Pioneer Array Workshops –

Exploration of Issues and Concerns Connected with the Planned OOI Pioneer Array Project

Summary Report

January 31, 2012

Report on a series of workshops held in the fall of 2011 during which scientists and fishing industry representatives discussed key issues and concerns connected with the planned Pioneer Array Project of the Ocean Observatories Initiative (OOI), and explored ideas and options for resolving those issues and concerns.

Organized and facilitated by the staff of the Commercial Fisheries Research Foundation through support provided by the Consortium for Ocean Leadership, Washington, D.C.

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Workshop Participants:

Bonnie Brady- Executive Director, Long Island Commercial Fishing Association
Bonnie has been working with the Long Island Commercial Fishing Association for 11 years.

Wendell Brown- Coastal Physical Oceanographer/Professor, UMass Dartmouth, SMAST
Wendell is a coastal physical oceanographer and is currently involved with the Mid-Atlantic Regional Association Coastal Ocean Observing System (MARACOOS).

Dan Farnham- Commercial Fisherman, Montauk, NY
Dan owns a 72 ft. long liner and a 95 ft. stern trawler and has been working in the commercial fishing industry for 32 years.

Donald Fox- Commercial Fisherman, Pt. Judith, RI
Don is the fleet manager for 4 fishing vessels ranging from 65-87 ft. in length and has 30 years of experience with many different types of trawl gear, fishing from Virginia to the Hague Line.

Glen Gawarkiewicz- Senior Scientist/Physical Oceanographer, Woods Hole Oceanographic Institution
Glen is a physical oceanographer interested in currents as well as water masses. Glen collaborates with marine mammal scientists, primary productivity biologists and chemists. He has 27 years of experience working in this field.

Kevin Maguire- Commercial Fisherman, Montauk, NY
Kevin owns 3 fishing vessels in the Montauk area as well as a seafood restaurant. He has been commercially fishing in this area for 35 years.

Fred Mattera- Commercial Fisherman, NESTCO, Pt. Judith, RI
Fred is a commercial fisherman and has been in the industry for 39 years. He has been the owner and operator of an 84ft freezer trawler out of Pt. Judith since 1984. Fred also owns the North East Safety Training Co. conducting safety training for commercial and recreational fishermen since 2004. He is Vice-President of the CFRF.

Al Plueddemann- Senior Scientist/Physical Oceanographer, Woods Hole Oceanographic Institution
Al is a project scientist for the Pioneer Array Project and his primary area of research is physical oceanography and air-sea interactions. Al has worked extensively with research moorings, and more recently with autonomous underwater vehicles. He has 25 years of experience working in this field.

Oscar Schofield- Professor, Bio-Optical Oceanography, Rutgers University
Oscar's research specializes in primary productivity, climate change and the oceans, evolution of phytoplankton and global geochemistry, hydrological optics, and integrated ocean observatories.

David Spencer- Offshore lobsterman, Spencer Fish & Lobster Inc., Newport, RI
David has been offshore lobstering since 1973. David owns and operates an 85 ft. lobster vessel out of Newport RI. He serves as President of the Atlantic Offshore Lobstermen's Association and President of the CFRF.

Bonnie Spinazzola- Executive Director, Atlantic Offshore Lobstermen's Association
Bonnie has been the Executive Director of the Atlantic Offshore Lobstermen's Association for thirteen years.

Norbert Stamps-Commercial Fisherman, Jason & Dannelle Inc., Pt. Judith, RI
Norbert is a commercial fisherman operating both inshore and offshore and has fished the area for 37 years. He also serves as the co-vice president of the Atlantic Offshore Lobstermen's Association and owns 2 offshore lobster vessels that fish in this area.

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Executive Summary

A series of four workshops, aimed at addressing issues and concerns connected with the Pioneer Array Project, were held in Pt. Judith, Rhode Island in the fall of 2011. Representatives from the commercial fishing industry based in Rhode Island and New York, and representatives from the science team working on the Pioneer Array Project, came together to identify potential gear interactions, safety hazards, and possible alternative siting arrangements, and discuss options for avoiding conflicts and handling negative interactions when they do happen. The workshops, organized, facilitated, and reported on by the staff of the Commercial Fisheries Research Foundation, were intended to provide an opportunity for discussion and sharing of information outside of public hearings or public participation events connected with the acquisition of permits for the project. The outcome of these discussions, in the form of a list of recommendations, is intended to serve as a basis for continued discussion by others in the science and fishing communities, and be used as a resource for guiding next steps.

Background information on the components and planned operations of the Pioneer Array Project and on the existing fishing activity in the study area was shared by scientists and fishing industry representatives early in the workshop process. The Pioneer Array Project study area is located along the Continental Shelf break, centered about 70 nautical miles south of Martha's Vineyard, and includes three major components: 1) Mooring Array; 2) Autonomous Underwater Vehicles (AUVs); and 3) Gliders. The Mooring Array is comprised of 10 moorings at 7 sites located within an area ranging in depth from 52 fathoms to 273 fathoms, and covering approximately 125 square nautical miles. It includes three types of moorings: 1) Surface Moorings (large buoys with 15 foot towers supporting scientific instrumentation and an instrumented mooring line and anchor); 2) Moored Profilers (smaller buoys supporting telemetry equipment and a wire-following profiler equipped with scientific instrumentation); and 3) Winched Profilers (supporting profilers containing scientific instrumentation that is winched up and down through the water column to make measurements). AUVs are propeller driven, 500 lb., cylindrical vehicles, powered by batteries, that will travel at up to 3 knots on routes undulating through the water column making measurements on temperature, salinity, pressure, dissolved oxygen, currents, optical properties, chlorophyll, organic matter, and nutrients. The AUV operating area covers an area of approximately 2400 square nautical miles (60 nm north-south by 40 nm east-west). Gliders, also cylindrical vehicles but without propellers, are able to "fly" on missions through the water column making the same types of measurements (other than nutrients), weigh about 100 lbs., and have wings on each side. They are battery powered, able to travel at a speed of about 0.5 knots, and can go to deeper depths than AUVs. The Glider operating area overlaps that of the AUVs, but extends further offshore, covering approximately 7,000 square nautical miles (100 nm north-south by 70 nm east-west). Scientists want to study the circulation and nutrient exchange between the continental shelf and slope, and relate these processes to productivity.

Existing commercial fishing activity in the Pioneer Array study area encompasses a large number of fishing vessels and gear types. Fishing industry representatives estimated a total of approximately 334 commercial fishing vessels with a total crew of about 1225 currently fishing in the area. Gear types include trawls, lobster and crab pots, gillnets, long lines, and rod and reel. Targeted species include

squid, silver hake, red hake, butterfish, tilefish, scup, black sea bass, summer flounder, jon dory, mackerel, monkfish, lobster, red crabs, swordfish, tuna, sharks, marlin, and mahi mahi, with commercial fishing occurring throughout the year. The study area overlaps with prime commercial fishing grounds, and is also used by the charter boat and recreational fishing sectors. A history of gear conflicts in the area has led to the establishment of fishing gear regulations.

The major concerns and issues raised during the discussions include the following:

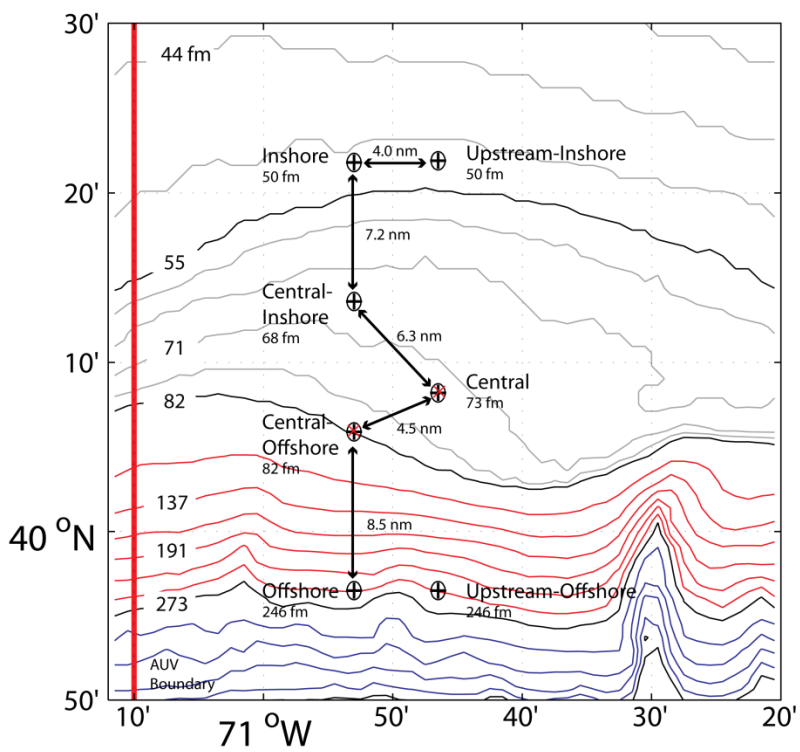
- ***Safety hazard* -** The straight line mooring arrangement designed to measure gradients across the shelf break in the original plan presents a major obstacle in terms of the maneuverability of fishing vessels, particularly trawling fishing vessels that frequent the study area in the winter months. In high seas, a trawler passing through the study area could get hung up on moorings leading to the possibility of a vessel capsizing and loss of life.
- ***Prime lobster fishing ground* -** Lobstermen need to retain access to the "mud patch" in this study area, a prime lobster fishing ground.
- ***Inadequate navigational aids* -** The existing plans for use of navigational aids such as guard buoys and visual aids attached to surface moorings is deemed by fishing industry representatives to be inadequate. Fishermen need to be informed of the exact locations (coordinates) of all moorings, the coordinates of all "site centers" and radius of the buffer zone circle surrounding the center so they are able to input this information into the onboard computers they use for navigation.
- ***Negative interactions with mobile science equipment*** - With AUVs being deployed in heavily fished areas, and traveling at up to 3 knots to the surface, there is a concern about them coming up and hitting the bottoms of fishing vessels, or colliding or entangling with the vessel paravanes (stabilizing "birds" located some 20-30 feet below the surface that are connected to fishing vessel outriggers). AUVs and Gliders could also become entangled in vertical lines (lobster trap lines and long line operations), or captured in trawls. Gillnets may be especially vulnerable to the mobile gear components of the Pioneer Array Project.
- ***Mooring movements* -** Storms in the area are capable of moving moorings. Planned maintenance schedules may need to be adjusted.
- ***Planning for what to do when something goes wrong and liability concerns* -** Based on the amount of fishing activity in the area, the type of science equipment being placed or operating in the study area, and the duration of the project (5 years), negative interactions, gear conflicts, and accidents are likely to occur despite efforts to avoid mishaps. There is concern that there are no guidance procedures in place to handle situations when interactions happen, and liability concerns have not been adequately identified and addressed. To proceed without addressing potential conflict situations and liability issues and concerns would be irresponsible given the safety hazards and potential gear conflicts identified in the discussions.
- ***Mass communication with fishing industry*** - Most commercial and recreational fishermen do not know about the Pioneer Array Project and need to be informed about the type of science equipment being deployed, what to do to avoid interactions and what to do if they inadvertently have an interaction, how long the project will be in place, the exact locations of science equipment, etc.
- ***Ongoing communication*** – A mechanism for ongoing communication between Pioneer Array scientists and fishing industry representatives over the course of the project to address areas needing further work or decisions that may arise has not yet been established.

- ***Research connections to fisheries science -*** Application of the research done through the Pioneer Array Project to fisheries research should be encouraged. It would be beneficial to address this subject further and broaden the discussion to include fishery scientists, managers, fishing industry leaders, and other Pioneer Array scientists.

Workshop participants developed a list of recommendations to address the issues and concerns raised along with the reasons for the recommendations (complete listing on pages 22-31 of summary report). Major recommendations include the following:

1. ***Rearrange the Mooring Array by shifting the whole arrangement to the west, the Central Site (74 fathom mooring) to the northeast, and northern most moorings (Inshore Site – 52 fathoms and Upstream Inshore Site – 52 fathoms) to the north (to 50 fathoms). Place the Central Offshore Site Mooring (82 fathom mooring) and Central Mooring (74 fathom mooring moved east to 73 fathoms) on existing shipwrecks.***

Proposed arrangement (for comparison purposes see original arrangement on page 9 of final report):



Note: Distances between mooring sites are the distance from buffer edge to buffer edge with the buffer zone being a .5nm radius around each site center.

2. Inform all fishermen fishing in the area of the exact locations (coordinates) of all mooring site centers and radius of the buffer zones circle surrounding each center, the type of individual moorings

within a mooring site, and of any changes in position over time. Couple this with improvements aimed at increasing the visible profile of moorings at sea.
3. Employ a number of communication options such as mailings, radio broadcasts, website postings, brochure distribution, notices to fishermen associations, and an information session at the annual Fish Expo to inform the members of the commercial fishing industry and recreational fishermen of the Pioneer Array Project.
4. Continue the process of scientists working with fishermen to develop routes, schedules, and suggestions on exterior modifications for AUVs and Gliders to help avoid negative interactions.
5. Immediately establish a working group or committee to address the subject area of what procedures should be followed when something goes wrong, the liability issues connected with those situations, and options for establishing an out of court dispute settlement process.
6. Follow the workshop model and establish an ongoing means of communication for fishing industry and scientists representatives for the duration of the project.
7. Organize additional opportunities for scientists involved with the Pioneer Array Project to discuss with fisheries scientists and managers, and members of the commercial fishing industry the type of data that will be collected as part of the Pioneer Array Project and how it might be interfaced with fisheries science research.

The remaining areas of work, as identified by workshop participants, include:

- Establishment of a committee to develop a process for dealing with situations when conflicts occur/something goes wrong/liability issues;
- Establishment of a process similar to this series of workshops for ongoing communication between scientists and representatives of the fishing industry relating to Pioneer Array operations;
- Programming of operational details for AUVs and Gliders including how far off the bottom and how close to the surface they will travel, and more specific mission routes and schedules;
- Development of modifications to AUVs and Gliders to diminish the chance of entanglements with fishing gear and impacts with fishing vessels;
- Development of modifications to moorings to aid navigation;
- Development of mass communication materials for the fishing industry (mailings to permit holders, laminated brochure, project website, etc.); and
- Further identification of connections between Pioneer Array Project data/studies and fisheries science/applications.

Workshop participants concluded that maintaining direct communication between members of the fishing industry and scientists is critically important, and additional outreach to the fishing industry and recreational fishermen is needed. They also concluded that further work on addressing liability concerns and what to do when something goes wrong is a top priority, and others with responsibilities and/or expertise in these areas need to be brought into the discussion. Participants observed that developing a cooperative/collaborative partnership between members of the fishing industry and

scientists has potential science benefits. Finally, participants concluded that the workshop series could serve as a model for how to foster better working relationships in these types of situations.

Electronic copies of the complete final summary report can be found at http://*www.cfrfoundation.org/* under the heading Pioneer Array Project.

Forward

The following report summarizes the discussions from a series of workshops held in the fall of 2011 that were aimed at addressing issues and concerns connected with the Pioneer Array Project. During these workshops, representatives from the commercial fishing industry based in Rhode Island and New York, and representatives from the science team working on the Pioneer Array Project, came together to identify potential gear conflicts, safety concerns, and possible siting arrangements, and discuss options for avoiding interactions and handling conflicts when they do happen. From these discussions surfaced a list of recommendations.

It should be noted that at the start, there was a high degree of uncertainty about what the outcomes of the workshop series would be, and how much could be accomplished in a relatively short number of meetings. But as this summary report and the information in the appendices attest to, a good deal of information was exchanged, much was discussed, and a carefully crafted list of recommendations was developed.

The heart of this summary report is the list of recommendations and reasons that the participants generated. It is hoped that this list will serve as a basis for continued discussion by others in the science and fishing communities, and be carefully reviewed and used as a resource for guiding next steps.

The staff of the Commercial Fisheries Research Foundation wishes to acknowledge the hard work and professionalism of the participants involved in this workshop series. They gave of their time to come to the table in good faith, with an openness and commitment to better understanding each other's perspectives, and to explore ways to co-exist in what is viewed by both scientists and fishermen as a highly dynamic and valuable part of the ocean. The participants' desire to have a process in which they could move past frustrations and mistrust, communicate in a meaningful and productive way, and develop a working relationship inspired us as staff to do what we could to support their efforts. Their hard work and dedication serves as a model to others involved in similar use conflict situations.

Copies of this summary report and all the information contained in the appendices can be found on the home website of the Commercial Fisheries Research Foundation at http://www.cfrfoundation.org/ [Pioneer Array Project page].

The Board of Directors and staff of the Commercial Fisheries Research Foundation express their gratitude to the Consortium for Ocean Leadership for its financial support of this workshop series.

Peg Petruny-Parker,
Executive Director
Commercial Fisheries Research Foundation

I. Description of Workshop Series

Purpose:

The purpose of the series of workshops held in the fall of 2011 was to make available a forum outside of the standard public information and hearing processes for representatives of the commercial fishing industry and scientists to discuss key issues and concerns connected with the planned Pioneer Array Project of the Ocean Observatories Initiative (OOI). The workshops were intended to provide an opportunity for a small group of participants to communicate and interact in a non-confrontational setting to better understand the project and its potential impacts on the commercial fishing community, and to explore ways the Pioneer Array Project could best be implemented to minimize conflicts and avoid safety hazards. The work done by this group, once summarized and distributed to others, was also intended to serve as a foundation for further consideration and discussion beyond this workshop series by a broader range of scientists and fishing industry members.

How workshops came about:

The workshops were organized in response to requests to the Commercial Fisheries Research Foundation (CFRF) from both scientists involved in the Pioneer Array Project and leaders in the commercial fishing industry based in Rhode Island to establish a neutral forum for discussions. Through support from the Consortium for Ocean Leadership based in Washington, D.C., the staff of the CFRF was tasked with organizing, facilitating, and reporting on a series of workshops that would be held outside of any public hearings or public participation events connected with the acquisition of permits for the project.

Major Objectives:

Generally, the overall objectives of this series of workshops were to provide an opportunity for discussion among scientists and members of the commercial fishing industry, and to develop a written summary of that discussion. More specifically, the major objectives of the workshop series were to:

- Initiate a productive and meaningful means of communication between scientists and members of the commercial fishing industry that would hopefully evolve into a working relationship;
- Identify and discuss in an organized way key issues and concerns connected with the Pioneer Array Project in the areas of potential gear conflicts, safety hazards, and siting decisions;
- Explore options for resolving potential use conflicts and safety hazards so as to minimize any negative impacts or disruptions from the research project on existing fishing activities in the study area, and allow the planned research project to be implemented in a safe and productive way;
- Begin to identify the types of things that could go wrong and options for dealing with those situations;
- Through discussion, identify areas of consensus among participants on potential recommended actions regarding key issues and concerns;

- Identify areas where consensus or resolution of issues was not reached within the workshops, and thus where further effort would be needed;
- Discuss the types of data to be collected from the project and their intended use, and initiate a discussion on how the results from the Pioneer Array Project can be interfaced with fisheries related research; and
- Provide a written summary of the workshop discussions that lists the topics discussed, major points made, and recommendations that developed that could be distributed broadly among the fishing community and within the Pioneer Array/OOI Program, and used as a basis for continued discussion and actions.

Premises workshops were conducted under:

The premises the discussions were based on included: 1) the Pioneer Array Project will proceed as planned in the general vicinity of where it is currently sited; 2) potential use conflicts and safety issues between commercial fishing and scientific research activities in the ocean area covered by the project do exist and should be clearly identified, discussed, and resolved as much as possible at this stage of the process; and 3) establishing a process for meaningful communication between fishermen and scientists is paramount to moving towards the development of possible options to address potential conflicts and/or safety issues. It was also noted at the beginning of the workshops that participation in the workshops did not preclude fishing industry members from opposing the project outside of workshops, and scientists connected with the project were not bound to any outcome or idea that may be generated from the discussions. It was also noted that workshop participants did not hold any decision making authority in regards to the project. And while this particular series of workshops were held in Rhode Island at the request of fishermen based there, they were not intended to preclude the formation and execution of similar discussions/workshops on this topic from being held elsewhere.

Process:

The overall workshop project commenced in September 2011 and ended in February 2012. The actual workshop series consisted of four workshops held during the time period of October through December 2011[1] (Appendices A-D). All meetings were held in Pt. Judith, Rhode Island and were approximately three and a half hours in duration. [2] In addition to the four workshops, participants exchanged information via e-mail correspondence in between meetings, and at times caucused in small groups for further discussions outside of the workshop sessions.

At the start of the workshop project, a list of potential workshop participants was developed by the CFRF staff in consultation with Pioneer Array scientists and leaders of the fishing industry in Rhode Island. Letters of invitation were issued to potential participants, and based on the responses, a final list of participants was developed by the first workshop held on October 5, 2011. Representatives were

[1] Workshop summaries for the workshops held on October 5, 2011, October 26, 2011, November 8, 2011, and December 14, 2011 are included in the appendices to this summary report. Readers seeking more details on the discussions should review these summaries.
[2] The last workshop held on December 14, 2011 was five hours in duration.

chosen who would be able to represent the different types of fishing activity in the study area and different aspects of the research program so issues could be fully and appropriately addressed. In total, there were eight fishing industry participants representing the lobster fishery, trawlers, and long line fishermen, and four scientists including the Project Scientist for the Pioneer Array. The number of participants in the workshop series was kept on the low side (12 people) in order to provide enough opportunity for all participants to speak and contribute on all the topics and issues raised.

The CFRF staff served in a support role, acting as neutral organizers and facilitators of the process. Their specific responsibilities included:

- *Organizing workshops* – CFRF staff worked with scientists/fishing industry leaders to finalize the plans for carrying out the workshop project i.e. approach, process, participants, agendas, etc. This included establishing, through written invitation, the workshop participants for the project, setting the workshop schedule, and securing meeting space.
- *Moderating/facilitating workshops* – CFRF staff moderated and facilitated discussions during workshops, and identified subject areas that participants needed to provide further information on. Agendas were developed in consultation with the workshop participants and reviewed at the start of each workshop, and direction was given to workshop participants to aid in preparing for upcoming workshops.
- *Creating a written record* – CFRF staff drafted workshop summaries for review and editing by workshop participants, coordinated and maintained a record of the exchange of information between scientists and members of the fishing industry, and compiled the final summary report.
- *Administrative tasks* – CFRF staff also maintained all financial records for the funding received to support the work.

Summaries of the discussion topics and major points made were developed for each of the four workshops, and circulated among the participants for comment and consensus after each meeting. These reports were utilized in developing this final summary report. In addition to the workshop summaries, copies of all handouts and working documents generated were made part of the written record. (Appendices E-I)

Major Topics Discussed:

During the four workshops, participants discussed a series of topics focusing on the following major areas:

- *Sharing of background information* – Participants exchanged background information on the Pioneer Array Project (science equipment involved, types of data to be collected and the processes being studied, and why scientists chose this particular site) and the existing fishing activity in the study site area (species targeted, types of gear deployed, estimates of the number of fishing vessels and crew members involved, seasonal fishing patterns, and existing gear regulations.)

- *Identification of key concerns and issues and possible solutions* – Participants discussed potential gear conflicts and safety concerns, and explored ideas about how to prevent conflicts as much as possible and reduce safety hazards, including siting modifications.
- *Planning for what to do when something goes wrong* – Participants began an initial discussion on the question of what process should be in place to handle situations when conflicts and problems occur, and discussed liability concerns.

Added to these discussion areas were the following:

- *Communication needs* – Participants discussed communication needs from two perspectives: 1) how to effectively inform all fishermen about the Pioneer Array Project including the location and type of science equipment they are likely to encounter, what to do if they have an encounter with the science equipment, and any changes to equipment deployments over the duration of the project; and 2) a process beyond this set of workshops that will enable representatives of the commercial fishing community and scientists to remain in communication throughout the project.
- *Science applications* – Participants began an initial discussion about how the data collected during the Pioneer Array work can be interfaced with fisheries science.
- *Next steps* – Participants concluded this series with the development of a list of areas needing further work.

The following sections, along with the additional information contained in the appendices, summarize the major points made during the discussions, and the recommendations that developed.

II. Summary of Major Discussion Points

Summary of background information shared

Pioneer Array Project

Fishing industry representatives participating in the workshops raised questions about the components and planned operational details of the Pioneer Array Project, including the number of buoys within the fixed mooring part of the project; the types of science instruments at each mooring site; how moorings are attached to on the bottom; and how the different science equipment functions including both the mobile and immobile parts. In response, scientists participating in the workshops provided the following information.

Major components-

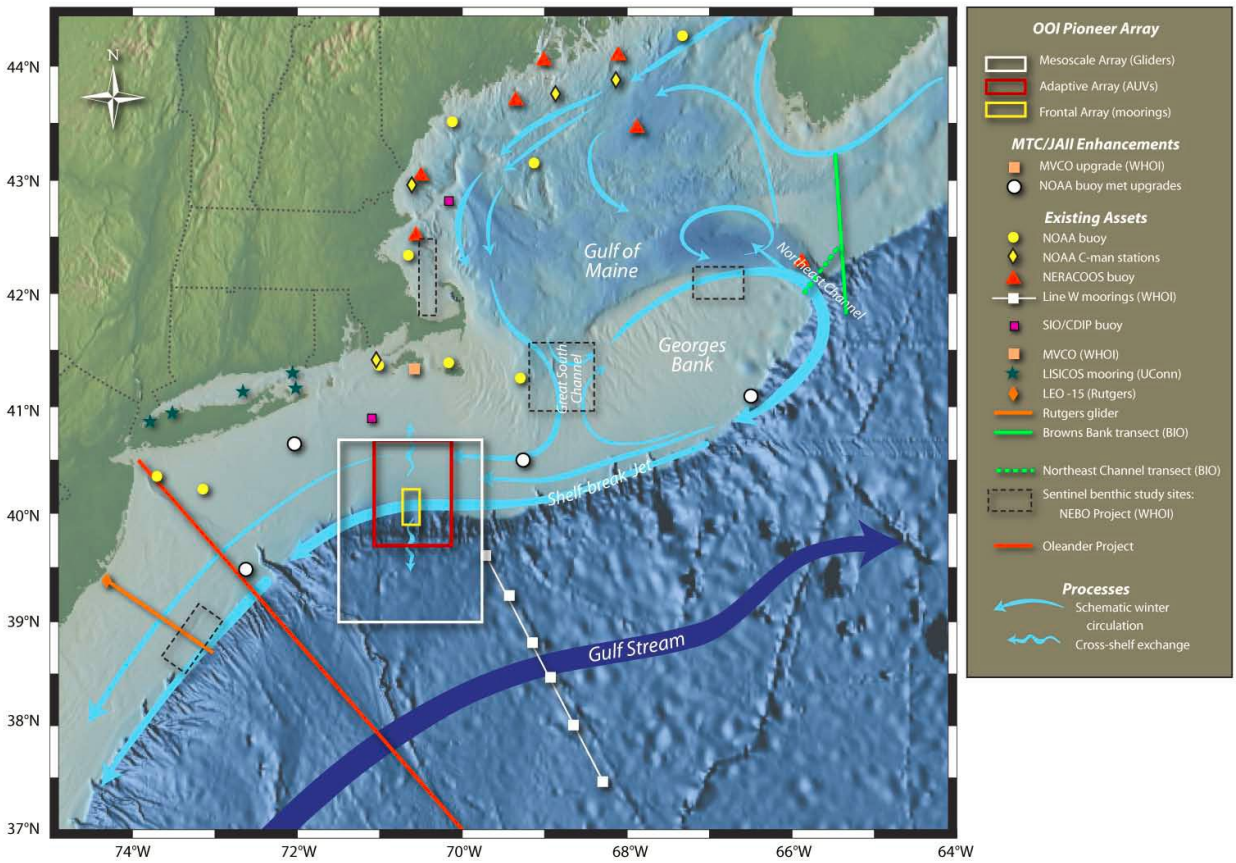
The Pioneer Array Project consists of three major components:

- Mooring Array (fixed moorings)
- Autonomous Underwater Vehicles (AUVs)
- Gliders

Study Area-

The general siting of the Pioneer Array Project is shown in Figure 1.

Figure 1 - Pioneer Array Study Area (Map)



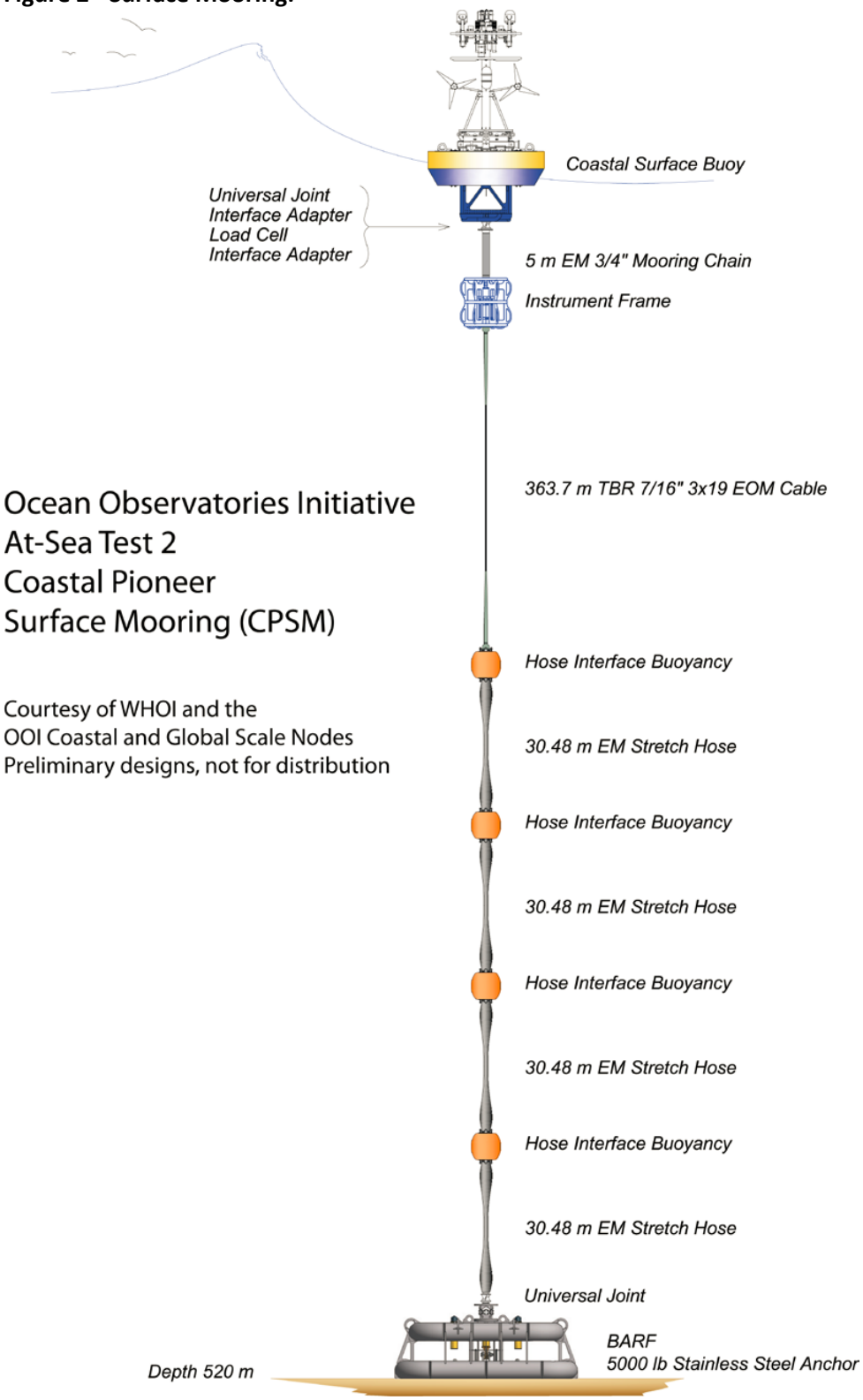
On this map, the yellow rectangle is the area within which the Mooring Array will be set up. The red box shows the operating area of the AUVs, and the white box depicts the area within which the Gliders will be operating.

Overview of science infrastructure – (more details found in Appendix E)

<u>Mooring Array:</u> There will be ten moorings at seven locations within the Mooring Array area (3 sites have 2 moorings), and there will be three major types of science moorings: 1) Surface Moorings; 2) Moored Profilers; and 3) Winched Profilers. Descriptions are as follows:

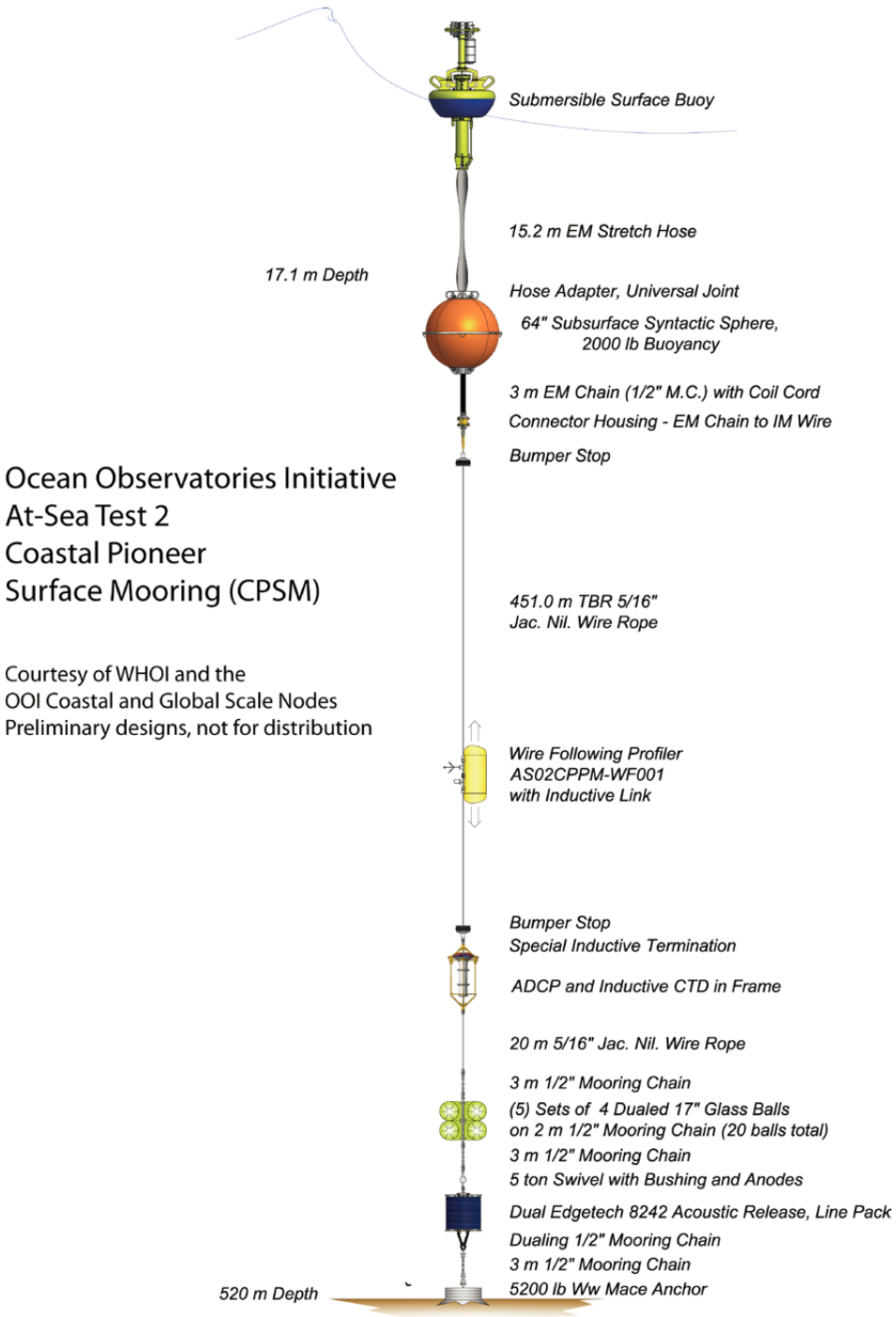
- **Surface Moorings** have relatively large buoys with 15-foot towers supporting scientific instrumentation and multiple navigation aids. The buoys are always on the surface and serve as flotation for an instrumented mooring line and anchor below. The anchor weight is 5000 lb. in air. (Figure 2)

Figure 2 - Surface Mooring:



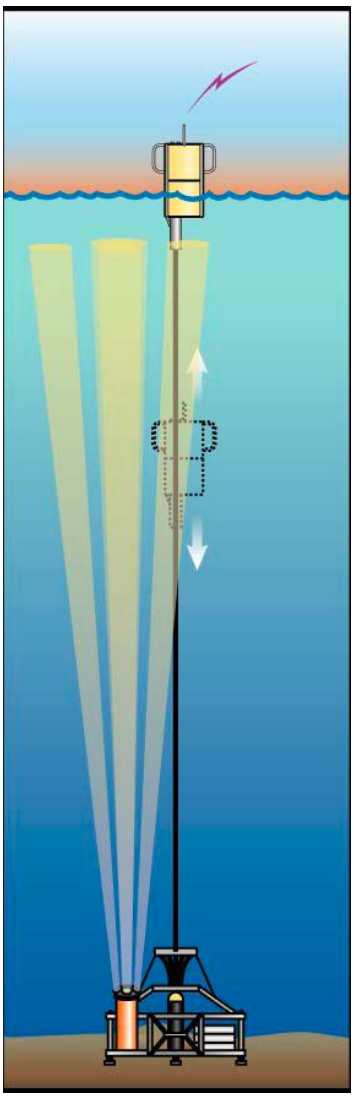
- **Moored Profilers** have smaller buoys with 6-foot towers supporting telemetry equipment. These smaller telemetry buoys could be partially submerged in rough weather, and are not as easily visible as the surface mooring buoys. The mooring line below the buoy supports a wire-following profiler (WFP) equipped with scientific instrumentation. The anchor weight is 5200 lbs. in air. (Figure 3)

Figure 3 - Moored Profiler



- **Winched profilers** have intermittent surface expressions. These moorings support profilers containing scientific instrumentation; the profilers are "parked" at a seafloor node (cradle at bottom of mooring) and winched from the seafloor to the surface and back to make measurements. The bottom frame or cradle consists of two pieces with one that can detach from the other. When the winch on the bottom frame is released the buoyant piece rises up towards the surface and that creates the profile. When it is done with the profile the winch is turned in the opposite direction and it is pulled back to the bottom frame. Winched profilers are designed to go up and down four times/day, and are controllable by sending commands through satellite communication. (Figure 4)

Figure 4 – Winched Profiler:



Winched
(surface-piercing) Profiler

Profiling Body

- Telemetry to shore
- Temperature and salinity
- Dissolved oxygen
- Dissolved carbon dioxide
- Currents
- Optical properties
- Chlorophyll, organic matter
- Nitrate

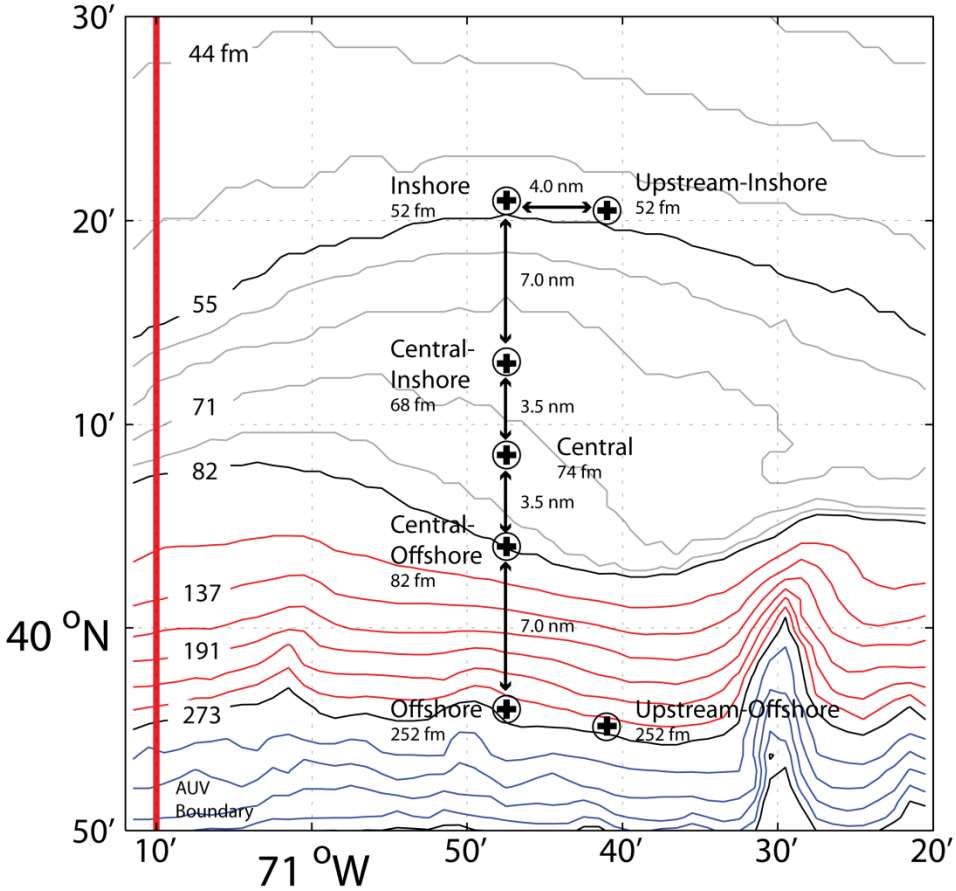
Bottom frame

- Water column currents

Instruments connected with these different types of moorings will be used to measure temperature, salinity, dissolved oxygen, pH, currents, optical properties, chlorophyll, organic matter, and nitrates. The Pioneer Array infrastructure will be controlled by the Ocean Observatories Initiative, with other scientists submitting proposals to do studies using the Array as well as further observations in the vicinity of the Array for limited duration (weeks).

Figure 5 depicts the planned mooring configuration as presented at the start of the workshop discussions.

Figure 5 – Original Mooring Arrangement:



<u>Autonomous Underwater Vehicles (AUVs):</u> The AUVS, (Figure 6) propeller driven, cylindrical vehicles, are one of two mobile assets of the Pioneer Array Project, with the other being Gliders. Two AUVs will be operating in an area roughly the size of the state of Delaware (2,500 square miles - red box area shown in Figure 1), and will be battery powered. They will be running for 20-40 hours every 5-7 days, and will need to return to a docking station at the base of one of the moorings to recharge before undergoing another mission. A third AUV would be periodically operated from research vessels during periods when the vessel was in the region for mooring service cruises and/or glider deployment and recovery, and for process-oriented research cruises.

AUVs travel at a maximum speed of 3 knots. AUVs are propeller driven, can power their way through most currents, and can be more precisely controlled than Gliders. AUVs weigh approximately 500 lbs., have a 1500 rpm propeller, and can go to a depth of about 500 meters (275 fathoms).

AUVs are typically operated in one of three modes: 1) Triangle mode – undulating between the surface and a specific depth while moving forward (commonly near the bottom); 2) Run at a constant depth; and 3) Run at constant altitude off the bottom. Pioneer Array scientists will likely use a triangle mode on a weekly sampling basis, but this has not been finalized.

AUV missions or "flight patterns" will likely be "T" or "X" shaped transects in the designated operating area with for example one AUV going along a depth contour and one going parallel to a mooring line across the Continental Shelf. Scientists will be using the AUVs to measure temperature, salinity, pressure, dissolved oxygen, currents, optical properties, chlorophyll, organic matter, and nutrients. [3] Scientists are seeking to use the data collected from the AUVs to better understand the frontal zone. They want to be able to measure the fluxes resulting from transport of high nutrient water between the Continental Shelf and Continental Slope. More details on AUVs are provided in Appendix E.

Figure 6 – AUV:

Gliders: The Gliders, also cylindrical, are shorter than AUVs and do not have propellers (Figure 7). They are about six feet long, weigh about 100 lbs., have "wings" on each side, and are able to travel at a speed of about 0.5 knot. They move by changing their buoyancy, and must always go up and down while moving forward. Scientists will be able to task the Gliders to "fly" from one location to another but will not be able to be in complete control of their location due to the strength of the prevailing currents.

[3] AUVS will be able to measure nutrients; Gliders will not.

Gliders will be able to go to about 1000 meters (550 Fathoms) deep, and six of them will be operating in the “white box” portion of the study area (Figure 1). This operating area encompasses about 7,000 square miles. They will be carrying their own battery packs and will be out for a few months at a time. Gliders can be programmed to go within a certain distance from the water surface and the bottom.

Gliders are neutrally buoyant in the water. The tube they are comprised of is held together by a vacuum. If it hits something, the seal breaks and it sinks to the bottom immediately.

Gliders will collect the same types of data as the AUVs, with the exception of nutrients. They provide a slice of data through the water column – measuring water properties. They are being used to help scientists better understand the depth of the mixed layer, and the types of water masses over the Continental Slope. The patterns of deployment are still being planned. More details on Gliders are provided in Appendix E.

Figure 7 – Gliders:

Length of Pioneer Array Project – The Pioneer Array Project will be at the existing site for five years. After that time, the project is set to move to another location somewhere along the U.S. coastline. There will be a competitive proposal process to determine the new location. There is a low likelihood that it will continue in the Mid-Atlantic region.

Planned Maintenance Schedule for Science Equipment - There will be two sets of all the science equipment so when one set is taken out for maintenance, another set will immediately be deployed (this turnaround is planned to happen two times per year for the Moored Array and at 2-3 month intervals for the AUVs and Gliders). A research vessel such as the R/V Knorr out of Woods Hole, MA (approximately 279 feet in length) would go out for about five days to pick up and replace the moorings. In addition there will be four trips in smaller research vessels such as the R/V Connecticut (approximately 75 feet in length) to go out and tend to Gliders and AUVs for a total of six trips per year. Guard buoys, if used, are likely to remain for 1-2 years.

Study Site Features

<u>What the scientists are interested in measuring and the oceanographic processes they are studying:</u>

- Scientists are interested in studying and understanding better the dynamics associated with the boundary between Continental Shelf and Continental Slope water masses (shelf break front or "break") at the edge of the Continental Shelf, the shelf break. They want to be able to re-construct the horizontal and vertical temperature gradients in the Pioneer Array area from surface to bottom.
- Scientists are seeking to be able to model the structure of properties such as temperature, salinity and nutrients and the exchange, or flux, of properties from the shelf to the slope or the slope to the shelf. This will enable them to better track the upwelling of high nutrient water, and understand better the movements and cycling of nutrients over the shelf area.
- Currently scientists are only able to obtain a snapshot of temperature, salinity, and nutrient levels from short-duration ship-based research – they would like to measure these parameters over time to gain a better understanding of the system and eventually be able to model it (predict changes). Continuous measurements allow scientists to see the impact of large events such as winter storms or hurricanes when research ships cannot be present.
- The study area exhibits big velocity shears and density differences. Scientists are interested in the fluid dynamics of the front and relating the changes in frontal structure to the processes underlying the productivity of the area. Scientists have observed a persistent upwelling cell (that stretches from the bottom of the ocean to the surface) in this area of the shelf, and they would like to know more about how changes in forces such as winds and proximity of Gulf Stream eddies affects the upwelling cell and the amount of nutrients it may carry from below into the near surface region where light is abundant.
- Eddies and fronts move long distances across and along the shelf in a short time period in this area so it is a very dynamic area. Scientists need a wide enough span to be able to monitor this and define how the shelf and slope water masses mix and intersperse. For example, one question is whether there is more phytoplankton out by these temperature

breaks or in the heart of the frontal zone. The jet is not very wide but may be located over a large cross shelf span. A sampling program that is wide enough to catch this jet movement over 20-30 miles is needed to be able to resolve details, and determine how sharp the cross-shelf gradient is. Stronger gradients mean a stronger jet, and likely stronger upwelling velocities.

The features and characteristics the scientists were looking for when choosing a site: During the discussions, scientists relayed that they looked for a study site in an area that is:

- a long enough stretch of relatively smooth bathymetry (e.g. without canyons) along the shelf to see the basic dynamics at play;
- free from the nutrient influence of big river inputs nearby (e.g. Hudson River, Delaware Estuary, Chesapeake Bay) to complicate the processes being studied;
- some distance from the Gulf Stream so this is not a dominant factor;
- not dominated by tides; and
- located where the bathymetry does not exhibit strong curves.

In essence, scientists are trying to study the frontal processes in isolation. This understanding will provide a basic foundation for a model to predict ocean dynamics (similar to studying weather frontal systems). Once this basic model is developed, then other factors (tides, river influences, etc.) can be added. In the end, scientists hope to better understand the physical processes that drive the biological variability, cycles in production, and generally, how energy moves through the ocean system in this area. Understanding these types of smaller scale processes and changes may lead to a better understanding of larger scale impacts due to things such as climate change, changes in rainfall, etc.

Existing Fishing Activity in Study Area:

Scientists participating in the workshops raised questions about the existing fishing activity in the study area, including what types of gear are used, when fishing occurs, how many vessels are involved, and the species that are targeted. In response, fishing industry participants provided the following summary information: [Note: In the table below, F stands for fathoms.]

Figure 8 – Fishing Activity Chart:

PIONEER ARRAY

An analysis of the Fishing activity impacted inside the designated macro site. Broken down by fishery, gear type, number of vessels, average number of crew / vessel, timeframe, depth and targeted fish species.

TRAWLERS:	bottom trawl	60-80 vessels	avg. crew 4	year round
	30F – 250F			

Mixed species: Squid (loligo, ilex), silver hake, red hake, butterfish, tilefish, scup, Black sea bass, summer flounder, jon dory, mackerel, monkfish

Monkfish: Directed fishery

LOBSTERING:	lobster pots	19 vessels	avg. crew 4	year round
Offshore	50F – 200F			
	Lobsters, Crabs			
Inshore	lobster pots	20 vessels	avg. crew 2.5	year round
	30F – 50F			
	Lobsters, Crabs			
RED CRABBING:	Crab pots	4 vessels	avg. crew 5	year round
	250F – 400F			
	Red Crabs			
LONGLINERS:	30-50 miles longline	4 vessels	avg. crew 4	year round
Bottom	50F – 150F	7 vessels	avg. crew 4	Nov. – March
	Tilefish			
Pelagic	30 miles longline	30 vessels	avg. crew 4	May – Nov.
	150F – 1500F			
	Swordfish, Tuna, Shark, Mahi Mahi			
GILLNETTERS:	6-10 miles Gillnets	30 – 40vessels	avg. crew 4	Dec. – May
	100F – 50F			
	Gillnets	15 – 20 vessels	avg. crew 4	May – Dec.
	30F – 60F			
	Monkfish, Summer Flounder			
ROD & REEL	Rod & Reel	80 – 100 vessels	avg. crew 6	June – Oct.

40F – 250F

Swordfish, Tuna, Sharks, Marlin, Mahi Mahi

TOTAL VESSELS: 334

TOTAL CREW: 1225

In addition, fishermen made note of the gear regulations that are currently in place to help mitigate gear conflicts among fishing sectors (trawling, lobster traps, gillnets, etc.). This information is included in Appendix N.

Identification of key concerns, issues, and possible solutions

As fishermen participants began to better understand the components and operational details of the Pioneer Array Project, and scientists began to better understand the existing commercial fishing activity in the study area, discussions shifted to identifying and minimizing negative interactions. This included potential gear conflicts and the resultant safety hazards, possible siting alterations for the fixed mooring component, and shifts in operational plans and exterior features for the mobile portion of the science components (AUVs and Gliders). The major issues and concerns raised during these parts of the discussions are summarized in the sections below.

Moorings:

Major points discussed:

- ***Arrangement of moorings within "yellow box" area of project*** **and general siting of moorings–** The original arrangement of moorings (Figure 5) shows a linear arrangement of five mooring sites, with an additional two mooring sites to the east of this alignment. Scientists had planned this arrangement to enable them to measure gradients over the Continental Shelf area but the straight line arrangement presents a major obstacle to trawling fishing vessels, and the maneuverability of all fishing vessels in the area. Fishermen also raised the point that if some attempt could be made to place the moorings on or very near existing obstacles such as shipwrecks and natural bottom obstacles, it would assist fishermen with avoiding the science equipment. Scientists noted that mooring proximity to a wreck may depend on guidelines for historical underwater sites and the need to avoid entanglement of the scientific gear with obstacles on the bottom.
- ***Spacing between moorings*** - Interactions that may happen between moorings and trawlers are a major concern. Fishermen relayed the dangers associated with trawlers going through the mooring arrangement in high seas and getting hung up. This could lead to the vessel capsizing and loss of life. Fishermen made the point that there needs to be enough space for trawlers to navigate past moorings - otherwise the area will be lost to trawling. This is an important fishing ground for trawlers, especially in the winter months. The nets are typically very wide (on the

order of 500 yards), making maneuverability of the trawlers very difficult, particularly in rough seas.

- ***Mooring sites and navigational aids –*** The group discussed the potential use of guard buoys, and how to best alert fishermen of the locations of science equipment. Fishermen in the group relayed that they did not feel the use of guard buoys was the best solution. Too many buoys increase the chances of fishermen hitting them, and in high seas and while fishing at night, fishermen did not want to have to rely on them as a navigational aid. Fishermen requested that they be informed of the exact locations (coordinates) of all moorings, including the site center coordinates and the radius of the buffer zones. Fishermen would be able to input this information into the onboard computers they use for navigation, and know where the obstacles are and the distance to maintain to best avoid them. Captains may not always be at the wheel and crew members need to be able to know easily what it is in the area.

  Mooring site centers will remain constant over the duration of the project but the position of the moorings within that 1 mile diameter encompassing the site center will change. Scientists relayed that current plans for deployment are for the moorings to be as close to the site center as possible. They also relayed that all moorings (including their watch circles or scope) will be located within the "buffer zone" around these site centers. They also relayed that the closest science moorings can be to each other is ½ mile (within the "buffer zone" circle). Scientists will be advising fishermen to stay outside of these buffer zones to avoid interactions, but these buffer zones are advisory only and are not enforced.

  Lobstermen made the point that they want to retain access to the "mud patch" in this study area in that it is prime lobster grounds. It will also be easier for lobstermen to work around moorings. Long line fishermen in the area will need to take extra precautions to avoid what to them will be another set of obstacles.

- ***Visibility of moorings –*** The visibility of the moorings was also identified as a major concern. In addition to knowing the exact locations of all moorings, fishermen requested that moorings be made as visible as possible. Surface Moorings, as currently designed, along with the intention of always having them on the surface, appear to present less of a visibility problem than the Profiler and Winched Profiler Moorings (submerged). Profiler moorings, as currently designed, do not have enough of a profile above the surface of the water to be adequately visible to fishing vessels in the area, and the Winched Profiler is not intended to be on the surface continuously but will conduct most of its operations below the surface (it goes up and down in the water column collecting data). The latter is of particular concern to fishermen. Visibility of moorings will be addressed with attachments such as marine lanterns emitting light, radar reflectors, and active radar "pingers", but height above the sea surface remains a concern. Fishermen noted they typically see 15 foot waves in this area in the winter. Scientists noted that providing adequate power sources for active navigational aids on profiler moorings could be a challenge.

AUVs and Gliders:

Major points discussed:

- ***Possible negative interactions -*** AUVs can be more dangerous than Gliders because they are traveling at greater speeds. There is a concern about AUVs coming up and hitting the bottoms of fishing vessels, or colliding or entangling with the vessel paravanes (stabilizing "birds" located some 20-30 feet below the surface that are connected to fishing vessel outriggers). They will be deployed in areas that are heavily fished, so the need to avoid interactions is great.

  Gillnets deployed on the sea floor may be especially vulnerable to the mobile gear components of the Pioneer Array Project. AUVs and Gliders could also become entangled in vertical lines (lobster trap lines and long line operations).
- ***Operational strategies -*** Gliders must always be moving up and down in the water column. Because of their design, they undulate through the water column as they move forward. AUVs can be programmed to undulate but they can also run at a constant depth or constant altitude above the bottom.

The operational strategies of AUVs and Gliders could be modified to minimize interactions. Scientists have some control of these devices – what they do and when they do it. This control is not complete – for example, an operator can request that a Glider run a direct line from north to south, but the actual line may divert to the southeast due to a prevailing current. In essence, the operators make navigation requests of the AUVs and Gliders and those requests are completed to a degree of accuracy determined by environmental conditions.

The typical draft of a fishing vessel is about 14-15 feet but they also have outriggers – these are flopper stoppers – that are used to stabilize boats. In fishing grounds, fishermen recommended AUVs and Gliders that should stay below 30 feet from the surface to avoid contact. Scientists noted that this distance would jeopardize the science parameters being measured.

Avoidance of shipping lanes needs to be considered.

- ***Why AUVs and Gliders are being used -*** AUVs and Gliders are being used to measure the nutrient flux and the cross shelf distribution of other properties including temperature, salinity, and chlorophyll. The central science question is whether the nutrients in this area are going from the Continental Shelf to the deep ocean or vice versa. AUVs are used to look for sharp temperature gradients. Scientists want to get better pictures of frontal system changes over time. The Continental Shelf and Continental Slope are dynamic areas. Scientists want to better understand the exchange between the two, and how fronts relate to upwelling cells.

Planned Maintenance Schedule for Science Equipment:

Major points discussed:

- ***Planned schedule –*** Fishermen recommend that the plans for replacing moorings (during the months of April and September) take into account the pattern of storm events. More specifically, they suggested that scientists wait until October because hurricanes (which may result in moorings "hopping" or moving from their original deployment locations) are most likely to occur before then.
- ***Communication needs-*** There is a need to communicate to the fishing industry: 1) when scientists will be out there working on the equipment; and 2) any changes in location or operations when redeployed.
- ***What happens when a mooring gets moved by a storm?*** Scientists will know this based on location information relayed by satellite from the moorings, but may not have the vessel lined up to go out and put it back on station until one of the preprogrammed intervals.
    - Fishermen noted that a combination of winds and tides together could change the criteria governing when a mooring moves. Three factors need to be considered: wind speed, wave height, and tidal current. The duration of these factors also is a consideration.
    - Fishermen relayed that the maximum speed of currents out in this area is about 3 knots.
    - Scientists relayed that the conditions that may result in a mooring hopping or submerging would be 2 knots current, 60 knots wind, and 40 foot waves. Under these conditions, engineering models indicate that submerging or hopping could occur 3% to 7% of the time.
    - Fishermen relayed that those conditions could occur once or twice a year in the study area.
- ***Other comments –*** Fishermen commented that more algae growth will occur on the equipment in the winter. Fish are likely to keep them clean in the summer months.

Planning for what to do when something goes wrong :

Major points discussed:

- ***Preparation for discussion -*** Fishing industry representatives were asked to consider the following questions: 1) What process would they would like to have in place concerning situations when an interaction occurs and if there is damage done to a fishing vessel or its gear, or to the scientific equipment?; 2) Are there examples from other regions of this country or from other countries that might serve as a template to use for this situation?

  Science representatives were asked to consider what their role should be when an incident occurs. How do they think things should proceed when there is an interaction? What part of that process will they be willing to be involved in?
- ***Fishing Industry responses*** -Workshop discussions have focused on potential interactions and what can be done to minimize these interactions, but the safety issues that were identified, the damage that could occur to science and fishing gear, and the likelihood of interactions given the degree of fishing activity in this study area remains a major concern of the fishing industry.

Procedures and protocols for what to do in these situations need to be established now to avoid possible loss of life, and closure of prime fishing grounds.

Fishing industry participants proposed, and science representatives agreed, that a committee should be formed outside of this workshop series to work on addressing how to handle potential interactions, liability issues, etc. Note: Fishing industry representatives presented a "straw man" paper on this issue that was discussed by the group. All workshop participants present at Workshop #4 agreed with the general sentiments and recommendation relayed in the straw man document. [4] (Appendix J)

Fishing industry participants presented an example from the west coast of a set of procedures put into place in connection with an offshore cable line, and concluded that with more discussion, an agreement of this type relating to moorings and mobile science equipment might be developed for the Pioneer Array Project. This example is included in Appendix K.

An additional option to consider is the establishment of a "sacrificial gear fund". This would be used to compensate fishermen who cut loose their gear when they become entangled with science equipment. This could help prevent a serious accident from happening, and/or expensive damage to science equipment. Fishermen would be more likely to cut gear loose in an entanglement situation if they knew there was a mechanism in place to compensate them for replacing their gear. A recent article on this subject in the Commercial Fisheries News was submitted as part of the record. (Appendix L)

Mobile science equipment should have information for fishermen (e.g. a contact address and phone number) and information should be provided (e.g. in the form of a poster or brochure) about what to do when they inadvertently capture them in their fishing gear.

Fishermen may need to consider establishing an umbrella organization for fishermen fishing in this area that would enable them to participate in an informal settlement dispute process outside of the court system.

- ***Science representatives' responses –*** Science representatives agreed with the recommendation that a committee or working group be formed to address establishing procedures and protocols for interactions, and liability concerns. They would want to be a part of that process.

  Scientists share the concerns raised by the fishing industry and agree that this is a priority subject area that needs to be worked on. But a committee with broader representation and expertise needs to be formed to follow through on this work.

- ***Other comments*** - It is important to bring the recreational fishing community into this discussion.

[4] The straw man document included in Appendix J includes some revisions based on the groups' discussion during Workshop #4. The revised "straw man" document was resubmitted for the record after the workshop.

Central to the liability issue is the question of who owns the science equipment being deployed. Workshop participants were unable to answer this question.

- ***Background information -*** Workshop participants received background information on this subject area from Anna-Marie Laura, Policy Advisor for U.S. Senator Sheldon Whitehouse, that included pertinent U.S. Coast Guard regulations (Title 33: Navigation and Navigable Waters – Part 66 – Private Aids to Navigation) and a copy of a Memorandum to P. Parker summarizing research on liability issues. These documents are included in Appendix M.

Communication Needs

Major points discussed:

- ***Major types of communication needed*** – Over the course of the workshops participants discussed two major communication needs: 1) mass communication to the commercial fishing industry and recreational fishermen about the Pioneer Array Project; and 2) ongoing communication over the course of the Pioneer Array Project between science and fishing industry representatives.
- ***Mass communication options*** – Most commercial and recreational fishermen do not know about the Pioneer Array Project and need to be informed about the type of science equipment being deployed, what to do to avoid interactions and what to do if they inadvertently have an interaction, how long the project will be in place, the exact locations of science equipment, etc. Some of the options discussed to meet these communication needs included:
    - NOAA notification system (Notice to Mariners)– use this system to send notices to the fishing community
    - Form an online social network
    - Conduct a mailing to all permit holders effected letting them know about this project
    - Communicate through fishermen associations
    - Put the information about the Pioneer Array Project on the VHS weather channel
    - Develop a brochure to be mailed to fishermen depicting what the science equipment looks like, what the equipment does, navigational information, what to do if fishermen encounter a gear conflict, what to do if you have an interaction, etc. This would be something fishermen can keep on their vessels.
    - Scientists might consider offering a reward for fishermen returning the equipment.

  Scientists relayed that they will be working on a project website to communicate information. They would like input from fishermen on how this website should be set up and for fishing industry representatives to be involved with the work being done by programmers/website designers.

- ***Ongoing communication*** – Participants discussed the option of continuing the workshops and evolving this group into a type of advisory committee within the OOS system that would provide an ongoing mechanism for scientists to communicate with fishing industry representatives.

Additional workshops could be used to continue the remaining work outlined by the group, as well as additional subject areas that may emerge – in particular recurring issues and/or "lessons learned" during operation of the Pioneer Array. They would also enable scientists and fishermen to continue to share observations about the study area. The CFRF could again play a supporting role.

Scientists relayed that some type of fishing industry advisory committee should be set up this coming spring. Scientists will be meeting then to discuss fixed sampling protocols, and it might be helpful to have fishing industry input involved in this planning.

- ***Other comments*** – Scientists are also seeking input on how data products can be used in fishery science. The CFRF could provide opportunities for Pioneer Array scientists to discuss the project and the data to be collected with fisheries scientists, managers, and industry leaders.

  The Marine Affairs Institute at the Roger Williams University Law School was mentioned as a possible resource to help identify liability concerns and legal issues, and dispute mechanisms.

  Congressional direction may be needed in terms of identifying compensation fund options.

Science Connections/Applications

Major points discussed:

- ***Review of what scientists are interested in studying*** – In general, scientists are interested in studying currents including shelf break frontal jet structure and nutrient cycling and upwelling in the Continental Shelf/Continental Slope area. They intend to measure chemical, physical, and some biological parameters (temperature, salinity, nutrient levels, dissolved oxygen, pressure, currents, chlorophyll, organic matter, and pH) to better understand how these processes relate to biological productivity. By modeling these systems they hope to create a predictive tool.
- ***Review of subject areas fisheries science is focused on –*** In general, fisheries research is focused on obtaining a better understanding of fish abundance and distribution, migration patterns, long and short term changes in species composition, food chain dynamics, natural history characteristics of commercially important species (growth rates, reproduction capacity, size distribution, essential habitat needs, gender ratios), environmental influences on fish populations, and disease. This type of information is used in improving stock assessments including biological reference points, and in better understanding ecosystem dynamics, environmental influences, and key habitat areas needing protection.
- ***Comparison –*** Workshop participants compared these two areas of study and noted that the Pioneer Array Project could be instrumental in providing important information on environmental influences on fish populations.
- ***Research possibilities*** – Fishing industry representatives mentioned some examples of possible joint research opportunities. Examples include:
  - Lobster tagging studies – Pioneer Array moorings could be used as listening sites for acoustical tagging studies for lobster. Lobster biologists and lobstermen are interested

in knowing more about the interaction of lobster populations in the Continental Shelf/Slope areas and if there are separate stocks of lobster. This has implications for management strategies.
    - Fish/lobster larvae studies – A better understanding of the physical processes in this area could be related to fish/lobster dispersal.
    - Food chain dynamics and productivity levels – A better understanding of the nutrient fluxes and upwelling events could lead to a better understanding of fish productivity cycles.

  Scientists noted that fishermen observations in the area could be very valuable to scientists in alerting them to changes over time. Fishermen logbooks hold a wealth of historic information that could be utilized.
- ***Widening the discussion*** – Workshop participants agreed that it would be beneficial to broaden this discussion to include fishery scientists, managers, fishing industry leaders, and other Pioneer Array scientists to further investigate the connections to fisheries science. The CFRF offered to organize a round table discussion through a one day workshop on this topic. The CFRF would choose a representative group of scientists, managers, and fishermen to participate.

III. Recommendations

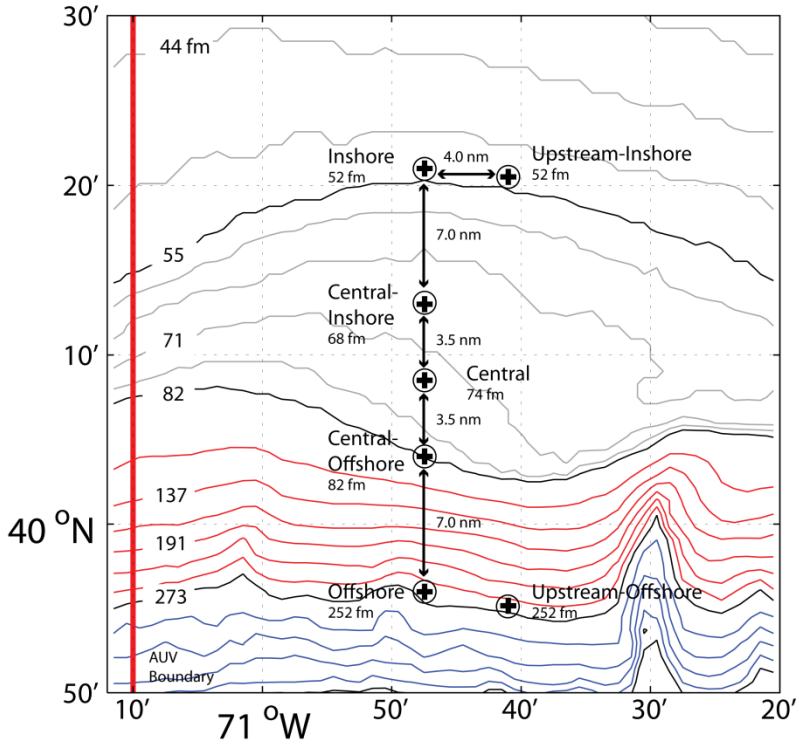
The following is a comprehensive list of the recommendations and the reasons for those recommendations that developed over the course of the Pioneer Array workshop series. The recommendations pertain to the following major subject areas and are organized accordingly below:

- ***Mooring Component*** (proposed rearrangement; navigational aids, and maintenance schedule);
- ***Mobile Science Equipment Component*** (programming of missions and "flight patterns"; vehicle modifications);
- ***Communication needs*** (mass communication to fishing industry; ongoing communication with fishing industry representatives);
- ***Planning for what to do when something goes wrong*** (identification of potential negative interactions, liability concerns, and options for resolution; establishment of process/procedures);
- ***Science connections*** (application to fisheries science).

Subject: Mooring Component:

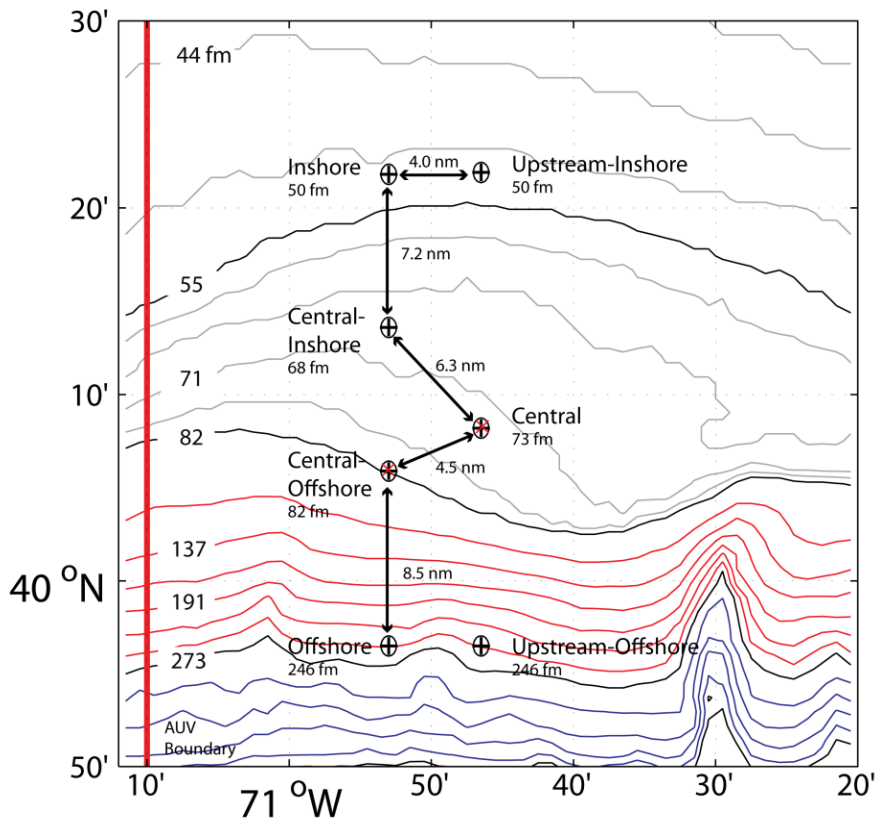
1. ***Fishermen and scientists recommend that the mooring configuration be rearranged by shifting the whole array to the west, then shifting the Central Site (74 fathom mooring) to the northeast, and northern most moorings (Inshore Site – 52 fathoms and Upstream Inshore Site – 52 fathoms) to the north (to 50 fathoms). In addition, the Central Offshore Site Mooring (82 fathom mooring) and Central Mooring (74 fathom mooring moved east to 73 fathoms) be placed on existing shipwrecks.***

Original arrangement:



Note: Distances between mooring sites are the distance from buffer edge to buffer edge with the buffer zone being a .5nm radius around each site center.

Figure 9 - Proposed arrangement:



Note: Distances between mooring sites are the distance from buffer edge to buffer edge with the buffer zone being a .5nm radius around each site center.

Table 1. Moored Array locations as proposed by workshop participants.

Site	Site Center
Inshore	40°21.8'N 70°53.0'W
Central-Inshore	40°13.6'N 70°53.0'W
Central	40°08.2'N 70°46.5'W
Central-Offshore	40°05.9'N 70°53.0'W
Offshore	39°56.4'N 70°53.0'W
Upstream-Inshore	40°21.9'N 70°46.5'W
Upstream-Offshore	39°56.4'N 70°46.5'W

Summary of mooring coordinates in proposed arrangement:

Summary of changes:

- Shift most of the Mooring Array to the west. The degree of shifting to the west is determined by the placement of the 82 fathom mooring (Central Offshore Site Mooring – has one Profiler Mooring) on an existing ship wreck site. (Bearings: 14 488.7 – 43 356.0 with the LAT/ LONG coordinates 40 05.9' N, 70 53.0'W)
- Line up the original 52 fathom mooring (Inshore Site – has a Surface Mooring and a Winched Profiler Mooring); 68 fathom mooring (Central Inshore Site – has one Profiler Mooring), 82 fathom mooring (Central Offshore site Mooring – has one Profiler Mooring), and the 252 fathom mooring (Offshore site – has both a Profiler and a Surface Mooring) in a north-south line based on the new position of the 82 fathom mooring.
- Line up the original 52 fathom mooring (Upstream Inshore Site – has one Profiler Mooring); 74 fathom mooring (Central Site – has Surface Mooring and a Winched Profiler Mooring); and 252 fathom mooring (Upstream Offshore site has one Profiler Mooring) in a line parallel to the first line. Placement of this line is to be determined by the placement of the 74 fathom mooring being moved to the east to 73 fathoms and placed on the site of an existing hang (Bearings: 14 446.7 – 43 369.5 with a LAT/LONG of 40 08.2' N, 70 46.5' W)
- Shift the two northern most moorings located at 52 fathoms in original arrangement north to 50 fathoms. [Note: This places the moorings on an existing fishing gear boundary, allows for more room between moorings, and is close to but not interfering with shipping lanes to the north.]

Reasons:

- The new arrangement increases spacing between moorings and staggers the north-south line of moorings so fishing vessels have more of an ability to maneuver in times of difficult winds, tides, and wave heights, and in areas of heavy fishing vessel traffic.
- The new arrangement is satisfactory to lobstermen in that it does not prohibit them from fishing on the "mud patch" – prime lobster fishing area. It is easier for lobster gear to be deployed around moorings but lobstermen have been concerned about being displaced from prime lobster grounds.
- The offset of the central mooring disrupts the continuity of the original cross-shelf line, but the two parallel lines of moorings do not compromise scientists' ability to measure gradients.

2. Fishermen requested that the exact locations (coordinates) of all mooring site centers and radius of the buffer zones circle surrounding each center, and information on the type of individual moorings and anchor locations within a mooring site be communicated to all fishermen using the study area.

Reasons:

- Fishermen will program these coordinates into their own navigational programs on their fishing vessels and will use this information to direct their vessels away from mooring sites. Most fishing vessels use onboard computers to navigate, and some rely on port plotters to give them navigational information via a CD they can upload into their onboard computers. Conveying information about the Pioneer Array Project that can be incorporated into these navigational

systems is the most direct way to avoid accidents. The information will be readily available and used by whoever is driving the vessel (captain or crew member).

- Scientists will always place moorings within the 1 mile diameter centered on the site center, and will ensure that this includes the "watch" or "scoping" area of the buoys around each individual mooring anchor location. Site centers will remain constant over the course of the project, thus the "buffer zone" for each mooring or set of moorings will remain constant. Individual mooring locations will change as moorings are recovered for servicing and redeployment. Ongoing communication about any changes in coordinates will ensure that the fishing industry always has a complete set of coordinates to guide their own navigational operations.
- Use of guard buoys was not recommended by the fishing industry representatives participating in the workshops. Their reasoning was that guard buoys will still be difficult to see in some sea conditions in this area and they do not want to rely on them. They also voiced concern about too many objects being placed in this area that they need to avoid.

Note: The group noted that there is a need for a continued discussion on the subject of "buffer zones" around mooring site centers, and what the expected rules will be for fishing vessels operating in this study area. Scientists indicated that the buffer zone is advisory, i.e. the suggested best practice is not to operate within the buffer zone, but it is not expected to be "enforceable" (e.g. by the USCG) as a no-entry zone. It is anticipated that the proposed continued discussion on liability concerns would provide further clarification of this subject.

3. In sites where there are to be two moorings, fishermen recommend that they be placed as close together as possible. This distance, as confirmed by scientist representatives, is ½ mile.

Reasons:

- Placing moorings close together will offer added protection in terms of fishermen being able to avoid them, and in dangerous sea conditions, maneuver around them.
- Scientists, in consultation with OOI engineers, indicate that operational constraints as well as the watch circles of the buoys create a minimum achievable separation for moorings. Experience indicates this minimum is about 2 times the water depth, or about ½ mile for the deeper Pioneer Array locations.

4. In sites where moorings could be placed near shipwrecks or existing "hangs" (obstacles), fishermen recommend that they be placed as close as possible to these existing hangs. [Scientists agreed but noted this will depend on guidelines they must follow concerning sites of historical significance, and they must also consider the dangers of getting scientific equipment entangled with these existing obstacles.]

Reason:

- Fishermen already avoid these obstacles – placing scientific equipment on or very near them will offer added protection in terms of fishermen being able to avoid them.

5. Fishermen recommend increasing the navigational aids pertaining to each individual mooring. This would include the following:

a. In addition to buoys being equipped with marine lanterns, and passive radar reflectors, (and some having active radar transponders), fishermen suggest that all buoys have active radar transponders (pingers). [Note: Scientists mentioned maintaining a source of power for these devices could be a challenge.]
b. Raise the height of the central tubing of the Profiler Mooring buoy up at least another 10 feet (so they can be seen in 15 foot waves) with a radar reflector and pinger on the top.

Reasons:

- This area typically exhibits high seas – every effort should be made to make the moorings as visible to fishermen as possible as an added precaution so they can avoid conflicts.
- Crew members may be in charge of navigating the fishing vessels – they need as much assistance as possible to avoid contact when filling in for fishing vessel captains.
- The Winched Profiler Mooring is of considerable concern to fishermen in that it comes up and down in the water column but does not have a surface component. Fishermen are asking that these mooring locations be very clearly marked, and their exact locations relayed.
- Broadly disseminated information about site centers, buffer zones, and mooring anchor locations, plus the fact that each Winched Profiler Mooring will have a Surface Mooring adjacent to it, was seen to mitigate the need for a guard buoy. It was noted that a guard buoy could be placed no closer to the Winched Profiler Mooring than the Surface Mooring.

6. Fishermen recommend that Pioneer Array leaders consider having fishing industry representatives involved in an advisory capacity when the science equipment is first being deployed at sea.

Reasons:

- Fishermen have first-hand knowledge of the study area, and are very familiar with factors such as currents, tides, bottom types, existing obstacles and their configuration, etc.
- Fishing industry representatives will feel confident that they know exactly where the equipment ended up being deployed.
- It will help develop a working relationship between scientists and fishermen.

7. Fishermen recommend that the planned months for replacing moorings (April and September) be reconsidered. More specifically, they suggested that scientists wait until October because hurricanes are most likely to occur before then.

Reasons:

- It would help to coordinate the maintenance schedule with likely storm events so moorings can be checked on and adjusted after possible damage or change in position.

- Bio-fouling is likely to be more of a problem in winter as fish tend to clean the moorings during the summer. This deployment schedule would have a shorter duration through the winter conditions than the summer conditions.

8. Fishermen recommend that a means be established for fishermen to communicate information to Pioneer Array scientists about when a mooring has moved.

Reasons:

- Fishermen will be at sea in this area throughout the year. They are likely to discover a change in a mooring position or damage to a mooring first.
- Scientists might know if guard buoys are moved if they have a GPS on the buoy but if this system fails, they may not know a change has occurred.
- Movement of moorings needs to be communicated to the whole fishing fleet in the area as soon as it is discovered to avoid conflicts as much as possible, particularly in the case of when a mooring may move outside the "buffer zone".

Subject: Mobile Science Equipment Component (AUVs and Gliders):

9. Fishermen recommend that AUVs and Gliders be programmed to come within a certain distance of the surface to avoid fishing vessel bottoms and go only to a certain distance off of the bottom to avoid interactions with gillnets and lobster gear set up on the bottom.

Reasons:

- To avoid having AUVs, traveling at relatively high speeds (3 knots), from hitting the bottom of fishing vessels.
- To avoid interactions with fishing gear as much as possible.

Note: Fishermen recommended that the distance be within 30 feet of the surface and 30 feet off of the bottom. Scientists relayed that maintaining these distances may compromise the ability to achieve science goals. Thus the issue was not completely resolved and needs further discussion. Scientists and fishermen (including gillnetters) need to work on the details of fishing gear types, depths, and locations and how they compare with scientific equipment operating areas and flight patterns. One possible compromise would be to adjust the distance from the surface and bottom depending on the location and timing (seasonality) of fishing activity and the operating area of the AUVs and Gliders relative to that activity.

10. Fishermen recommend that AUVs and Gliders be programmed to follow predictable routes, and that this be done in consultation with fishing industry representatives who know the patterns of fishing activity and existing gear restrictions in the area. Scientists noted that while many of the routes will likely be repeat lines (and thus predictable), there will be some non-repeating lines (i.e. a route relative to an oceanographic feature rather than geographic coordinates), and also times when the repeat mission track lines will be purposefully changed to meet the science goals.

Reasons:

- Having AUVs and Gliders follow predictable schedules and paths could help avoid conflicts. In the process of meeting science goals, risks should be minimized. Gliders, because of their slower speeds, are more limited in their ability to follow scheduled paths.
- Consulting existing gear regulations for this area could help scientists better plan how use of their equipment can best fit into existing seasonal use of fishing gear to avoid possible negative interactions and disruptions.
- Fishermen relayed that there is not much trawling activity in the study area from May through November each year. Coordination of planned science missions and fishing activity by trawlers would help avoid negative interactions.

11. Fishermen recommend that the exterior of mobile science equipment be modified to add features that would help avoid entanglements and increase safety. Possible features to consider include: a) rounding nose cone; b) addition of thin wire (fair lead) from the body to the rear fins; c) court nozzle or propeller shroud around the propellers on the AUVs.

Reasons:

- Protruding elements such as wings, instruments, and antennas need to be protected.
- Entanglements could be better avoided if protruding elements were protected.
- If an AUV is hauled onboard a fishing vessel, or comes into contact with fishing gear, a court nozzle or propeller shroud would offer some protection from a moving propeller.

Subject: Communication Needs

12. Fishermen recommend that a notification be mailed to all fishing permit holders informing them of the Pioneer Array Project. In addition, fishermen recommend that scientists utilize NOAA NMFS and U.S. Coast Guard communication systems to inform fishing industry members about the Pioneer Array Project, and that information about the Pioneer Array Project be issued on the VHS weather channel, and the upcoming Fish Expo.

Reasons:

- Most of the fishing community does not even know about this project yet.
- Fishermen come to fish in this area from as far away as Maine and North Carolina. A direct mailing to permit holders might be the best way to inform everyone impacted.
- Members of the fishing industry are aware of and normally utilize these methods of communication.

13. Fishermen recommend that Pioneer Array scientists develop a brochure to be mailed to fishermen explaining what is being studied and how long the project will be in place, the type of science equipment being deployed and exact locations, and what to do to avoid interactions and what to do if they inadvertently have an interaction.

Reason:

- This would be a reference document fishermen could keep on their vessels.

14. Scientists recommend the creation of a special project website to display real time information.

Reason:

- This could be a useful way for members of the fishing industry to stay informed about the Pioneer Array Project.

15. Fishermen recommend that a process be established for how to deal with interactions with AUVs and Gliders. They would also recommend that scientists consider establishing a reward program for fishermen reporting and returning science equipment.

Reasons:

- When fishermen have interactions with the mobile science equipment at sea e.g. a Glider or AUV being towed up in a fishing net; a Glider or AUV entangled in a vertical fishing line, etc., it would be helpful to have a process in place that directs fishermen on what to do.
- Such a process will help minimize conflicts between fishermen and scientists, help scientists retrieve their science equipment sooner, help prevent further damage, etc.
- A reward program would provide an incentive for fishermen to do the added tasks involved in reporting and returning the equipment.

16. Both scientists and fishermen recommend that an ongoing means of communication between members of the fishing industry and Pioneer Array scientists be established for the duration of the project. This would follow the existing model of this workshop series with the CFRF playing a supporting role.

Reasons:

- Scientists and fishermen still have areas they need to work on together, and anticipate that other subject areas will arise over the course of the project.
- This type of communication would be an avenue to continue to address concerns that may come up over the course of the project, share observations about the study area, and serve as a means for scientists to seek input and advice from fishermen regarding decisions that could come up.
- This type of small group communication has proven to be a valuable means of communicating.

Subject: Planning for what to do when something goes wrong

17. Both fishermen and scientists recommend that a committee or working group be formed to address the subject area of what happens when something goes wrong, and the liability issues connected with those situations. It is recommended that the committee be comprised of representatives from the commercial and recreational fishing fleets, Woods Hole Oceanographic Institution, Ocean Observatories Initiative, National Science Foundation, and state/federal government representatives, and also include representatives from the U.S. Coast Guard, and legal counsel that could help inform the discussions. The scope of work for this committee would center on:

- ***Identifying in a comprehensive manner the types of negative interactions that could occur;***
- ***Reviewing liability concerns and issues;***

- ***Developing a set of procedures for dealing with gear conflicts and further guidance for avoiding such conflicts;***
- ***Discussing compensation mechanisms in cases of damaged gear or science equipment;***
- ***Discussing rules for governing and directing fishing/science activities in the study area; and***
- ***Identifying options for developing an informal dispute settlement process outside of the court system.***

Reasons:

- To proceed without addressing potential conflict situations and liability issues and concerns would be irresponsible given the safety hazards identified in these discussions.
- Despite this group's best efforts to work on solutions to potential problems and to offer suggestions on how to modify the project to reduce the risk of negative interactions, gear conflicts and accidents are likely to occur. This conclusion is based on the amount of fishing activity in the area, the type of science equipment being placed or operating in the study area, and the duration of the project (5 years).
- Other participants need to be drawn into this discussion. It goes beyond the experience and expertise of the participants involved in this workshop series, although they agree it is a critical area that needs to be addressed.

18. Fishermen recommend that through the work of the committee established to address liability issues, an informal dispute settlement process be established.

Reason:

- This would provide an option for out of court resolutions and settlements to occur.

Subject: Science Connections

19. Scientists and fishermen recommend that other workshops be organized to provide additional opportunities for scientists involved with the Pioneer Array project, fisheries scientists and managers, and members of the commercial fishing industry to discuss the data that will be collected as part of the Pioneer Array project and how it might be interfaced with fisheries science needs and priorities.

Reasons:

- The initial discussion on this subject in these workshop sessions pointed to the possibilities for collaboration and cooperation among scientists, fishermen, and resource managers.
- Connecting the science work being done as part of the Pioneer Array Project with fisheries science broadens its application.
- Both groups would benefit greatly from sharing information and data. It would increase the understanding of the ecosystem dynamics at work in this part of the ocean, possibly lead to further research ideas, and foster working partnerships.

IV. Areas Needing Additional Work

At the end of Workshop #4, participants reflected on the subject of additional areas needing further discussion and work and developed the following list:

- Establishment of a committee to develop a process for dealing with situations when conflicts occur/something goes wrong/liability issues;
- Programming of operational details for AUVs and Gliders including how far off the bottom and how close to the surface they will travel, and more specific mission routes and schedules;
- Modifications to AUVs and Gliders to diminish chance of entanglements with fishing gear and impacts with fishing vessels;
- Modifications to moorings to aid navigation;
- Mass communication materials for the fishing industry (mailings to permit holders, laminated brochure, project website, etc.); and
- Further identification of connections between Pioneer Array Project data/studies and fisheries science/applications.

V. General Observations/Conclusions

The primary outcomes of the discussion that took place over the course of this four workshop series are compiled in the list of recommendations that were generated, and the reasons for those recommendations, all listed above. In addition, some general observations and conclusions can be drawn from the workshop process itself. They include the following:

- ***Direct communication between members of the fishing industry and scientists is critically important –*** Both scientists and fishing industry participants acknowledged that this workshop series was instrumental in enabling them to move past a sense of mistrust and to begin working together to find ways to co-exist in this area of the ocean. They also acknowledged that this type of communication should have happened sooner in the Pioneer Array Project process.

  Participants also concluded that maintaining a direct line of communication between fishermen fishing in the study area and scientists overseeing the deployment of science equipment and science protocol is essential for a successful implementation of the Pioneer Array Project, and allowing fishermen to maintain access to prime fishing grounds.
- ***Further work is needed on addressing liability concerns and what to do when something goes wrong –*** Given the extent of the existing fishing activity in the study area, the duration of the project, and the science equipment being deployed, workshop participants concluded that to proceed without addressing how to handle interaction situations and liability concerns is irresponsible. Information shared in this workshop series indicates that there already has been a series of conflicts between different fishing gear types in this area to the point where gear regulations needed to be established. With the Pioneer Array Project superimposing its own set

of science equipment on top of this fishing gear arrangement, careful coordination will be needed, along with a set of procedures to follow when gear conflicts occur.

- ***The exchange of background information served as an important foundation for discussions***- Both fishermen and scientists learned from each other during this workshop series. Fishermen were able to ask direct questions about the type of science equipment being deployed, operational plans, and the reasons for choosing this area to study. In turn, scientists learned more about the existing fishing activity in the study area, the safety concerns, and the challenges involved in sharing this area of the ocean. The exchange of background information was an essential first step in being able to explore solutions to potential problems.

- ***Issues and concerns raised during these workshops had not been adequately addressed in previous meetings and hearings*** - Fishing industry representatives noted that public hearing processes and sessions up to this point had not provided the type of format or environment for this type of communication to take place. In addition, they noted that the Environmental Assessment that had been conducted for this project had not adequately assessed the potential impacts on the commercial fishing industry, and most importantly, had not identified the safety issues and concerns raised during these discussions.

- ***Additional outreach is needed*** – There is much work to be done in terms of communicating to the commercial and recreational fishing communities what the Pioneer Array Project is, exactly where it will be located, and what type of science equipment will be deployed.

- ***The workshop series is a possible model process for co-existing –*** An underlying lesson from this workshop series is that use conflicts need to be worked through directly with the stakeholders involved, which in this case, are fishermen and scientists. The workshop series provided an opportunity for participants to have an honest dialogue, without worry about statements or ideas being misconstrued. In this sense, the workshop series may serve as a model that could be used in other situations where stakeholders need to work with each other to find ways to best share geographic areas of the ocean.

- ***Developing a cooperative/collaborative partnership between members of the fishing industry and scientists has potential science benefits*** – Fishermen frequently fish in the study area for the same reasons scientists want to study it – it is a highly dynamic and productive part of the ocean. Sharing information, data, and observations, and working together to identify key research questions, can lead to a much more comprehensive understanding of ecosystem dynamics. One of the more obvious conclusions from the discussion that took place during these workshops, both during and outside of meeting times, is that scientists and fishermen have much to learn from each other and they share many mutual interests in terms of wanting to better understand what is happening and why it is happening in this part of the ocean.