history will inform any market related policies in the future, especially if there is a decline in landings.

The population of lobster license holders is rapidly getting older leading to questions regarding the apprenticeship system's ability to handle the turnover in an equitable and efficient way.

Disease and sometimes other dynamics in a population can lead to sudden changes at high densities and Maine has very high densities of lobsters. Collapses in other fisheries and other kinds of systems elsewhere have happened for a variety of reasons and in a variety of ways. There is no clear way to prepare for a possible collapse of the lobster fishery, except to understand what has happened elsewhere, in other fisheries, and in other comparable arenas.

Patrice McCarron of the Maine Lobstermen's Association also described a profitability study being conducted in partnership with the Gulf of Maine Research Institute. The project is collecting data across the region, including the landside component of the business. Information is being collected through intensive interviews and will include documenting earnings, bait, gear, debt, time spent on water and elsewhere, etc. There will also be a more broad based, simplified survey in Area 1.

The discussion on lobster socioeconomics included the potential impact of marine spatial planning initiatives on the lobster industry and the lobstermen's willingness to engage in the planning process. Specifically, potential displacement of lobstermen as a result of efforts to develop the offshore wind energy industry in the Gulf of Maine was discussed. Recent legislation in Maine established the process for determining ocean wind farm sites and the lobster industry harbors mistrust of the process.

Priority Research Needs:

1. *Determine the potential economic value to the industry of investing in the lobster industry and what strategic investments should be made.*
2. *Produce better bio-economic models that describe the biological, economic, and management links between key Gulf of Maine species.*
3. *Develop an understanding of the history of price/market fluctuation to inform related policies in the future.*

4. *Explore the value of the lobstering space (areas) and the value of the lobster fishery to the community, especially in regard to competing uses for marine space such as offshore energy.*

Lobster Priority 4: Governance

Although not presented as a separate topic, the session on socioeconomics included a great deal of discussion on lobster management and the scale of governance. The lobster industry is made up of a large and diverse population of fishermen making it difficult to have rules that can be applied to everyone. Even within zones, the industry is a collection of multiple small businesses with different perspective on the best strategy for their business.

Engaging with the zone council process requires changes in behavior and cultural attitudes toward governance. 'Self-governance' is difficult and the zones have struggled with how to deal with the big hard questions. Education and training is necessary. Perhaps target objectives should be established at a higher level for the finer scale management to work toward. Alternatively, sometimes people just need to have data available to allow the attitudes to percolate and shift.

Priority Research Needs:

1. *Evaluate the zone council process; include considering if the zone council process can be improved by giving the zone councils more resources, independence, and/or increasing responsibility of districts.*
2. *Provide education or other assistance with regard to governance (i.e. publicizing examples where industry's input/advice has impacted management and science).*
3. *Explore what incentives may motivate voluntary self-restraint through regulation.*
4. *Learn from other fisheries in the world that have collapsed, such as Chesapeake blue crab.*
5. *Determine what tools and models are needed to allow better collaboration between management and industry.*

Lobster Priority 5: Marine Mammal Interactions

Erin Summers of the Maine DMR presented information on marine mammal interactions. The Powerpoint presentation is summarized below and the full presentation can be found at http://www.maine.gov/dmr/research/priorities10/lobster/summers.pdf.

There are three endangered whale stocks in the Gulf of Maine – right whales, humpback whales, and fin whales. Right whales and humpback whales are currently over their potential biological removal (PBR) and therefore regulations to reduce entanglement risk are necessary.
The Atlantic Large Whale Take Reduction Team is the advisory board to NMFS that recommends regulatory measures to reduce fishery related takes. It is made up of state and federal managers, industry representatives, whale biologists and representatives from the conservation community. In April 2009, requirements to use sinking groundline outside of the exemption line and vertical line marking were implemented. Draft rules for vertical lines are planned for spring 2013 with the final rules adopted by spring 2014. NMFS has always

maintained that both groundlines and vertical groundlines would be managed, regardless of how the sinking groundline rules affect the population.

There is very little data on where entanglements occur and what types of gear are involved. There is no data to determine whether entanglements happen with trawls or with single traps. Larger whales break the gear, so there are no traps or buoys to provide information. Most information regarding whales is outside of three miles. There have been five whale entanglements inside State waters between 1997-2005.

Past survey initiatives to document the fishery have included voluntary surveys and annual logs to estimate how and where the gear is fished. Maine currently requires 100% dealer reporting and 10% harvester reporting which provides more accurate effort data (versus using trap tag purchases) and allows for an estimate of latent effort in the fishery. NMFS is working on a co-occurrence model to find "hot spots" where the highest density and distribution of gear corresponds to the different species of whales. Therefore, regulations on vertical lines can be focused in these hot spots.

Current initiatives include ground truth of information from surveys and logs. Aerial surveys take place in regulated state waters from September through November. Whale distribution is monitored through the use of passive acoustic buoys in waters off of Mount Desert Rock. The distribution of whale prey (copepods) is monitored through inshore-offshore surveys in the summer and fall, with prey most often found outside 50 fathoms. Modeling of particle movements is also used to predict prey distribution. There are several potential projects in the future including investigating the diving behavior of whales and acoustic monitoring of state waters.

Priority Research Needs

1. *Establish a more accurate accounting of lobster fishing effort (including latent effort) to determine how many traps are being fished and where.*
2. *Evaluate the magnitude of marine debris/ghost gear as a potential consequence of sink rope regulations.*
3. *Evaluate the success of current regulations.*
4. *Expand information on whale distribution inshore and seasonally (summer) through sightings data.*

V. Lobster Observations and Questions from Discussion

Stock Assessment:

- Time variable stock recruitment relationships (e.g. 50 yr/other), context of stock size over time and relative vulnerability.
- Is there a relationship between size class abundance offshore vs. inshore abundance?
- At what spatial scale do we start to see the spawner to recruit relationship?
- What is the right spatial scale for the assessment? (evidence for W.GOM vs. E.GOM)
- What are the environmental factors that might correlate to lobster abundance? [Water quality, habitat, oceanography, temp, pH (acidification)] and how can/should these be measured and integrated into stock assessment models?
- What is "normal" in the lobster fishery (change is normal)
- Need better understanding of stock-recruit relationship – how local is local? What is the best spatial scale?
- Need better accounting of natural mortality (M)
- What are the best reference points? (trend-based, biological?)
- Are we better off using data intensive and complicated models, or more common sense approaches?
- Can the length-based model incorporate ecosystem information? What is needed for this to happen and what is the added value of such a move?
- What are the key factors that industry can assist with in stock assessments? (For example, sea samplers and stomach contents)
- How can they best add to the data? For example: fewer fishermen each collecting more data, or many fishermen each collecting just a little (process for productive collaboration)
- Expanded time frame of assessments?
- Survey for larger lobsters; gill net or trammel nets?
- Molt increment data needed for big lobsters – lab study?

- Are the current abundance estimates for large lobsters accurate?
- Population scale genetics: We should do on a finer scale (such as for growth)
- Research effects of methods to determine fishing mortality: How do these methods that we use influence our stock assessments?
- Control fishing mortality in stock assessment
- Regular peer review in place to be sure current monitoring and management, (and research) is on target
- We need to understand population crashes, and learn from other examples.

Life History:

- Predator/prey relationships between lobster and other species (crab/groundfish) (*at large scale so you can see what is happening on Northern end of range vs. Southern end of range*)
- Crowding effects, potential impact from cannibalism, housing shortage, and disease?
- What is the epidemiology of lobster diseases (shell disease/ *Gaffkemia*)?
- Is settlement index sufficient for tracking time trends or should we also use random, stratified sampling approach for abundance estimates?
- Linking of various monitoring programs/life stages to overall abundance and health of fishery
- Are there concerns about impacts from alternative/artificial baits (disease, invasive species)
- Biosecurity in general
- Egg quality in relation to age of female lobster
- And sperm production in males (*Is the lobster fishery currently sperm limited?)*
- How do we capture the changes in fishing patterns over time? How to deliver that information back to industry and others?
- Are we looking too closely, is it a broad enough view?

- Natural mortality rates (M) are key to understand – also changes in predators (spp, pressure) need to be understood

- Historical view of lobster with regard to predators in the GOM? (Cash economy makes this difficult); BUT how relevant is historical data to today given change in environment, predators, etc?

- How to capture/model/display survival bottlenecks, which change over time (predation, climate change)

- Disease: would like to know more, but that won't change the impacts if disease pressure increases – effects may be different based on location

- Production is down in rivers and estuaries – what's going on? (Is predation part of this – stripers?)

- Is V-notching too effective? Are there disease risks from such increased population levels? Attitudes toward V-notching seem to be changing?

- What is the meta-population structure for lobster? (includes sub-population)

- What is the population structure by sex? Behavioral difference? (esp. in larger sizes)

- Growth models improving but still have gaps, especially for larger/older lobsters

- Density-dependent

- Research on impacts of ocean acidification effects

- Watershed runoff creating pollution

Ecosystem Dynamics:

- What is the aggregate potential impact of lobster traps and fishing practices on habitat? (response to MSC need)

- Are ghost traps an issue?

- Ocean acidification impact on fishery and other community assemblages (estuary vs. coastal waters)

- In the future, habitat impacts will be likely coming– Habitat research to determine behavior trends? Do we know the carrying capacities for juvenile and adults? (rearing/survival bottlenecks)
    - Bettering bycatch (i.e. flounders)
    - Leading to management of crab spp.

- Effects of traps and bait on lobster behavior and population (example: putting traps on mud, lobsters will follow? How many needed? Density?)

- Is there a correlation between the urchin fishery (macroalgal cover) and lobster abundance?

- Potential impacts of pesticides from aquaculture (or land side) or juveniles

- Is the GOM balanced with respect to lobster biomass?

- Need better bio-economic models that describe the links (biology, economics, and management) between key GOM species

- A need for newer, regionalized data and bioenergetic components

Marine Mammals:

- Need more accurate accounting of effort (not just for mammal issues) –how much and where

- Trap density through buoy data from aerial surveys

- Local/habitat specific studies of behavior

- Gear/rope research and related problems with ghost gear/marine debris

- Assessment of success of current regulations [to protect marine mammals]

- Bolster studies on scarification on whales

- Need finer scale whale movement (satellite tracking or other technologies)

- Marine debris/ghost gear as a consequence of regulations

- Tagging alternatives for Right whales – acceptable to NMFS

- Benefits of extending trawl-only areas? What data would be needed to explore this?

- Need for sightings data in inshore areas
    - No data presently
    - Extend the observation season

- Ropeless gear:
    - Research needed for "hot spots"

    - (proposals for research have been denied, need to get around reasons why)

- Potential for ghost gear

- Need to understand enforcement issues with regard to ropeless gear

- Impacts of wind farm development on acoustic technologies?
    - Developers must address this is their plans

- Impacts of wind farms on the whales themselves (i.e. habitat displacement 'masking')

- Latent Effort:
    - Knowing how many extra traps are purchased?
    - What is the value, or use, of getting more precise information on latent effort?
    - How do we survey accurately for effort? Need more statistically defensible methods.

- Expand study of whale prey to Downeast region
    - Expand also with regard to vertical distribution
    - Does this need to be long term to account for variability?

- Prey studies:
    - Are there technologies/approaches that can be used on industry boats?
    - Yes, need a ground-truthing step ($)

- Turtles: simmering background issue

- Impacts from seals: grey, harbor

- What other data sources could we use to understanding whale occupancy (especially inshore); feed, bathymetry, oceanography, other historical data sets?
    - Can apply DAM analyses to resulting maps

- Is there a need to monitor transiting areas?

- Whale distribution inshore and seasonally (summer)

- Monitoring gear densities and effort long-term

- Vertical behavior of whales and their prey in rocky habitats

- Monitoring effectiveness of regulations (scarification analysis)

- Habitat use differences between persistent aggregation sites and transiting areas

- Effects of trawling gear in different areas

Socioeconomics:

- Understanding of the history of price/market fluctuation to inform related policies in the future.

- How will attrition and the apprenticeship program affect the demographics of the industry? (entry/exit ratios)

- Why has the market performed so well? How did this happen?

- Will the apprentice question handle the turnover in the fishery, equitably?

- Need stats on the lobster industry secondary and tertiary economic benefits to communities.

- What are the costs to maintain infrastructure? (bait, fuel, etc.)?

- What behavior knowledge do we need to change this dynamic, including perspectives from the past?

- Strong role for education or other assistance with regard to governance (i.e. publicizing case where industry's input/advice has impacted management and science)

- How does the bar get set for change? Who sets it?

- Marine spatial planning

- Basic information like bathymetry and mapping

- Hard to have trust in sharing fishing information with regard to offshore energy
    - Need to understand and articulate the value ($ and otherwise) of fishing and other current uses vs. proposed uses like energy

- Value of space; value to the community

- What are the lessons from interaction between wind and fishing, in other countries?
    - How do we get this information and get it to the fishing industry?

- What information is available to industry so they can engage in the [ocean energy] process well?

- What is the potential value to the industry of investing in the lobster industry? What should those investments be? (i.e. strategic investments)

Governance:

- How do we manage exploitation? [trap density studies, etc., effort]
- Are there other fisheries in the world that have collapsed to learn from, such as Chesapeake blue crab?
- Can we improve the zone council process by giving the zone councils more resources/independence and/or increasing responsibility of districts?
- Would finer scale governance rules about trap limits be more effective?
- Can we learn from mistakes in other fisheries that suffered collapse?
- Evaluation of zone council process: Is it working? Where and how?
- What are the limits of what we can reasonably expect fishermen to do in managing their own fishery?
- What are some incentives that motivate voluntary self-restraint through regulation?
- Can we improve state and zone governance?
- Opportunity to understand and use the dynamic:
    - Most fishermen believe there are too many traps, but
    - Few what to reduce their traps (but some exceptions to this)
- How could management change the "come to a meeting to fight" mindset to "come to the meeting to talk" appraoch? … more flexibility … inclusiveness
- What tools and models do we need to allow better collaboration between management and industry?

VI. Lobster Meeting Participants

David Libby, Linda Mercer, Kate Burns, Laura Taylor Singer, Carl Wilson, Mark Gosselin, Dana Morse, Sarah Cotnoir, Erin Summers, Richard Nelson, Kathleen Reardon, Ryan Haskell, Jonathan Grabowski, Jeanie Cushman, Charlene Bergeron, Curt Brown, Patrice McCarron, Larry Knapp, Pat White, Alexa Dayton, Jim Henderson, Zach Whitener, Rick Whale, Lilia Percy, Jack

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