Workshop Summary:
Changing Ocean Conditions Related to Fisheries
held at
Rutgers, The State University of New Jersey
New Brunswick, NJ
April 4-5, 2017

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Led by the Mid-Atlantic Regional Council on the Ocean (MARCO) and the Mid-Atlantic Regional Association Coastal Ocean Observing System (MARACOOS).[1]

[1] The information in this report should not be construed as an endorsement or policy of the organization involved. MARCO and MARACOOS hope that others find the information in this report useful to their changing ocean conditions efforts.

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Workshop Goals

The changing ocean conditions workshop was held on April 4-5, 2017 at the Rutgers University Inn and Conference Center. The workshop was jointly convened by the Mid-Atlantic Regional Council on the Ocean (MARCO) and the Mid-Atlantic Regional Association Coastal Ocean Observing System (MARACOOS) as part of the larger project entitled 'Mid-Atlantic Regional Resilience: Linking Coastal Ocean Information to Enhance Economic, Social and Ecological Resilience'. Participation in the workshop was drawn from expertise within MARACOOS and MARCO communities as well as invitations to federal, state and industry partners currently engaged in activities linking ecology with living resource management. Twenty-seven participants gathered for the presentations and discussion. The goals of the workshop were to:

1. *Identify regional data sources and assets relevant to ecological observation and modeling.*
2. *Inventory existing efforts in the Mid-Atlantic Region (including states, federal, academic and private sectors) that explore how changing ocean physical conditions may reflect ecosystem shifts that are impacting fisheries and associated marine resources of cross-regional importance.*
3. *Identify gaps to more efficiently develop tools that support ecologically informed management.*
4. *Develop an initial strategy to improve communication among these efforts so that planning tools improve the characterization of the structure of the ocean to help steer improved policy, and fish community level analysis.*

The agenda and this workshop summary are organized around sessions focused on each of these stated objectives.

Welcome and Overview

(Josh Kohut, Rutgers University/MARACOOS and Peter Moore, MARACOOS)

Josh Kohut and Peter Moore opened the workshop by welcoming the participants and providing a brief description of the *Mid-Atlantic Regional Resilience: Linking Coastal Ocean Information to Enhance Economic, Social and Ecological Resilience*[2] project. They introduced and thanked the steering team members for their help in framing the agenda. Finally, they discussed the agenda with a particular focus on the objectives of each session. Their presentation reminded the participants that prior to the workshop all invitees were asked to provide input related to the four topics covered in the four sessions of the workshop agenda. For each session, a speaker was assigned to introduce the topic and summarize the input received prior to the workshop.

The following sections of this workshop are organized by session, presenting a brief summary of the introductory presentation and the discussion that followed.

[2] This broader project seeks to: (1) Characterize changing ocean conditions affecting ecological, social and economic resilience of coastal communities, land and ocean use; (2) Strengthen regional collaboration, identification and sharing of state and regional resilience strategies and best practices; and (3) Expand communication regarding the role of the coastal ocean in community resilience, and risks posed by a changing climate.

Session 1: Inventory of Existing Datasets

Review of existing data resources and assets (Kevin Friedland, NOAA Northeast Fisheries Science Center)

Kevin Friedland presented a review of existing data resources and assets. His presentation summarized the federal data routinely collected in the region relevant to Mid-Atlantic Bight (MAB) fisheries. These included in-situ and satellite based measurements of physical (temperature, salinity, etc.) and biological (chlorophyll, trawl) parameters. His presentation described the different visualizations of data available including seasonal maps and decadal trends. At the conclusion of Kevin's presentation, Josh Kohut presented a summary of other relevant data provided by meeting participants prior to the workshop. These data are summarized in the following general categories:

National Programs

- Mid Atlantic Regional Association Coastal Ocean Observing System (MARACOOS), a regional component of the Integrated Ocean Observing System (IOOS).
- National Science Foundation (NSF) Ocean Observing Initiative's Pioneer Array.

Environmental

- Water temperature (collected on gear and by surveys)
- Water salinity (collected on gear and by surveys)
- Tidal velocity
- Wind speed
- Sea state
- Dissolved oxygen
- pH
- Chlorophyll A
- Wind direction
- Wind speed
- Beaufort number
- Sediment type
- Surface water temperature from satellites
- Surface chlorophyll from satellites
- Turbidity/clarity

Surveys

- NEFSC Bottom Trawl Survey
- ECOMON Surveys
- NEAMAP Trawl Survey
- Connecticut Trawl Survey
- New Jersey Trawl Survey
- New York Ocean Haul Seine Survey
- Delaware Electrofishing Survey
- New York YOY Seine Survey
- New York W. Long Island Seine Survey

- New Jersey YOY Seine Survey
- Virginia YOY Seine Survey
- Maryland YOY and Age 1 Seine Survey
- Maine-New Hampshire Inshore Trawl Survey
- Massachusetts Division of Marine Fisheries Bottom Trawl Survey

Species Data

- Weights
- Lengths
- Diets
- Abundance
    - Video camera (Habitat mapping systems)
    - Fishery dependent data
    - Fishery independent data
- Bycatch species
- Fish behavior (Video recording)
- Telemetry – Animal Movement

Vessel Data

- Boat tracks
- Swept area of the gear
- Gear type
- Position
- Scope ratio
- Wire out
- Vessel speed and direction

Session 1 Discussion Summary

A discussion among all the participants followed Kevin's presentation. This discussion was organized around two guiding questions.

1) Are there other kinds of data we could include that would make this inventory more useful for you?

In response to this first question, participants offered a list of additional datasets not specified in either Kevin's presentation or the input received from the participants prior to the workshop. These additional data include:

- Environmental, economic, and social data provided by the NOAA/NMFS/NEFSC Study Fleet Program.
- Output from numerical ocean models configured as hindcasts (the prior several decades), nowcasts/forecasts (today to two days into the future) and future projections (many decades into the future).
- Climatologies (long term mean fields) derived from existing in situ and satellite datasets described in Kevin's summary.
- Social data collected by federal, state and industry partners that include vessel trip reports and economic information (trip and market costs)

- The participants discussed a need to fill geographic gaps in the existing datasets in addition to adding new data types. Filling gaps in both physical and fisheries data off the continental shelf were a high priority.
- There are opportunities to fill gaps in these data inventories with citizen science programs targeting the collection of ocean data.

2) What other reporting mechanism might increase your awareness and use of this information?
The discussion of the second guiding question was centered around new or existing reporting mechanisms that foster communication of these data to decision makers. The initial discussion was on the existing roadblocks in communication of data synthesis throughout the stakeholder community. These roadblocks include:

- Sharing of study fleet bottom temperature data.
- In general, there was a consensus that data sharing was limited by the availability of direct contacts. Mechanisms for automated access to data is not clear. This was a particular issue for the industry participants who clearly indicated the issues they have with accessing relevant environmental and social data.

These roadblocks could be overcome between the communities through increased collaboration. It was noted that these collaborations were critical to ensure that data can help improve understanding and applications. Additionally, these barriers could be addressed with:

- More effort to share documentation on the parameters/steps needed to access the data.
- Map interfaces to discover and share data.
- Data providers to provide exemplars of data access as a template for new groups interested in using their data in their own synthesis.
- Use of trends and anomalies as a first synthesis to make the relevance of the data more evident.

Session 2: Inventory of Existing Syntheses

Review of Existing Synthesis (Peter Moore, MARACOOS)

Peter Moore presented a summary of the existing data synthesis inventory provided by the participants prior to the workshop. His presentation included syntheses from federal, academic, and collaborative efforts in the region. These are summarized in the list below.

Federal Data Synthesis

- NOAA/NMFS/NEFSC Ecosystem Status Reports (annual)
- NOAA/NMFS/NEFSC "Ecosystem Advisory" (now called "Current conditions") (annual)
- NOAA/NMFS/NEFSC Northeast Regional Action Plan (periodic)

Academic Community

- Project reports
- Project websites
- Scientific peer reviewed literature

Government, Academic, Industry Partnerships

- IOOS/MARACOOS Website and published reports
- Mid-Atlantic Acoustic Telemetry Observation System (MATOS)
- MARACOOS Industry Partnerships
    a. TruWeather Solutions-MARACOOS Aquaculture Weather and Water Decision-Support and Alert Notification System (under development)
    b. Weatherflow™
    c. Roffers Ocean Fishing Forecasting Service, Inc. (ROFFS™)

Session 2 Discussion Summary

A discussion followed Peter's presentation among all the participants, which was organized around three guiding questions.

1) What kind of efforts should be captured in the inventory that would make it most useful to you?

The participants articulated that the usefulness of these data syntheses is hindered by a flawed model. The broad community is creating solutions looking for a problem, rather than identifying the problem and finding a solution. In other words, the community needs to be more purposeful in the effort to synthesize and share data. The problems should be identified collaboratively among all the relevant stakeholders. The solutions to these problems could then be drawn from available syntheses, as mentioned above, as well as other syntheses such as the following that were offered by workshop participants:

- Ocean Adapt
- Trawl survey data (southeast, MAB, Scotian Shelf)
- Species distribution projections
- Other agency syntheses, including the U.S. Navy
- Acoustics to estimate biomass
- Seasonal reporting of ocean currents (HF Radar and moorings)
- Dynamical analysis of circulation (Lagrangian Coherent Structures)
- Fish phenology
- *Sargassum* weed tracking and reporting
- Laboratory data that is useful to go beyond abundance (Survey)

The solutions should address region specific ecological processes:

- Cold Pool Variability
- Links to winter fisheries
- Links to upwelling
- Atlantic Meridional Overturning Circulation (AMOC)
    i. Gulf Stream flow north of Cape Hatteras
    ii. Monitoring over 26.5N

The participants stressed the importance of considering the relevance to managing living marine resources and impacts to the operation of the industry when examining the problems and

associated solutions. While industry partners have valid hypotheses to inform and test solutions, they often lack the rigorous scientific means to test them. The management community needs these data syntheses to be presented in a way that is accessible to the public process.

2) What mechanisms could be used for updating and sharing this inventory? (e.g., regular updates? websites? shared work spaces? etc.)

This discussion centered around a recognition that the existing data are under analyzed. This was attributed to the difficulty in finding relevant data and the lack of effort and resources to do the analysis. The discussion then shifted to possible solutions to overcome some of these barriers. Access to the data could be improved with better coordination with regional data providers (MARCO/MARACOOS, others), community software toolkits to access and handle the data (R Python, Matlab, modeling testbed as an example of how to do this, gitHub), and smart databases that integrates state, federal, and international surveys (i.e. maps on request).

3) What other reporting mechanism might increase your awareness and use of this information?

Data discovery was a key issue discussed throughout this session. Solutions were centered on the need for improved communication of data resources and means to access them. These solutions include:

- Adequate metadata should be provided to facilitate synthesis data discovery.
- Documentation on the length of time a data series must have for reliable trend analysis.
- Need to make sure metadata and provenance are properly included with data.
- Ecosystem monitoring and fisheries catch reporting must approach "real-time" to match the speed of the ecosystem change in order to produce actionable datasets.

Session 3: Gaps and barriers to more efficiently develop tools that support ecologically informed management

Incorporating environmental data into management (John Manderson, NOAA Northeast Fisheries Science Center)

John Manderson opened session three with a presentation introducing concepts of dynamic habitat. He described important differences between terrestrial landscapes and marine seascapes. He concluded his presentation with examples of the opportunities to enable more relevant environmental data into the management process. He stressed that these gaps can be filled through collaborative workgroups that include expertise for all the impacted stakeholders in the region.

Session 3 Discussion Summary

The desired outcome of session 3 discussions was that participants use their knowledge of existing data, resources, and efforts to identify opportunities to improve ecologically informed management. Following John Manderson's presentation, the participants were divided into three breakout groups of approximately nine people. A facilitator was assigned to each breakout group and guided the discussion through the following guiding questions. Here we summarize the key points that came from the three breakout groups collectively.

1) What kind of information would improve ecologically informed management? Is there an existing effort to collect that information or is it a gap?

Participants generated lists of additional datasets that were not explicitly described in the inventories discussed in the prior two sessions. While there is some overlap with prior sessions, the participants wanted to make sure the gaps were clearly communicated as an output of the workshop. There was consensus across all three groups that more environmental data is needed, particularly bottom temperature, salinity, dissolved oxygen, current, structure and sediment data. These data should be mapped to facilitate dialogue on the synthesis and application to management. Collaborative workgroups that include industry knowledge of the system should define and prioritize the common indicator variables of ecosystem health. In addition, these collaborative workgroups should identify the entry points for this ecological information to inform existing management and decision-making process.

There was a recognition among the breakout groups that new technology is becoming more available to augment existing data streams. These include animal borne sensors and camera systems in nets that will provide additional behavior and movement data. Physical models of past, present and future conditions can also be generated to inform ecological models. Such ecological models that incorporate these physical fields are then used to incorporate the ecology, economics, and human behavior (e.g. ATLANTIS). Even with these new technologies and products coming online, bottlenecks still exist, particularly fish data (age and diet) and data that integrate across social and economic aspects of the ecology.

2) What are some of the gaps in data resources and assets? Will some existing activities address those gaps? If not, what could be done to address them?
The consistent theme that came from all the breakouts groups in response to this question was the need for more opportunities for collaborative approaches. Through collaborative groups, represented with individuals from all impacted communities, efforts could be prioritized so that data can be synthesized and model assumptions can be defined in a way that is more readily incorporated in ecologically informed management. The available data resources still do not consider environmental and social data. In addition, it was noted that there is a temporal disconnect between the rate of change in the ecological system and the speed of the science. The science often lags the ecological change. Through a collaborative workgroup, these issues can be addressed.

Following the breakout discussions, all participants collectively reviewed the flipcharts that summarized the discussion from each breakout group. Each participant was also given six dots (two green, two red, and two yellow) to classify the key points from each group. The colored dots were placed on the flipcharts based on the descriptions below:

- **Green/NOW!** -- characteristics include: easy to implement, previous examples, high acceptability, low risk, and quick wins
- **Red/WOW!** -- characteristics include: innovative ideas, potential breakthroughs, exciting ideas, make a distinction, and can be implemented.
- **Yellow/HOW?** -- characteristics include: future ideas, dreams, challenges, visionary, and red ideas for tomorrow.

The results of this exercise are summarized in the same general categories:

Actions to be taken right away (**Green Dots**)

- Better incorporation of fisherman's ecological knowledge of the system into the management process.
- Dedicate more resources to event response (i.e. anomalous temperature events, anomalous catch densities).
- Simplify data presentation to be more appropriate to targeted audience. It is critical to clearly define the audience for the data presentation.
- Incorporate animal behavior and movement data from acoustic and satellite sensors.

Longer term action (**Red Dots**)

- Develop techniques to better tell ecologically relevant stories with the data. Management needs to transition to a process that acknowledges and quantifies the dynamics of the system, appropriate for ecologically based management.
- Improve data translation by engaging computer science expertise.
- Incorporate growing genetic datasets into population estimates and stock assessments, including population and meta-population studies, origin, stresses, EDNA (existing tool), and stable isotope analysis.

Future ideas that require much more time (**Yellow Dots**)

- More expertise is needed to bridge the significant information gap that presently exists between the biology (individual species' population dynamics) and the ecosystem (ecosystem-based fisheries management).
- Develop methodology for audience and application appropriate visualization of more complex ecological model output.
- Incorporate additional fish information, including disease and predation data.

Session 4: Develop an initial strategy to improve communication so that planning tools better characterize the structure of the ocean to help inform better policy, and fish community level analysis

Presentation (Josh Kohut, Rutgers/MARACOOS; Jay Odell, TNC; Warren Elliott, Mid-Atlantic Fishery Management Council)

A joint presentation opened session four. Each speaker briefly discussed data interfaces and communication requirements based on the primary audience they serve. Josh Kohut presented the MARACOOS OceansMap portal (http://oceansmap.maracoos.org/). The primary audience of this portal is interested in the delivery of real-time mapped data. The data input are raw level data feeds from MARACOOS and other federal and state partners. Jay Odell then presented the MARCO Mid-Atlantic Ocean Data Portal (http://portal.midatlanticocean.org/). The target audiences of this portal are ocean planners, natural resource managers, regulators, permit reviewers, first responders, industry and citizens. The data is synthesized and presented on time and space scales more relevant to longer term planning. Data stories and blogs are used to communicate portal functions and introduce new layers into the portal. Finally, Warren Elliott presented on data to inform the decision-making process of the Mid-Atlantic Fishery Management Council. He stressed that the data must be easily interpreted and clearly communicated. A recent Mid-Atlantic Fishery Management Council document, Ecosystem

Approach to Fisheries Management (EAFM), was given as an example of how relevant ecological data should be presented to decision-makers.

Session 4 Discussion Summary

Following this presentation, the participants were assigned to new breakout groups. Once again, each of the three groups was comprised of approximately nine people. A facilitator assigned to each group guided the discussion around these questions:

1) Who are the key audiences for the communication strategy?

The discussion on relevant audiences to ecologically based management identified several key audiences:

- The general public
- Policy makers, particularly data synthesized to facilitate stoplight decisions highlighted by Warren Elliott's example (EAFM)
- The commercial and recreational fishing communities

Additional audiences identified across the three breakouts include:

- Wind energy sector
- Maritime commerce
- Shipping
- Sand and gravel mining
- Scientific community (researchers)
- Planners
- Recreational users (i.e. surfers, boaters)

2) How will they use the information?

Strategies were discussed on how to better engage these audiences. The most common strategies discussed across all the breakout groups included ensuring relevance of the data presentation to the decision-making process, repeating the communication of the information to the target audiences and the need to engage third party developers trained on effective data communication techniques.

Following the breakouts, all participants collectively reviewed the flipcharts that summarized the discussion from each breakout group. Each participant was also given six dots (two green, two red, and two yellow) to classify the key points from each group. The colored dots were placed on the flipcharts based on the descriptions below:

- **Green/NOW!** -- characteristics include: easy to implement, previous examples, high acceptability, low risk, and quick wins
- **Red/WOW!** -- characteristics include: innovative ideas, potential breakthroughs, exciting ideas, make a distinction, and can be implemented.
- **Yellow/HOW?** -- characteristics include: future ideas, dreams, challenges, visionary, and red ideas for tomorrow.

The results of this exercise are summarized in the same general categories:

Actions to be taken right away (**Green Dots**).
The actions deemed easiest to implement all fell into the common theme of internal communication/action. These include:

- Form collaborative workgroups that include end users to plan and develop new tools and information.
- Continue to develop audience specific portals that are collectively interoperable (i.e. data layers easily shared between the various portals).
- Encourage and support collaboration throughout the existing management process.
- Encourage student training opportunities to help distribute the workload.

Longer term action (**Red Dots**).
The actions deemed longer term to implement all fell into the common theme of external communication. These include*:*

- Develop more effective strategies to better communicate uncertainty in the data and model output.
- Make better use of social media outlets to communicate synthesis of data or model output to end user communities.
- Educate the end user communities so that they are more aware of information and familiar with what the data means - including the data collection process and model configuration process - for more informed decision-making.

Future ideas that require much more time (**Yellow Dots**)
The actions that require much more time to implement all fell into the common theme of relevance of the data and synthesis. These include*:*

- Ensure that the synthesis of the data and model outputs are relevant to the specific decisions to be made. It is important to understand the tools that are most appropriate to address the problem to be solved.
- Use available resources to address gaps in time series of ecological variables including physical, fishery, economic, and social data.

The workshop then concluded with a thank you to the workshop organizers, steering team members, and the meeting participants.

Summary

The input received before and during the workshop by the participants highlighted the variety of resources available to support scientific research, assessment, and decision making related to changing ocean conditions and fisheries in the MAB. Data sources include environmental data from integrated ocean observing systems (e.g. MARACOOS), industry based data collection, and both state and federal survey based observations (Session 1). Synthesis of these data are done on a variety of time scales including annual and seasonal reports (Session 2). Given this great effort, the meeting participants identified some critical short and long term gaps to both better utilize existing resources and invest in additional needs (Session 3). On the short term, the primary communication goal was to facilitate collaborative interactions among all the subject matter experts, including industry, government, and academic stakeholders (Session 4). Over the longer term, effort is needed to engage a broader group with better communication strategies (Session 4). These new groups will facilitate the synthesis of large datasets becoming more

readily available in a way that fits the timescale of the assessments and decision-making processes.

Appendix 1. Agenda

Workshop:
Changing Ocean Conditions Related to Fisheries
April 4-5, 2017

Tuesday April 4, 2017

8:30 - 9:00 a.m.: Registration; Light refreshments provided

9:00 - 9:15: Welcome & Logistics (Josh Kohut) – ***Conference Room A***

9:15 - 9:30: Workshop Objectives and Format (Peter Moore) – ***Conference Room A***

Objectives:

1. *Identify regional data sources and assets relevant to ecological observation and modeling.*
2. *Inventory existing efforts in the Mid-Atlantic Region (including states, federal, academic and private sectors) that explore how changing ocean physical conditions may reflect ecosystem shifts that are impacting fisheries and associated marine resources of cross-regional importance.*
3. *Identify gaps to more efficiently develop tools that support ecologically informed management.*
4. *Develop an initial strategy to improve communication among these efforts so that planning tools improve the characterization of the structure of the ocean to help steer improved policy, and fish community level analysis*

Session 1: Review and Discuss Inventory of Existing Datasets

9:30 – 9:45: Review of existing data resources and assets - Kevin Friedland (NOAA/NMFS/NEFSC) – ***Conference Room A***

9:45 - 10:30: Discuss working inventory of regional ecological observation and modeling data sources, assets and accessibility within MARACOOS and the MARCO Ocean Data Portal. – ***Conference Room A***

Outcome -- Generate and improve sharing of more refined list of data resources and assets on changing ocean conditions in the Mid-Atlantic.

Discussion Questions:

- *Are there other kinds of data we could include that would make this inventory more useful for you?*
- *What mechanisms could be used for updating and sharing this inventory? (e.g., regular updates? websites? shared work spaces? etc.)*
- *What kind of reporting currently exists to share information about this data? What other reporting mechanism might increase your awareness and use of this information?*

10:30 - 11:00: Break

Session 2: Review and Discuss Inventory of Existing Syntheses

11:00 – 11:15: Review of existing syntheses across state, regional, federal and private sectors – Peter Moore – ***Conference Room A***

11:15 - 12:00: Discuss inventory of existing efforts in the state, regional, federal and private sectors that explore how changing ocean physical conditions may reflect ecosystem shifts that are impacting fisheries and associated important living marine resources. – ***Conference Room A***

Outcomes: Participants have an increased understanding of existing state, regional, federal and private efforts to understand changing ocean conditions.

Discussion Questions:

- *What kind of efforts should be captured in the inventory that would make it most useful to you?*
- *What mechanisms could be used for updating and sharing this inventory? (e.g., regular updates? websites?, shared work spaces?, etc.*
- *What kind of reporting currently exists to share information about this data? What other reporting mechanism might increase your awareness and use of this information?*

12:00 - 1:00: Lunch – Dining Room

Session 3: Gaps and barriers to more efficiently develop tools that support ecologically informed management.

1:00 - 1:15: Introduce discussion on gaps – John Manderson (NOAA/NMFS/NEFSC) – ***Conference Room A***

1:15 - 3:00: Break-out Sessions: Discuss gaps in the natural, social and economic systems – ***Conference Rooms A, B, and B Annex***

Outcomes: Participants use their knowledge of existing data, resources, and efforts to identify opportunities to improve ecologically informed management.

Discussion Questions:

- *What kind of information would improve ecologically informed management? Is there an existing effort to collect that information or is it a gap?*
- *What kind of tools could be developed that support ecologically informed management?*
- *What are some of the gaps in data resources and assets? Will some existing activities address those gaps? If not, what could be done to address them?*

3:00 - 3:30: Break

3:30 – 4:15: Review Break-Out Discussions – Walk around - – ***Conference Room A***

- As you circulate, take note of questions you have about another group's ideas, and observations about what the groups came up with (e.g., every group mentioned . . . , curious that only one group mentioned . . . , it became really apparent that . . . , etc.
- You will be given 5 dots to characterize the gaps and prioritize some that could be worked on in the near-term. Color codes:
    - Green/NOW! -- characteristics include: easy to implement; previous examples, high acceptability; low risk; and, quick wins
    - Red/WOW! -- characteristics include: innovative ideas; potential breakthroughs; exciting ideas; make a distinction; and, can be implemented.
    - Yellow/HOW? -- characteristics include: future ideas; dreams, challenges; visionary; and, red ideas for tomorrow.

4:30 – 5:00: Session 3 Group Discussion and Summation – ***Conference Room A***

Wednesday April 5, 2017

Session 4: Develop an initial strategy to improve communication so that planning tools better characterize the structure of the ocean to help inform better policy, and fish community level analysis.

8:30 - 9:00 am.: Improved communication strategies – Josh Kohut, Rutgers/MARACOOS; Jay Odell, TNC; Warren Elliott, MAFMC – ***Conference Room A***

9:00 - 10:30: Break out groups – Communication strategies relevant to the natural, social and economic systems – ***Conference Rooms A, B, and B Annex***

Discussion Questions:

- *Who are the key audiences for the communication strategy? How will they use the information?*
- *What kind of actions could be taken to improve communication about the structure of the ocean and changing ocean conditions?*
- *What actions could be undertaken easily/right away? What actions require more time and investment to accomplish?*

10:30 - 10:45: Break

10:45 - 11:30: Circulate and Review Small Group Discussion. – ***Conference Room A***

As you circulate, take note of questions you have about another group's ideas, and observations about what the groups came up with (e.g., every group mentioned . . . , curious that only one group mentioned . . . , it became really apparent that . . . , etc.

11:30 - 12:00: Session 4 Group Discussion and Summation. – ***Conference Room A***

12:00 - 12:30: Final thoughts and adjourn – ***Conference Room A***

12:30: Lunch

Appendix 2. Workshop Steering Team Members:

- Physical Oceanography: Josh Kohut (Rutgers/MARACOOS)
- Ocean Observing: Peter Moore (MARACOOS)
- MARCO: Kate Morrison (MARCO)
- NOAA/NMFS (Climate): Vince Saba (NOAA/NMFS/NEFSC)
- NOAA/NMFS (Ecosystems): Sarah Giachas (NOAA/NMFS/NEFSC)
- Commercial and Recreational Fishers: Mitch Roffer (ROFFS™)
- MARCO Portal Team: Tony MacDonald (Monmouth University)
- Fisheries Management: Rich Seagraves (MAFMC)
- Fisheries Social Science - Lisa Colburn (NOAA/NMFS/NEFSC)

Special Thanks: Karl Vilacoba, Laura McKay, Darlene Finch, Chris Kinkade

Appendix 3. Workshop Attendees

Bill Bright, FV Enterprise, Cape May Courthouse, NJ

Matt Campo, Rutgers University, New Brunswick, NJ

Lisa Colburn, NEFSC, Narragansett, RI

Kaycee Coleman, USF&W Service, Washington, DC

Warren Elliott, Vice Chairman-MAFMC, Dover, DE

Darlene Finch, NOAA OCM, Silver Spring, MD, darlene.finch@noaa.gov

Mike Ford, NOAA Climate Office, Silver Spring, MD

Kevin Friedland, NOAA NEFSC, Narragansett, RI

Jenna Gatto, Rutgers University, New Brunswick, NJ

Danielle Haulsee, UDEL, Lewes, DE

Todd Janeski, Virginia Commonwealth University, Richmond, VA

Josh Kohut, Rutgers University, New Brunswick, NJ

Rick Lathrop, Rutgers University, New Brunswick, NJ

Tony MacDonald, Urban Coast Institute, Monmouth College, NJ

John Manderson, NOAA NEFSC, Narragansett, RI

Laura McKay, VA DEQ, Richmond, VA

Peter Moore, MARACOOS, Newark, DE

Janet Nye, SUNY Stony Brook, Stony Brook, NY

Jay Odell, TNC, Richmond, VA (MARCO Ocean Data Portal)

Beth Phelan, NOAA NEFSC, Sandy Hook, NJ

Malin Pinsky, Rutgers University, New Brunswick, NJ

Vince Saba, NOAA GFDL, Princeton, NJ

Emily Slesinger, Rutgers University, New Brunswick, NJ

Ron Smolowitz, Coonamesset Farm Foundation, Falmouth, MA

John Wiedenmann, Rutgers University, New Brunswick, NJ

Bill Woodward, NOAA IOOS ATN, Silver Spring, MD

Riley Young-Morse, GOM Research Institute, Portland, ME