NROC
Northeast Regional Ocean Council

Final Report to the Northeast Regional Ocean Council:

Commercial Fisheries Spatial Characterization

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I. INTRODUCTION

In 2012, the Northeast Regional Ocean Council (NROC) commissioned the Island Institute, the Coastal Resources Center, and George Lapointe Consulting to undertake a project that describes how New England's commercial fishing industries, including party/charter businesses, utilize the region's ocean space. Based on maps NROC created using National Marine Fisheries Service (NMFS) information, the project focused on the use of Vessel Monitoring System (VMS) and Vessel Trip Report (VTR) data sets available for federal and state waters off the New England coast.

Data sets were configured to spatially represent specific fisheries and timespans. Subsequently shared with members of those industries, the resulting maps were refined based on feedback and information gleaned over the course of 50 community meetings.

In total, the NROC team spoke with more than 200 fishermen, scientists, and fisheries managers. Meetings were held in a variety of different forums and locations between Ellsworth, ME, and Stonington, CT. For added perspective, a few presentations were also made to fishermen and fisheries managers outside New England. Results are synthesized in this report, which also contains a series of recommendations for NROC.

Ocean space used for fishing activity in New England is driven by a complex set of factors that are not all captured or represented in existing data sets. Maps generated from this project have inherent limitations that are explained in this report.

Decisions about the quality and portrayal of data were made within the context of developing information for ocean planning. Therefore, use of the maps in other forums (fisheries policy or management) should occur only with a full understanding of the information the maps do, and more importantly, do not show.

II. PROJECT OVERVIEW

The Northeast Regional Ocean Council (NROC) is a state and federal partnership that coordinates the New England states, federal agencies, regional organizations, and other interested groups to work on ocean and coastal issues best addressed at the regional level. NROC's ocean planning work focuses on supporting more formal efforts underway in New England by developing information (data and map products) and engaging affected constituencies.

In 2012 and 2013, NROC worked to characterize various activities in New England waters to allow NROC members and other decision makers access to the most up-to-date, available information on ocean uses. This includes:

i. Characterization of commercial fishing spatial patterns, including party/charter;
ii. Marine industry engagement, including aquaculture, ocean energy, and shipping/ports;
iii. Conservation and scientific community engagement;
iv. Review of marine habitat classification, characterization, and modeling activities;
v. Northeast recreational boating survey.

For example, maps of shipping activity, other human uses, and natural resources are publicly available through the Northeast Ocean Data Portal (http://www.northeastoceandata.org). NROC frequently updates the Ocean Data Portal with new information; interested readers should go directly to the website.

Commercial fishing is one of the industries that built New England. Beyond its rich tradition and historical importance, fishing still provides much needed employment and economic activity in many coastal communities. Surveying fishing activity, generating maps and reports based on this information, and making that information readily available and accessible to the public is an important part of NROC's effort to characterize ocean use in New England.

Determining how New England fishing industries use ocean space is challenging, given the complexity of the natural environment, interaction between fisheries, and regional differences in species and fishing effort distribution. The patterns of individual fishermen based on weather, fishery regulations, or personal preference must also be taken into account.

The regional distribution of fisheries is impacted by a number of considerations – target species population and habitat requirements, seasonal variations in species distribution, weather, gear type used, management decisions, linkages to fishing ports and communities, and socioeconomic factors. Many fishermen are familiar with sub-regional and local patterns for fisheries in which they participate. Those also involved in the fisheries management process tended to have even greater knowledge about a variety of the region's fisheries and were able to frame some of their comments in ways that were very helpful to the project team.

The purpose of this project was not to map individual actions, but rather, to use existing VMS and VTR data sets to begin to understand the spatial footprint of fishing over the entire region. It is important to note the significant limitations of existing data, as well as the lack of data for certain regionally important fisheries.

Objectives of this mapping project were to:

- Using existing VMS and VTR data sources, develop a series of maps that characterize New England's commercial fishing patterns, including party/charter boats;

- Meet with fishermen and others to modify the maps based on their feedback, to best reflect historic and current fishing patterns in New England;

- Make recommendations for future work to improve mapping efforts of commercial fishing activity in New England.

Many fishermen the project team spoke with emphasized that the lack of accurate information about current and recent fishing patterns can result in mistrust and confusion in the ocean planning process. Recent efforts to site new energy projects like the Ocean Special Area Management Plan (SAMP) process in the waters off Rhode Island, or the joint Wind Energy Area (WEA) project area off Massachusetts and Rhode Island, highlight how important it is to initiate the planning process with sound information and conversations with fishermen.

For ocean planning to appropriately account for commercial fishing activity, the context behind a fishery – why it is happening here, now, and who is participating in it – is equally as important as spatial data collection and helps to inform why the spatial information appears as it does. It is also important to recognize that while spatial data tells only part of the commercial fishing story, it can indicate areas where additional work may be necessary in order to better understand how commercial fishing uses ocean space. Assessing the multiple impacts specific activities like shipping and other emerging ocean uses (e.g., ocean energy projects) may potentially have on the region's commercial fishing activity will require collecting data or analyzing existing data in that specific context.

This report summarizes work done on spatial characterization (mapping) of New England's commercial fishing industry, including the party/charter fleet. The resulting maps allow discussions about ocean activities to be based on the best information available, e.g., historical trends and emerging use of regional ocean waters.

Data sets were processed and decisions about their representation were made within the context of regional ocean planning purposes. These maps were not designed for use in the fisheries management process, and to the extent that they are used for fisheries management, they must be viewed with careful consideration of metadata and this report, to understand their significant limitations.

III. APPROACH AND METHODS

At the start of this project, NROC received available VMS data from the NOAA Office of Law Enforcement in the form of a database. It included data sets from 2006-2010, although for most fisheries, data availability began in 2007. NMFS describes VMS as "a satellite surveillance system primarily used to monitor the location and movement of commercial fishing vessels in the U.S." It was originally intended to support federal fishery law enforcement activities such as regulation of spatial management areas; thus, it is available only for certain federal fisheries.

The system uses satellite-based communications from on-board transceiver units, which vessels operating in certain federally-managed fisheries are required to carry. VMS data is subject to strict confidentiality requirements. As a result, data obtained from NOAA contained only points of each reported location, associated declared fishery, and the day/month/year of the reported point location. No vessel identification data or other ways of identifying specific vessels were received from NOAA. For purposes of this project, VMS-derived map products included a relatively high degree of confidence in their spatial accuracy, although there was no way to differentiate fishing activity from other vessel activity. While there may be errors in terms of inaccurately declaring fisheries, according to NOAA staff these declaration errors there are a relatively small number of these errors although they may exist in VMS data (personal communication, NOAA staff, August 22, 2013). As will be discussed further in this report, no calculations related to vessel speed were included in the data received from NOAA.

The first step of the NROC project was to convert the VMS database from NOAA to a GIS-compatible database to enable mapping of points. Once this was completed, the visual characterization of VMS data was explored in phases to discuss utility of viewing the raw VMS data, as well as a set of derived density grids that portrayed fishing intensity using a color ramp (blue-green-red).

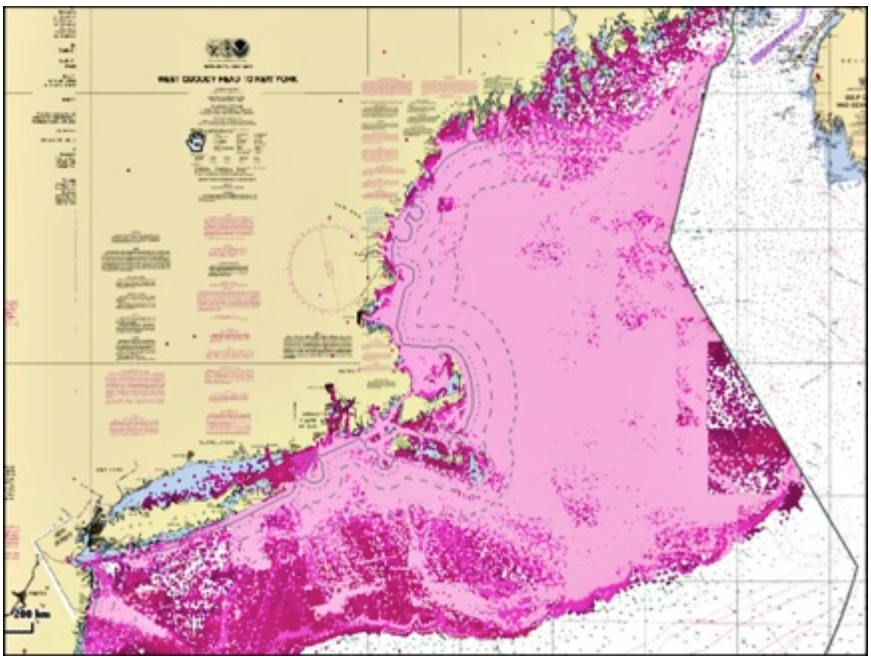
The initial assessment reviewed information in its most basic form as raw points. Over the time period of available data (years), some areas in New England waters contained thousands of points superimposed on one another, which made discerning variability in fishing activity at these locations difficult (**Map 1**).

Thus, the next phase of this assessment was to develop a color ramp (blue-green-red) to differentiate areas with lower (blue) to higher (red) densities of VMS points. This basic analysis formed the maps that were then used throughout the rest of the project's discussions with the fishing industry.

The result of this process (**Map 2**) shows different patterns of multispecies vessel location density from which patterns of fishing activity and vessel transit can be discerned. This allowed the project team to show maps to fishermen and other stakeholders in a way that reflects the activity occurring in a particular fishery. The project team used the VMS density maps for those vessels declaring in the multispecies, monkfish, scallop, herring, and surf clam/ocean quahog fisheries in meetings with stakeholders. Additionally, a composite VMS map combining the multispecies, monkfish, scallop, herring, and surf clam/ocean quahog fishery activity was used to show some overall activity for multiple fisheries.

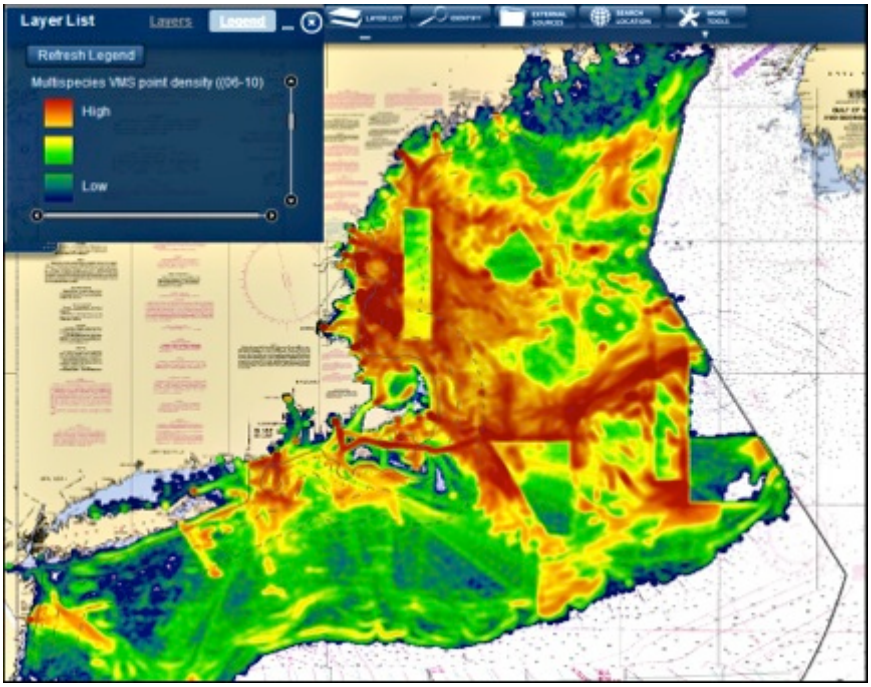
NROC also obtained a NOAA database (from the Northeast Regional Office, NMFS) with summarized information from Vessel Trip Reports (VTRs) resulting from analyses conducted by NMFS staff. The analyses provided information from VTRs describing, species landed, area fished, and date of activity, enabling summary maps to be produced showing fishing activity by trip or catch over time (months/years), In general, as described below, the spatial accuracy of VTR-derived location data was a significant concern. For this reason, the project used data from VTRs plotted on 10-minutes squares – which in some cases may still give a false sense of where

fishing activity is taking place. For example, where a closed area exists, the VTR data appears to indicate fishing activity inside the closed area rather than showing that a significant amount of activity is occurring just outside the closed area.



Map 1: Multispecies VMS locations, 2006-2010

Map 1 shows raw data points for the NE Multispecies fishery. Note that it is difficult to discern any meaningful patterns from this data. **Map 2** shows the same data set after it was processed in the manner described above.



Map 2: Multispecies VMS point density, 2006-2010

The project team put significant thought into how to share the maps and what process to use. This approach was informed in part by the team's experience working with fishermen and conducting various kinds of mapping. For the Island Institute, this project represented a natural next step in of its Mapping Working Waters project, and for the Coastal Resources Center, a natural next step from the Ocean SAMP mapping project.

To avoid duplication of prior mapping efforts, ensure use of appropriate methodologies, and provide overall guidance, the project team formed a Steering Committee. Members were chosen based on a combination of factors – previous mapping experience, expertise in working with and/or within the fishing industry, and connections to a regionally diverse set of local fishing constituents. They included:

- Madeline Hall Arbor, MIT Sea Grant;
- Ken LaValley, NH Sea Grant;
- Nancy Balcolm, CT Sea Grant;
- Carla Guenther, Penobscot East Resource Center; and
- Kevin St. Martin, Rutgers University.

The Steering Committee attended several early team meetings to review initial maps, help build an outreach plan, and provide input on earlier mapping interactions with New England fishermen. The team also had numerous informal conversations with Steering Committee members to update them on the status of the project, or to seek advice on a particular issue.

Under guidance from the Steering Committee, the team began by analyzing methods and results from other mapping projects within New England. A description of prior mapping projects can be found in **Appendix D**.

The team strongly believed that the best and most important feedback would come from fishermen themselves – appearance of the maps, quality of underlying data, and missing information.

The first set of draft maps was shown to select fishermen and managers with whom team members had an existing relationship. Changes were made based on collected feedback and conversations with the Steering Committee before the maps were shown to additional fishing industry members. All comments fed into subsequent iterations of the maps and led to even more conversations. Each generation significantly improved the content and accuracy of the maps.

For example, initial VTR maps contained scales based on standard deviations. This view of fishing effort did not reflect current practices; important differences were downplayed while minor ones were highlighted. Other examples of early suggestions were to combine all species in the groundfish complex on one map, and to divide other maps into different time periods based on critical management decisions or seasonal patterns present in a particular fishery.

Conversations with initial reviewers also led to suggestions about other individuals and groups who might be interested in examining the maps. In was strongly recommended that the team prioritize speaking with fishermen who had experience in multiple fisheries. Those subsequent talks yielded even more valuable insight and criticism.

Outreach efforts were explicitly tailored to maximize productive discussions. In order to reach the greatest number of fishing industry members within the project's limited timeframe, the team sought meetings at times and in places that made the most sense for fishermen. They also relied on more than one meeting format. Meetings ranged from individual targeted discussions, to open group forum, to formal management meetings.

This multi-pronged approach allowed the team to have effective, engaged conversations with the fishing industry. Future projects undertaken by NROC that involve the fishing industry should explicitly recognize the value and importance of working with fishermen's schedules.

The team made presentations about the project at fishing association meetings, groundfish sector meetings, and state advisory board meetings. They prioritized being available for conversations and feedback at times around these meetings.

In addition, the team held a series of three open meetings that coincided with other significant events attended by the region's fishermen – the New Bedford Working Waterfront Festival, the January New England Fisheries Management Council Meeting, and the Maine Fishermen's Forum. This was yet another attempt to maximize engagement. Finally, team members met with fishermen who contacted them individually, or who contacted NROC to express interest in reviewing the maps.

The following is a breakdown of meetings with industry members by state. (Please note that meetings with fisheries managers and scientists are aggregated across all states.)

- Maine – 7, including Maine Fishermen's Forum
- New Hampshire – 3, including NEFMC Meeting (January)
- Massachusetts – 12, including New Bedford Working Waterfront Festival
- Rhode Island – 7
- Connecticut – 4
- Fisheries managers and scientists – 27

Some meetings engaged single individuals while others had multiple attendees (fishermen, fisheries managers, scientists, etc.). Some one-on-one sessions were with fishermen who did not belong to formal associations, or whose schedule was challenging to accommodate. These usually "opportunistic" meetings typically occurred with little advance notice and involved diverse individuals… a Rhode Island herring fisherman, a Maine lobsterman, or NOAA and SMAST researchers.

On numerous occasions, team members were able to engage groups of six or more people at once. Most of those meetings were arranged by association presidents or spokespeople who encouraged their membership base to attend and comment on the maps. Identifying the right leader in these groups is a key aspect of any project of this nature; they spread the word more effectively than any electronic or print media, with the added benefit of 'peer pressure' to assure turnout. For example, in order to improve outreach to the party and charter fleet, the project team hired Patrick Paquette of Basic Strategies to help schedule meetings and connect with key stakeholders.

Meetings with more than six attendees included:

- New Hampshire Marine Fisheries Advisory Council (~13 people);

- New England Fisheries Management Council (20 people);
- Stellwagen Bank Charter Boat Association (~34 people);
- Northeast Seafood Coalition (~15 people);
- Maine Association of Charter Captains (~12 people);
- Maine Fishermen's Forum (~16 people);
- New Bedford community meeting (~6 people);
- Northeast Charterboat Captain's Association (~20 people);
- Maine Coast Fisherman's Association (~10).

The team was unable to talk with all interested or impacted parties within the region, despite their best efforts. Further work should prioritize additional meetings and outreach, particularly if those meetings focus on specific issues. Recommendations for continuing this work, including ideas for additional outreach, are discussed in depth at the end of this report.

IV. RESULTS AND FINDINGS

One key finding clearly emerged from the interview process: from an ocean planning perspective, a complex set of factors influences how the region's fisheries appear on maps. New England fishermen operate in a highly integrated regulatory, scientific, social and natural environment. The challenge in the mapping process, as voiced repeatedly, is to gather and translate information that accurately illustrates these complexities. Numerous fishermen expressed concerns that decision-makers in the ocean planning process may not understand the full scope of the fisheries industry, which in turn could lead to misinterpretation of map data.

Results and findings are grouped below into the following categories:

- General Results
- Meeting Results
- Recommendations for Posting the Maps
- Recommendations for Future Work, and

- Long Term Considerations.

A. General Results

The General Results section includes important contextual information necessary to understand concerns raised later in the report. Specifically, those regarding how the maps are displayed, management measures that impact the spatial distribution of the region's fisheries, and participation in the project.

1. Map Display

The NROC mapping effort was the first time this VTR and VMS data was used in conjunction with a public, stakeholder-informed process in an attempt to understand fishing effort on a regional level. Creating maps for review by fishing industry members proved to be an insightful mechanism by which to capture feedback. It highlighted many strengths and weaknesses inherent in the data sets, and delineated limitations on their use.

The vast majority of comments received were based on the VMS maps. Many were data-specific, location-specific or species-specific, while still others pertained to aspects of management. Only a few comments were entirely positive. Almost everyone to whom the team spoke remarked on why a map appeared the way it did, or how they thought "something was missing." Many fishermen viewed the aggregate data as not representing "their" activity. Almost all wanted to provide additional context, which will only aid in accurate map interpretation going forward.

Much of the feedback received on the maps related to the quality of underlying data. Fishermen not only commented on what they thought was important, but noted where they thought data was inadequate, vague or even missing altogether. Vessel Trip Report (VTR) maps and Vessel Monitoring System (VMS) maps each pose a unique set of issues to consider: they display different kinds of information, and have limitations in how they can be effectively used. The manner in which some fisheries operate means that they lack adequate VTR or VMS data. As a result, they are underrepresented or even unrepresented. Reporting requirements for various fisheries may also influence how they appear in these maps due to the fact that some fisheries are represented in VMS data as a subset of other fisheries. For example, skates and dogfish fisheries use a groundfish or monkfish day-at-sea unless the vessel is participating in an exempted fishery. Vessels directing on those species will appear in

VMS data for groundfish or monkfish, or if fishing under an exempted fishery will not appear in any VMS data at all. These issues are discussed further later on in the report.

Beyond feedback about the quality of the data, fishermen provided insight to why the maps appear as they do. Factors that influence fishing activity displayed on the maps include the quality of source data, analysis techniques, interpretation of results, decisions about visual representations of data, fisheries reporting requirements, and fisheries management measures. Acknowledging all these underlying factors is necessary in using the maps throughout the ocean planning process. This section discusses a number of issues that bear directly on the maps' appearance and usefulness. There are also caveats included, since particular aspects of the maps may be misleading.

These factors should inform and guide NROC's future work with the fishing industry. A synthesis of meeting results and outline of the overall project are laid out below. Also included are the impact of management measures on the maps, concerns about data quality, and recommendations for information that should accompany the maps when NROC makes them public.

> *"If aliens were to land and wanted to go scalloping, this is the map I would give them to show them where the scallops are."*
>
> — Comment received on the VMS scallop map

a. VMS Maps

This display of VMS data in a point density fashion produced "heat maps" of high and low vessel presence. The results were easy to interpret and the approach resonated relatively well with the fishing community.

Individuals tended to like the point density variation and felt the color ramp from "cool" (blue) to "hot" (red) was intuitive, providing good visual representation of the data. In particular, the scallop VMS point density maps were cited as giving an accurate picture of scallop abundance and fishing effort. Discussion on specific issues associated with maps created from VMS data can be found below.

b. VTR Maps

Maps using VTR to depict fishing activity were not as well received, likely due to the fact that very few fishermen have confidence in the underlying data. Many assume that if they don't carefully complete the location portion of the VTR,

others also fail to do so. The team heard this sentiment almost any time VTR maps were displayed or raised in conversation. The longer the distance traveled in any given fishing trip, the worse the comments were regarding accuracy of the location portion of VTR data.

2. Management Measures

Fisheries management measures are a major driver of how ocean space is used, directly impacting the intended fishery and in many cases, indirectly impacting other fisheries as well. Some management measures are apparent on maps of fishing activity because they are a defined set of boundaries around a geographic location where people are allowed to fish. Others are not explicitly spatial, but ultimately influence how fishermen conduct business.

A number of different management bodies make decisions that impact New England fisheries. These include: the New England Fisheries Management Council, the Atlantic States Marine Fisheries Commission, the Federal government (in conjunction with international bodies like International Commission for the Conservation of Atlantic Tunas), and some of the New England states. In general, the National Marine Fisheries Service has oversight responsibilities for federal fisheries management pursuant to the Magnuson-Stevens Act.

This report identifies and discusses a number of major management measures. Future conversations with fishing industry members that center on specific questions will only strengthen connections between fisheries management decisions and how the region's fisheries use ocean space.

Illustrating management measures with fishing activity provides key contextual information that enhances map interpretation. Many fishermen were concerned management measures wouldn't be explicitly displayed on maps. An excellent example of how misleading the maps can be without this contextual information is **Map 3.** From the map, it appears that there is little fishing activity in the middle of the map. This is not due to a lack of fish. The pattern appears as it does because the area is closed to fishermen. This is precisely why spatial management measures should be shown on NROC maps.

Other management measures are more difficult to illustrate but still highly relevant. When it is not possible to visually display management measures, they should still be described in accompanying text. Examples of how they impact the map should be

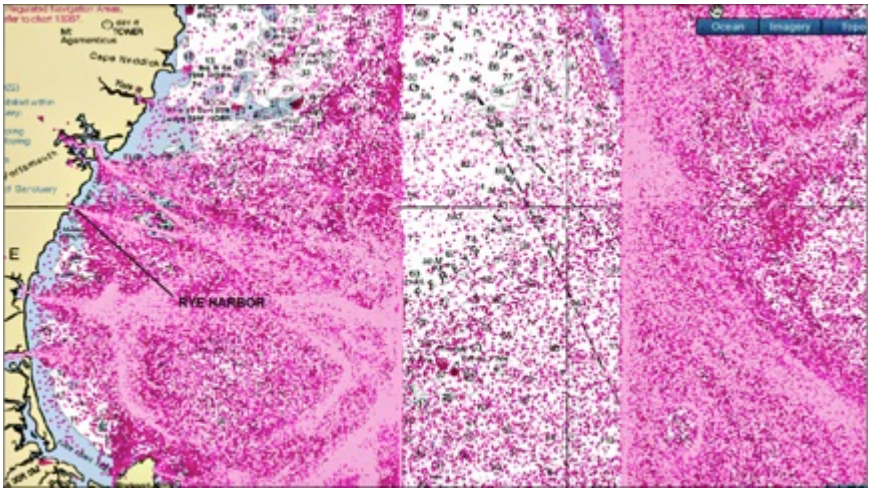
noted directly on the map. Regulations on "time out" of a fishery, or catch levels (daily limits, trip limits, or quotas) can significantly influence when and where people fish.

Moreover, fisheries management measures that impact how fishermen use ocean space are not fixed and will likely change over time. Fishermen expressed general concern that the mapping process does not reflect prior fishery shifts due to regulatory changes, fish distribution patterns, or environmental factors. NROC should bear in mind that the location of fishing activity is in part driven by fisheries management, and that fisheries managers may reconsider management measures as health of the region's stocks fluctuates.

c. Closed or Restricted Access Areas

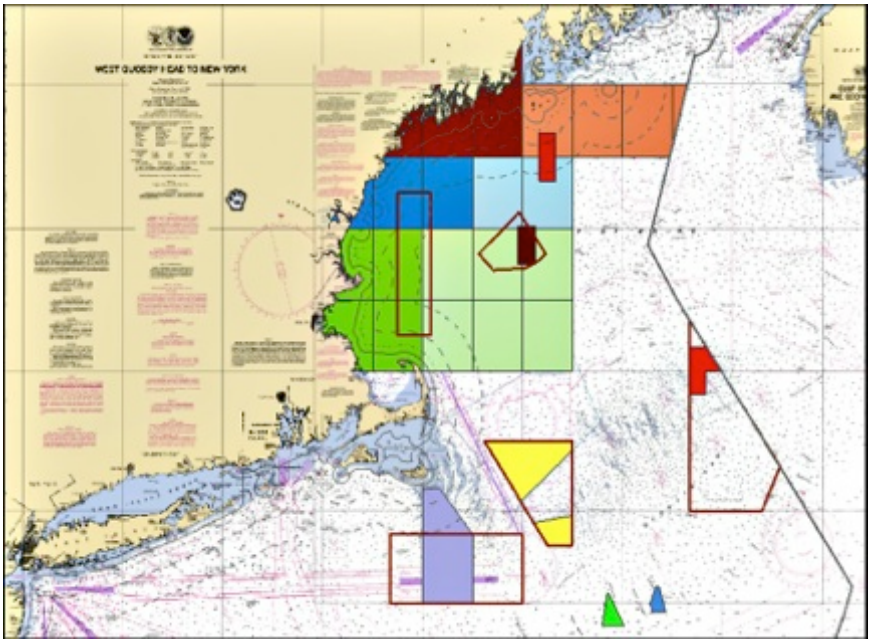
In terms of direct spatial management measures, some impacts (like groundfish closed areas) are obvious, while others surfaced in meetings with industry members. As noted above, an example of how spatial management measures can affect fishing effort is **Map 3**, which shows the Western Gulf of Maine Closed Area off of New Hampshire.

In the map below, pink dots represent individual vessel "pings" from the raw VMS data used as the base for the VMS density maps. From the data alone, it would appear that fishing activity significantly decreases in the middle of the picture. Additional context necessary for interpreting this data is that the reduced number of vessel pings in this area is driven by the presence of a groundfish closed area.



Map 3: Groundfish VMS points (or "pings") for 2006-2010 for the Western Gulf of Maine Closed Area off the New Hampshire coast show very heavy VMS signals that become nearly indistinguishable near shore and east of the closed area.

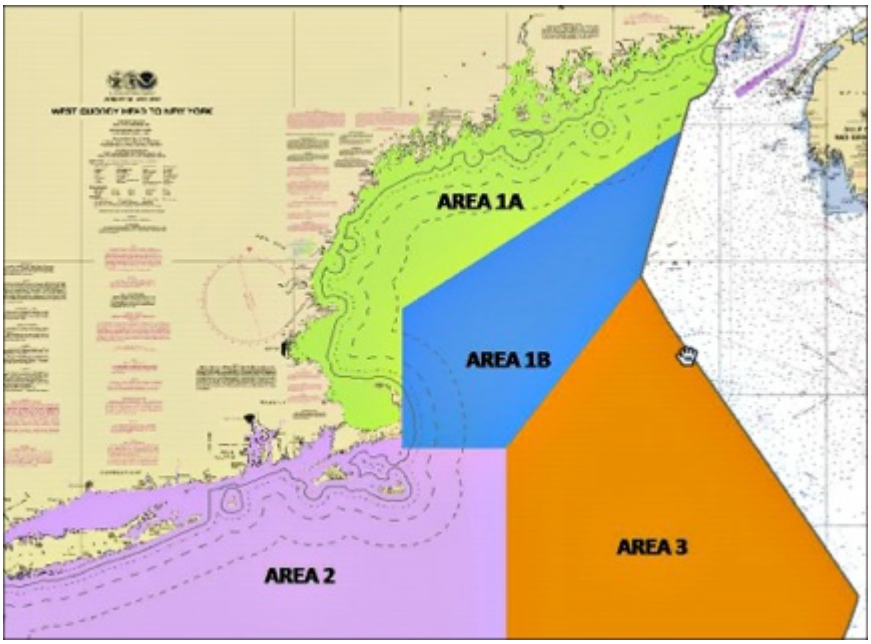
Regionally, there are numerous layers of spatial management. Some are year-round, some are seasonal, some are gear specific, and some are on a multiple year closure rotation. For example, **Map 4** shows management closed areas such as groundfish closed areas, groundfish rolling closures, and habitat closures. This map illustrates how the ocean can be subdivided in ways that affect fishing spatial use as shown on VTR or VMS maps.



Map 4: Examples of management area restrictions or closures in the groundfish fishery include groundfish closed areas (year round), groundfish rolling closures (seasonal), and habitat closed areas (gear specific/year round). Other fisheries management plans also use various spatial measures that are tailored to a specific species or set of species. (Source: NOAA NMFS, New England Fishery Management Council)

The herring industry is another example of how management measures can influence spatial distribution of fishing activity on a seasonal basis. Harvest in a certain area is determined by both the presence of herring – a pelagic species that exhibits significant shifts in spatial use of the environment over the course of the year – and by regulations like the annual total allowable catch (TAC) limit (**Map 5**), which is divided up into different management areas. Combined, this effectively restricts where and when herring fishing can occur.

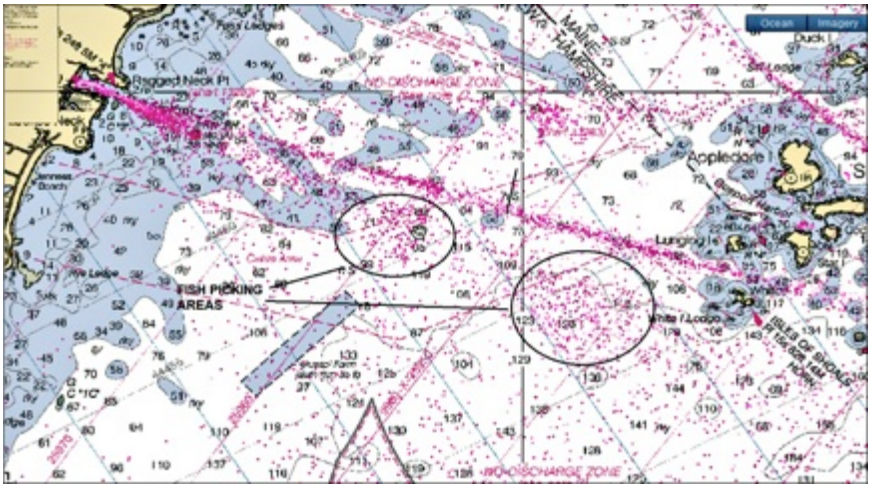
For example, Area 1A restricts herring fishing to certain gear types based on season; in summer, purse-seine and fixed gear are limited. From a spatial use perspective, this means midwater trawlers and pair trawls must move into other areas during the designated period of gear restrictions. The regulation by area of certain by-catch of species such as haddock also influence herring fishing activity .



Map 5: Herring fishery management areas (Source: Atlantic States Marine Fisheries Commission)

d. Time-Based Effort Controls: Days At Sea Counting

Beyond explicit spatial measures, many other aspects of fisheries management influence where people fish. For example, one measure impacting fishing patterns is the change in groundfish management from groundfish days-at-sea (DAS) to the sector system enacted in 2010. Under the DAS system, fishermen had an incentive to leave port, fish, and return to port as quickly as possible. This stratagem reduced excessive fishing time (days or partial days), which tended to push them to inshore areas, closer to port.



Map 6: Close up of groundfish VMS points (or "pings") for 2006-2010 for the area off the New Hampshire coast.

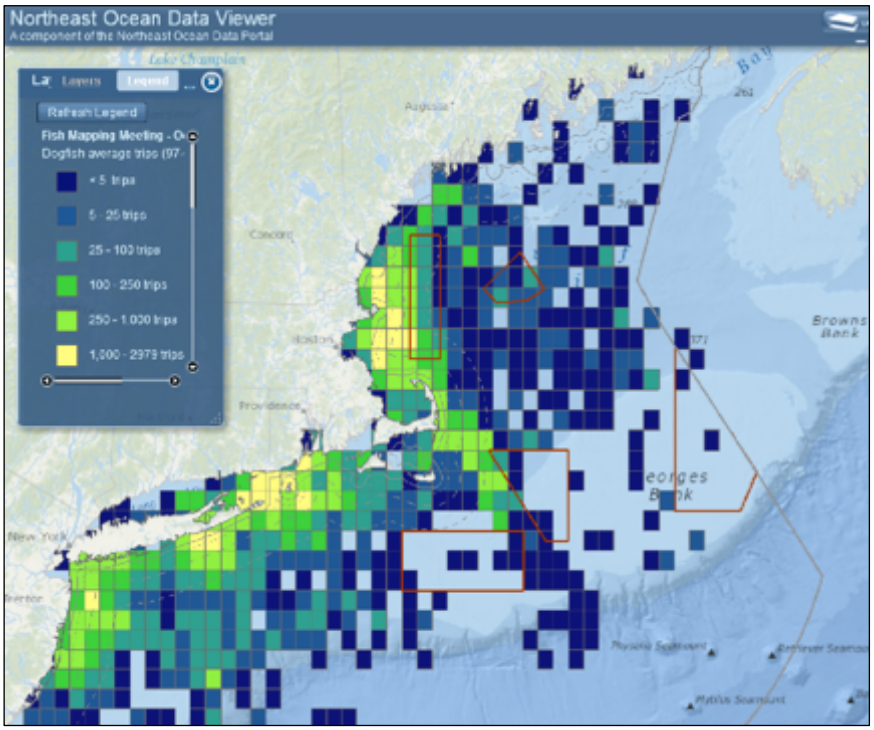
Conversations with New Hampshire fishermen revealed that areas which appeared to have some level of fishing were those where fishermen "picked," or sorted fish near shore after fishing further offshore (**Map 6**). This was done intentionally, so vessels were inside the demarcation line while picking fish. Under DAS management, that meant they were no longer being charged for fishing time.

Under the sector management system instituted in May of 2010, groundfish fishermen have a set amount of fish they can catch. This allows them to choose to fish for reasons other than minimizing time fishing, thus changing the spatial patterns of fishing vessels. Although most of the active groundfish industry participates in the sector system, VMS maps developed through this project are based predominately on years during which DAS was used to control effort. As such, the changes in fishing patterns resulting from the shift to sector management are not represented in this project's data sets.

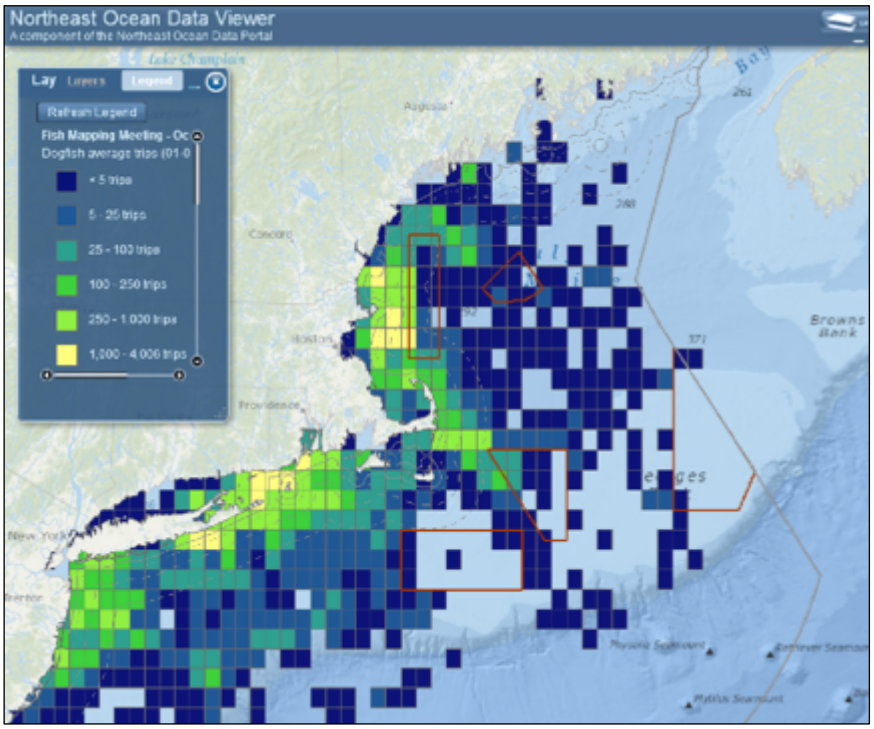
Conversations with fishermen indicate that VMS data from 2010 might not be entirely representative of fishery spatial distribution under the sector management system. Fishermen were still in the midst of figuring out how significant management changes impacted their businesses; 2010 was a trial and error year for adapting to the new system. Subsequent years of VMS data should more accurately show any shifts in fishing patterns relative to the implementation of sector management (see Recommendations section below for more discussion of this).

e. Trip Limits

Management measures such as daily trip limits can have a significant impact on where fishing activity takes place. The display of trip data includes all trips where the species was landed, even if it was not a directed trip on that species or a targeted species. The dogfish fisheries management plan was implemented in 2000 with very low daily trip limits, set at levels that discouraged directed fishing on dogfish (300-600 pounds). Since then, the daily trip limit has increased; in 2009 the fishery was declared rebuilt and had a daily trip limit of 3,000 pounds. The two dogfish average trip maps below (**Map 7** and **Map 8**) where identified as examples of how changes in the daily trip limit for dogfish impacted the industry.



Map 7: Dogfish average trips 1997-2000



Map 8: Dogfish average trips 2001- 2009

The team consistently asked fishermen to describe how management measures impact where people fish. This led to a number of responses regarding fisheries management and its underlying science. While it is difficult to specifically reference the science, or define how it impacts use of ocean space, it is clear from these conversations that many current management measures shape where and how people fish.

B. Lack of Participation

Although the team spoke with over 200 fishermen, scientists, and fisheries managers, there remains a large segment of the fishing industry that has not participated in this mapping project. Based on the level of interest by exhibited industry members and the amount of funding available, the team feels relatively comfortable with the level of participation to date. Engaging a broader segment of the industry likely requires a project that could show an immediate and tangible impact to fishing businesses. Such a project would also involve significant time spent on the docks and in the coffee shops of the region's fishing ports, something funding for this project did not allow.

Some fishermen declined to review maps with the project team. Reasons given included time constraints, conflicting obligations, meeting overload, and direct skepticism toward the project itself. One fishermen even cited "map meeting fatigue" from prior efforts. NROC should recognize the participant limitations inherent in this type of project, and how that may affect resulting products.

As noted in the Project Approach and Methods section, the team prioritized reaching out to fishing associations and regional leaders of the fishing industry. They were also able to have some insightful talks with fishermen outside the various fishing associations. It is thought that majority of fishermen involved in regional level management were at least aware of the project. The comments below shed some light on difficulties that NROC will continue to face as it attempts to engage the fishing industry.

1. Timing

The project was originally scheduled to take place in the late summer and early fall of 2012. Based on advice from the Steering Committee and project team, NROC decided to extend it so meetings with fishermen could occur during the fall, winter, and spring. This balanced the need to collect information for NROC's purposes with trying to ensure as many fishermen as possible could meet with the team between fishing seasons.

Despite the extended timeline, attracting project participants was a challenge. At the December 2012 and January 2013 New England Fisheries Management Council meetings, NEFMC prepared to make large reductions to the region's available groundfish catch. Many fishermen attended the meetings, drafted position statements, and prepared their businesses in anticipation of these major changes. This created a lack of time and enthusiasm for involvement in a project that did not have an immediate, tangible, or concrete impact on their livelihood, even though it might have long range implications.

2. Misconceptions about the NROC Mapping Project

While the project team attempted to differentiate this mapping effort from work done by the Bureau of Ocean and Energy Management (BOEM) and other agencies, it was often perceived as part of another entities' overall effort. This misconception fueled skepticism over data and distrust about possible links to wind farm siting, or to development authorities. Offshore wind farms are generally viewed by members of the fishing industry as competition for ocean space, negatively impacting fishery

resource access and ecosystem health. Several BOEM meetings held throughout New England at the same time as this project's further confused stakeholders regarding the intent and organizers of the NROC mapping effort.

3. Involvement in Prior Mapping Efforts

Despite clearly and consistently reiterating the differences between this project and others around the region, the response was often: "Didn't I do this with the Ocean SAMP [or Island Institute, or others]? Can't you just use that information?" It was widely believed feedback could be transferred from one project to another. This misconception was particularly challenging to overcome in southern New England, where the team drew from the same relatively small pool of active participants. Many had participated in the Ocean Special Area Management Plan (SAMP) two years before, a heavily stakeholder-driven process that compiled multiple maps of fishing activity across the fishing gear types and geographies in Rhode Island.

> *... will comment on these maps but you must promise to not use it against us; was "burned" in the past...*
>
> — Connecticut fishermen

Certain individuals felt they had been "burned" in past efforts (see Stonington, CT, meetings), or that time and energy invested did not directly benefit them in the end. Overall, it was difficult for some fishermen to separate or distinguish the NROC mapping effort from their past experiences, especially the negative ones.

At this point, NROC and the RPB both have an opportunity to address the issue of multiple processes that generate the same (or similar) information. A mechanism that allows fisherman to participate by having one conversation that is ultimately shared in multiple venues would be a vast improvement over prior, redundant efforts. It will also allow for streamlined data collection. Furthermore, a central data repository will aid all parties in accessing related information, keeping abreast of current issues, and learning about ongoing/new projects.

As mentioned in the methods section, the team compiled a list of prior mapping projects in the region for which it had information (**Appendix D**). This list allows readers to access and compare maps and results. Important differences between the NROC effort and others is that this project, by design, 1) covers all of New England; 2) is largely based on VMS and VTR data; and 3) was commissioned by NROC, a body that contains representatives from the New England states and federal agencies.

4. Apathy

Participation fatigue (i.e., meetings, decisions, projects and research) was often cited as a major reason for lack of interest. The fishing sector has a limited number of regionally engaged individuals who are willing to participate in multiple policy venues. With a burst of activity in relevant projects, many people simply did not have the energy, time, or willingness to meet with the NROC team or undertake new ventures.

C. Meeting Results

1. Stakeholder Input

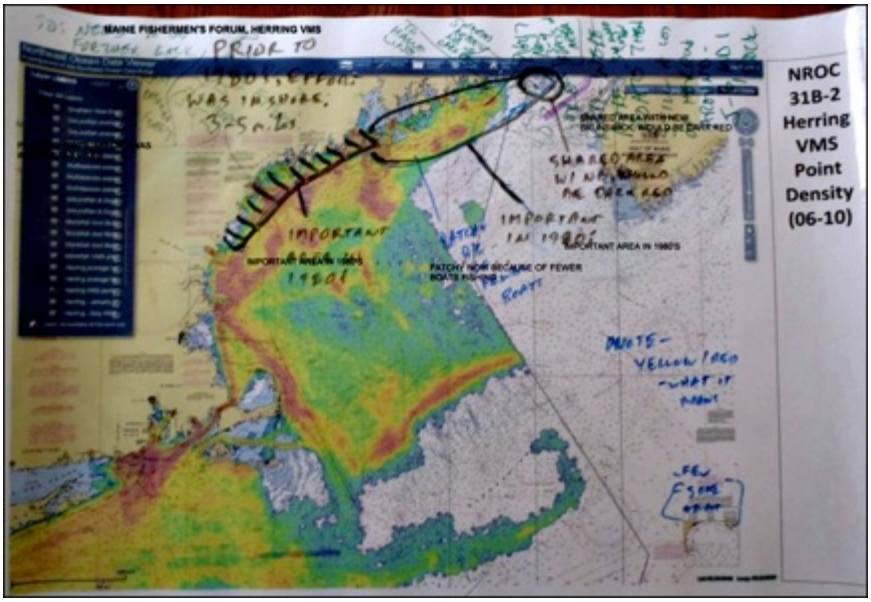
The team recognized the value in offering stakeholders a chance to view maps digitally and in print. They provided several laminated, poster size maps of key commercial species, allowing individuals the opportunity to physically draw their observations, uses, and perspectives. Paper charts were often the preferred means of review; fishermen appeared to relate to them better.

Digital maps offered a wider suite of options for exploring data – viewing species that weren't represented on paper maps, clicking on and off layers, zooming in and out, and accessing metadata. Of particular note for NROC in planning future projects: while digital charts served some important functions, they also led to instances where the ability to zoom in and explore a specific area led to confusion about the actual ocean locale under discussion.

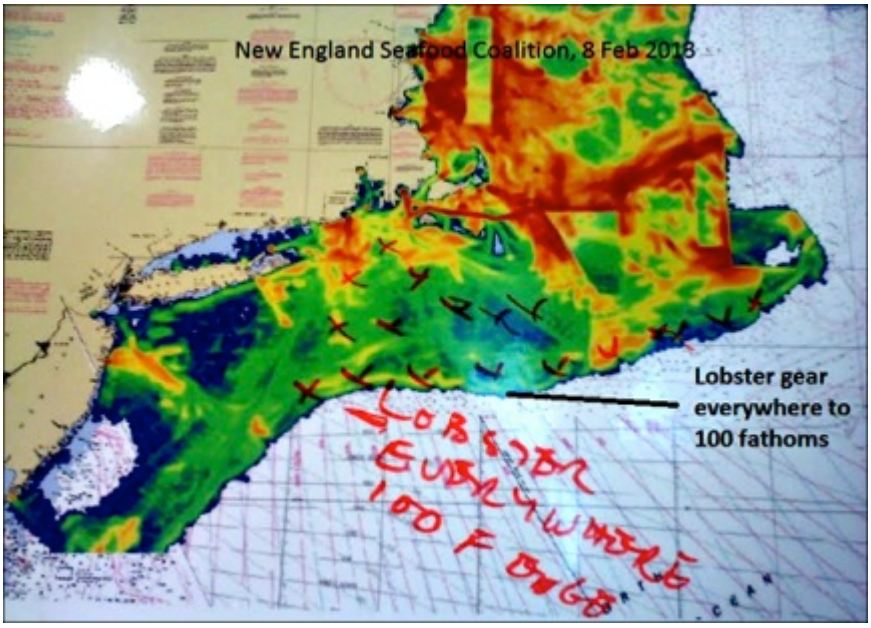
One key feature of these larger scale printed maps was that fishing activity was overlaid on a chart of the region. This allowed participants to orient themselves and the displayed fishing activity to bottom features or navigational aids with which they were familiar. This is an important point – conversations involving fisheries data overlaid on a chart were ultimately more productive. The scale of charts used over the course of the project varied, however, the most useful comments came when fishermen viewed the scale of chart used on their boats. Larger scale images often led to increased confusion and difficultly relating to the data.

Overall, participants edited 22 maps. The team did not employ a standardized approach when requesting data; instead, they focused on using limited resources to engage as many fishermen as possible during the project timespan. Photographs of each map were taken at the end of meetings. Since fishermen's comments often

included personal information, the maps are not available for public consumption. **Map 9** and **Map 10** are photographic examples of map comments.



Map 9. Comments provided on the Herring VMS map by participants at the Maine Fishermen's Forum show historical and inshore perspectives.

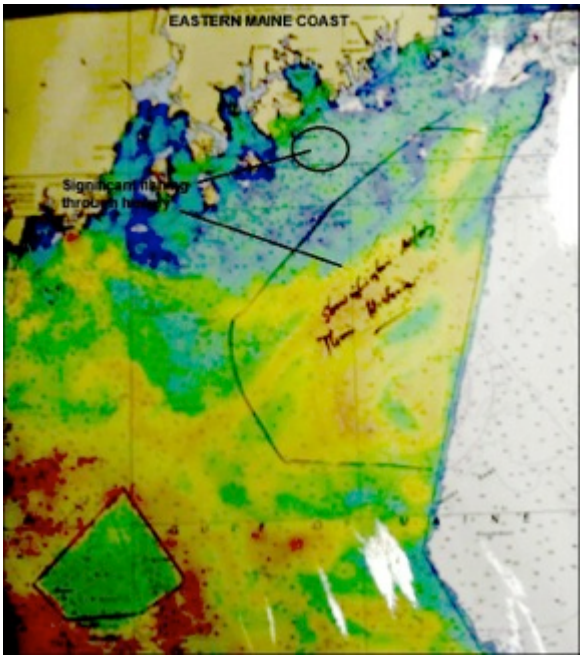


Map 10: Comments provided by members of the Northeast Seafood Coalition show lobstering effort.

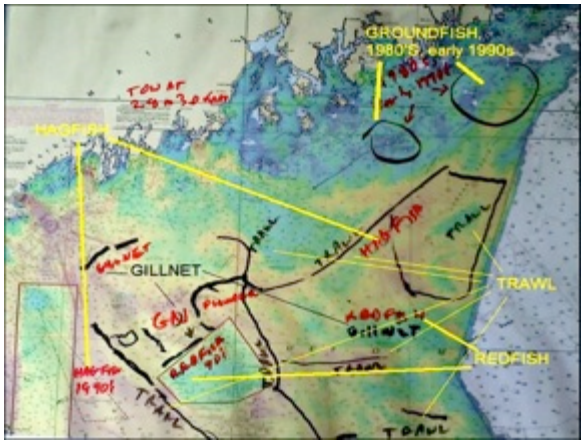
Concerns were expressed about how the project would incorporate written and verbal information provided during the meetings. It is important for NROC to show responsiveness around participation. At the very least, it should acknowledge that those who provide feedback are helping to shape the ocean planning process. Establishing a direct connection between this effort and future NROC work is critical.

2. Historic Data

Data used in the maps doesn't reflect historic fishing activity; VMS data sets in this project do not show fishing activity prior to 2006 and VTR data sets begin in 1997. This precluded examination of historical fishing activity prior to the mid-90s. A number of fishermen stated that where they fished in the 80's and early 90's is different from where they fish today. For example, data sets do not show that there used to be an inshore groundfish fishery in the eastern Gulf of Maine (**Map 11** and **Map 12**).



Map 11



Map 12

Maps 11 and **Map 12:** Both maps indicate historic fishing areas identified off of Downeast Maine. Note the low level of fishing activity in the small circle on the VMS map and compare it with the comment, "There used to be significant historical fishing activity there."

3. Other Maps

a. Non-VTS/VMS Fisheries

A number of fisheries do not have accurate VTR data and/or are not required to report in the VMS program. VTR submission is not mandated for federally permitted lobster fishermen. For species like tuna, data is aggregated with other highly migratory species. For segments of the industry like the party/charter fleet, the manner of operations makes existing spatial data highly questionable. Because the team was able to create maps for species with VMS data or even nominal VTR data, feedback on those maps was more specific.

For species without useable data, the team attempted to identify data sets created for other processes that might be helpful to this project. Most of the comments noted below result from meetings where a lack of species-specific maps was extensively discussed.

b. Lobster Fishing Map

Lobster is New England most profitable fishery, with a landed value of $419 million in 2012 (NMFS 2012). In spite of its economic importance, regional VTR or VMS spatial data sets are not available. Reporting requirements of this Atlantic States Marine Fisheries Commission (ASMFC) managed fishery vary among states and do not include spatial components similar to VTR or VMS. That said, there have been some other recent efforts to map the lobster fishing. Maps of New England lobster fishing that the project had access to include:

1) Lobster trap density maps compiled by the Maine Lobsterman's Association and a Keene State University researcher – Lobster trap density was shown monthly for one year (2011), in geographic areas limited to shoreline waters off Maine's coast (ASMFC Lobster Management Area 1). Note: this area provides the majority of the region's lobster landings.

2) Island Institute maps of lobster fishing areas off Maine's coast – This project piloted mapping the lobster fishery by communities' use and was based on 2010 and 2011 interviews with Maine fishermen. It covered a geographic scope similar to that of the MLA mapping effort cited above.

3) VTR map of pot/trap catch – Available for 1996-2009, these data sets include pot/trap fisheries other than lobster gear. It is important to note they are

limited to vessels that are 1) utilizing VTRs, and 2) permitted in other federal fisheries. Those fishing exclusively for lobster are not required to report using VTRs.

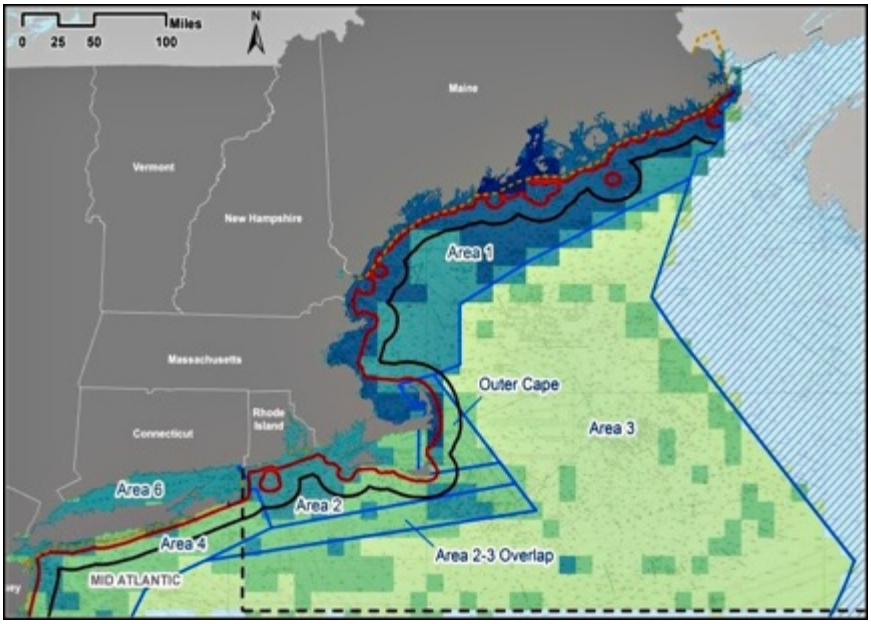
4) Fixed gear maps from the Ocean SAMP process in Rhode Island – These maps include lobster fishing, along with other types of fixed gear like fish traps and gillnets

5) MA Department of Marine Fisheries' maps – These maps were developed as part of the MA Ocean Management Plan, and include catch by statistical reporting area within state waters.

6) NMFS Protected Species Division map (**Map 13**)

The NMFS Protected Species Division map (**Map 13**) is probably the best example of regional distribution of lobster fishing. It was developed for use in the Atlantic Large Whale Take Reduction Team (ALWTRT) planning process to show the density of trap or trawl endlines.

Endlines are lines attached to traps on the ocean floor and a buoy on the surface. This information will be used by the ALWTRT to discuss management options that reduce the risk of endlines pose to large whales. The information also provides a useful proxy for the level of lobster fishing for that area, though an exact correlation is not possible.

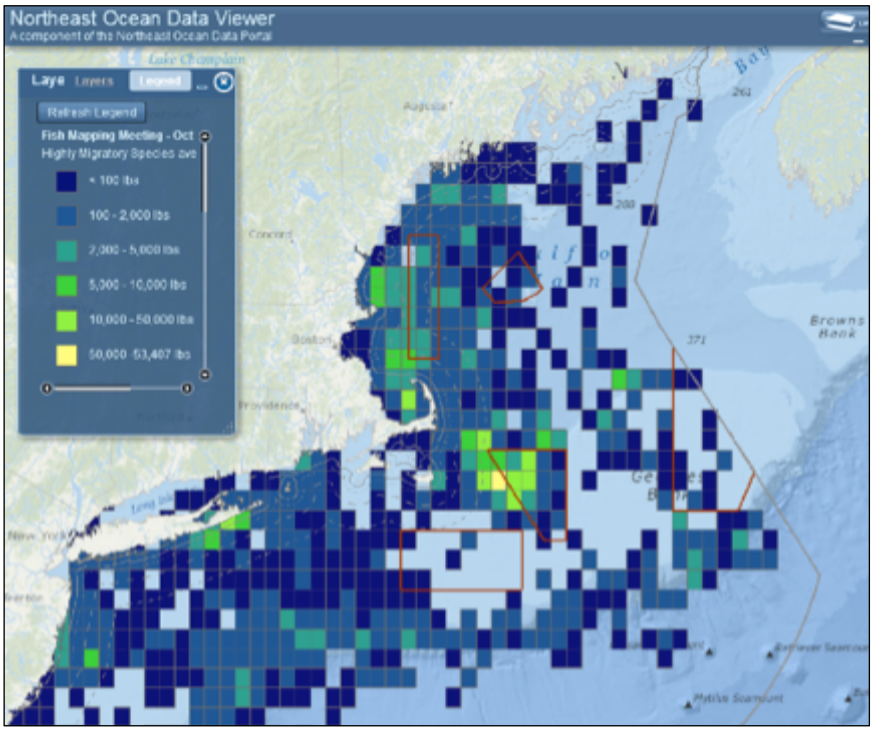


Map 13: Lobster trap endline density in New England. Darker shades indicate areas with relatively higher line densities. (Source: National Marine Fisheries Service, Northeast Regional Office, Protected Resources Division)

c. Tuna Fishing Map

Tuna is an important species for many New England fishermen. The vast majority also participate in another fishery, and usually supplement their annual income with tuna fishing. Tuna is also a popular target species for the party/charter fleet.

The Highly Migratory Species VTR map below (**Map 14**) shows aggregate catch for all billfish species, as well as a number of species of tuna and shark, rather than distinguishing among them. This limits the map's utility in representing specific areas of tuna fishing activity, and exemplifies the limitations of VTR data. Conversely, it emphasizes the importance of identifying and gathering additional information for fisheries with insufficient data.



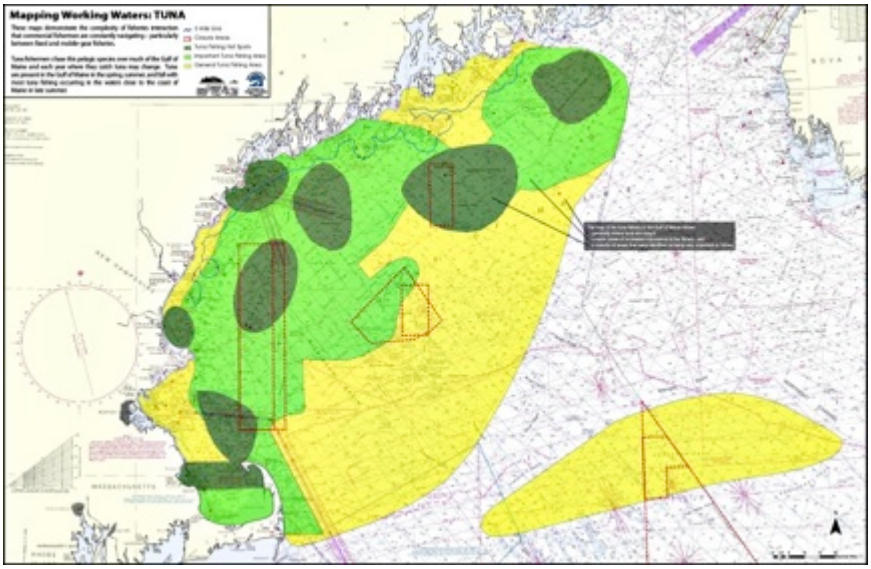
Map 14: VTR catch map for highly migratory species (1997-2009). *Note:* This includes tuna species, billfish species, large shark species and swordfish.

Interestingly, VMS requirements for highly migratory species, including tuna, swordfish, billfish, and sharks, were recently implemented for federally permitted vessels (NMFS 2013). These requirements may result in producing a supplemental data source beyond the current VTR map (**Map 14**).

The VTR data from NMFS does not do an adequate job of portraying the tuna fishery. As such, the team also used a map of tuna fishing activity in the Gulf of Maine produced by the Island Institute.

As part of its Mapping Working Waters Project, the Island Institute drafted a more accurate representation of tuna fishing activity (primarily bluefin tuna) in the Gulf of Maine. Seven interviews were conducted with Maine fishermen and the resultant map represents an aggregate of information gathered. Fishermen identified areas of low, medium, and high (yellow, light green, and dark green) fishing activity based on their own experience and what they knew about other fishermen's level of activity. This map (**Map 15)** captured "hot spots" and places with increased activity, creating a snapshot of where the tuna fishery takes place in the Gulf of Maine.

Used during this project's stakeholder meetings, the tuna map was favorably received by those who fish in the western Gulf of Maine. Meetings on Cape Cod and in Southern New England noted that the map did not cover their fishing areas and thus, they were not represented in the activity. Their feedback indicated a need to collect additional information to accurately reflect their regional fishing patterns on future maps.



Map 15: Areas of low (yellow), medium (light green), and heavy (dark green) tuna fishing activity in New England. (Source: Island Institute)

d. Party/Charter Fleet Maps

The party/charter sector comprises an important and significant portion of New England's marine resource users. Due to operational aspects of how the fishery works and data quality issues, this group is not accurately portrayed in the NMFS data set used for this project.

The party/charter fleet tends to fish for multiple species in different locations – sometimes miles apart – during the course of any given trip. Discussions with fleet members revealed that they frequently fish in an opportunistic manner, targeting species that "happen to be nearby." This combination of fishing in multiple fisheries and different locations is a difficult challenge in terms of VTR reporting. Further information is necessary to accurately characterize how the party/charter fleet uses ocean space.

One of the factors that motivated party/charter industry members to participate in this project is the lack of existing spatial data about their industry; even though VTR data may be available, there are quality concerns with that data, as explained above. Some feel this has decreased their ability to participate in the management process. A federally recognized data set that the industry felt was representative of their fishing activity was mentioned numerous times as a hopeful outcome for this project or future work. A recommendation for additional data collection is found at the end of the report.

4. Map Contextual Information and General Use Caveats

Another clear concern voiced by fishermen was that NROC maps would be misused and the associated contextual information would be misinterpreted, or even lost in translation. A number of fishermen suggested that they note concerns directly on NROC's maps, or otherwise attach them to maps. The most pressing limitations are set forth in the discussion about metadata and abbreviated metadata (see section below).

Combating potential misinterpretation or misuse of the maps and how that may in turn impact fishermen's view of the ocean planning process is an issue NROC will continue to face. The team recognizes that the inherent complexity of New England fisheries makes providing a complete analysis very difficult.

a. Timely Display of Maps

The NROC team fielded numerous inquiries from industry members, asking when the maps would be made available for public viewing. Part of their concern stems from engagement in prior research projects where data and results were not posted in a timely fashion, or even shared at all with those who participated. Many fishermen used valuable time they could have spent out on the water, managing other aspects of their businesses, or simply enjoying life with their families.

To be responsive to these concerns and respect the time and efforts of project participants, the team encourages NROC to accept the recommendation below and move quickly to display the maps online.

V. RECOMMENDATIONS FOR POSTING MAPS

A. Part 1

Although the maps are in some respects flawed, the team feels it is important that they be posted online. Displaying them with the associated caveats and contextual information will hopefully elicit additional, valuable feedback from viewers. It is recommended that the following maps be posted as soon as NROC can add information from **Parts 2** and **3** of this recommendation.

1. All VMS Fisheries map
2. VMS Multispecies
3. VMS Herring (with caveats)
4. VMS scallop
5. VMS Surf Clam/Ocean Quahog
6. Groundfish Average Catch (97-09)
7. Groundfish Average Trips (97-09)
8. Southern New England (97-09)
9. Herring Average Catch (97-09)
10. Highly Migratory Species Average Catch (97-09)
11. Highly Migratory Species Trips (97-09)
12. Dogfish Average Catch (97-00) and (01-09)
13. Cod Average Catch (97-09)
14. NMFS Lobster
15. Gulf of Maine Tuna Map (Island Institute)

If applicable, maps should be cross referenced to show VMS and/or VTR data, or composites of multiple fisheries. This will serve as an indicator that related information is also available on other maps.

There are some maps that the team recommends not be posted. Those are ones with inadequate data or ones which comments indicated contain flawed data. These include:

1. maps received from other projects that the team did not receive permission to post (i.e., the NMFS herring maps and lobster association maps);

2. VTR recreational fishing maps;

3. VTR lobster catch maps;

4. VTR pots and traps.

B. Part 2

All maps made available online should include:

1. associated abbreviated and full metadata;

2. descriptions of the data caveats;

3. information on map limitations as described elsewhere in this report; and

4. this report, in its entirety.

C. Part 3

The team recommends displaying the maps in a pre-packaged set of layers that open automatically when the data portal is activated. These layers include:

1. NOAA chart view with a pre-set transparency of approximately 30 percent, which will allow the fisheries data layer to be viewed in addition to the chart;

2. groundfish closed areas; and

3. the 10' square grid.

Users should be able to turn off different layers. However, setting the initial display as recommended will improve their and understanding of the information contained within.

D. Abbreviated Metadata

The project team was frequently asked questions about underlying source data. To help clarify information contained in each map and provide additional context about the data, they developed short, 2-3 sentence descriptions, termed "abbreviated metadata." Abbreviated metadata descriptions provide users with important details that cannot be captured in a map title but are more easily accessible to non-GIS savvy users than the full metadata. Abbreviated metadata is more explicit, and outlines specific technical, source and processing details.

Recommended abbreviated metadata:

- VMS maps:
    - VMS, All Fisheries (06-10): Represents all VMS pings between 2006 to 2010 reported for the following fisheries: Herring, NE multispecies (American plaice, Atlantic cod, Atlantic halibut, haddock, ocean pout, pollock, redfish, white hake, windowpane flounder, winter flounder, witch flounder, and yellowtail flounder), monkfish, scallop, and surf clam/ocean quahog fisheries. Obtained from NOAA in monthly text files and modified for the purpose of importing into ArcGIS, raw VMS data contains information for date (by day), geographic position, and Declaration Code, which represents the VMS fishery plan, programs, and associated geographic or gear type information. Note: this data also includes all trips that utilize the VMS codes for these fisheries, and as such, may include trips that direct on other fisheries but use a DAS and/or VMS declaration for another fishery as a management and reporting mechanism.

    - VMS Multispecies (06-10): Represents all VMS pings between 2006 to 2010 reported under the multispecies fisheries (American plaice, Atlantic cod, Atlantic halibut, haddock, ocean pout, pollock, redfish, white hake, windowpane flounder, winter flounder, witch flounder, and yellowtail flounder). Obtained from NOAA in monthly text files and modified for the purpose of importing into ArcGIS, raw VMS data contains information for date (by day), geographic position, and Declaration Code,

which represents the VMS fishery plan, programs, and associated geographic or gear type information. Note: this data also includes all trips that utilize the VMS codes for these fisheries, and as such, may include trips that direct on other fisheries but use a DAS and/or VMS declaration for another fishery as a management and reporting mechanism.

VMS Herring (06-10): Represents all VMS pings between 2006 to 2010 by reported by vessels with a federal herring permit. Obtained from NOAA in monthly text files and modified for the purpose of importing into ArcGIS, raw VMS data contained information for date (by day), geographic position, and Declaration Code, which represents the VMS fishery plan, programs, and associated geographic or gear type information. Some vessels reporting activity in the herring fishery through VMS may be fishing in other fisheries, e.g. squid, mackerel, butterfish, but also possess a federal herring permit requiring VMS use. Separating these different types of fishing reported under the herring VMS requirement will require examination of permit types, catch, and VMS records.

- VMS Scallop (06-10): Represents all VMS pings between 2006 to 2010 reported by vessels with a federal scallop permit. Obtained from NOAA in monthly text files and modified for the purpose of importing into ArcGIS, raw VMS data contained information for date (by day), geographic position, and Declaration Code, which represents the VMS fishery plan, programs, and associated geographic or gear type information. This includes Limited Access vessels and General Access category vessels in the scallop fishery.

- VMS Surf Clam/Ocean Quahog (06-10): Represents all VMS pings between 2006 to 2010 reported by vessels with a federal surf clam/ocean quahog permit. Obtained from NOAA in monthly text files and modified for the purpose of importing into ArcGIS, raw VMS data contained information for date (by day), geographic position, and Declaration Code, which represents the VMS fishery plan, programs, and associated geographic or gear type information. These data sets also include vessels permitted in the Maine mahogany clam fishery that fish in eastern Maine under a specific provision of the Mid-Atlantic Fishery Management Council FMP for Surf Clam and Ocean Quahog.

- VTR Maps:

For VTR-derived products, it should be noted that all VTR data is self-reported by fishermen. In addition, the following information should accompany specific maps.

- Groundfish Average Catch (97-09): Represents the average annual groundfish catch in pounds made by federally permitted commercial fishing vessels from 1997 to 2009. Based on annual VTR summaries provided by the National Marine Fisheries Service, the catch is aggregated by ten-minute squares. The dataset includes VTRs for Atlantic cod, haddock, pollock, yellowtail flounder, witch flounder, winter flounder, windowpane flounder, American plaice, redfish, ocean pout, white hake, silver hake, red hake, offshore hake, and wolffish.

- Groundfish Average Number Trips: Represents the average annual groundfish number of trips made by federally permitted commercial fishing vessels from 1997 to 2009. Based on annual VTR summaries provided by the National Marine Fisheries Service, the catch is aggregated by ten-minute squares. The dataset includes VTRs for trips that reported catching Atlantic cod, haddock, pollock, yellowtail flounder, witch flounder, winter flounder, windowpane flounder, American plaice, redfish, ocean pout, white hake, silver hake, red hake, offshore hake, and wolffish.

- Herring Average Catch (97-09): Represents the average annual Atlantic herring catch in pounds made by federally permitted commercial fishing vessels from 1997 to 2009. Based on annual VTR summaries provided by the National Marine Fisheries Service, the catch is aggregated by ten minute-squares.

- Southern New England (97-09): Represents the average annual catch in pounds for southern New England species made by federally permitted commercial fishing vessels from 1997 to 2009. Based on annual VTR summaries provided by the National Marine Fisheries Service, the catch is aggregated by ten-minute squares. The data set includes VTRs for Atlantic mackerel, summer flounder, butterfish, and scup.

- Highly Migratory Species Average Catch (97-09): Represents the average annual catch in pounds for highly migratory species made by federally permitted commercial fishing vessels from 1997 to 2009. Based on annual VTR summaries provided by the National Marine Fisheries Service, the catch is aggregated by ten-minute squares. The dataset includes VTRs for albacore tuna, bigeye tuna, blackfin tuna, bluefin tuna, little tuna, skipjack tuna, yellowfin tuna, and swordfish.

- Highly Migratory Species Trips (97-09): Represents the average annual number of trips for highly migratory species made by federally permitted commercial fishing vessels from 1997 to 2009. Based on annual VTR summaries provided by the National Marine Fisheries Service, the catch is aggregated by ten-minute squares. The dataset includes VTRs for albacore tuna, bigeye tuna, blackfin tuna, bluefin tuna,

little tuna, skipjack tuna, yellowfin tuna, and swordfish.

- Dogfish Average Catch (97-00) and (01-09): Represents the average annual dogfish catch in pounds made by federally permitted commercial fishing vessels from 1997 to 2000 and from 2001 to 2009. Based on annual VTR summaries provided by the National Marine Fisheries Service, the catch is aggregated by ten-minute squares. The dataset includes VTRs for chain dogfish, spiny dogfish, and smooth dogfish, as well as records where dogfish type is unspecified.

- Cod Average Catch (97-09): Represents the average annual cod catch in pounds made by federally permitted commercial fishing vessels from 1997 to 2009. Based on annual VTR summaries provided by the National Marine Fisheries Service, the catch is aggregated by ten-minute squares.

- Other Maps:

  - NMFS Lobster: The NMFS trap endline density survey map provides the most comprehensive map of trap fishing in New England. The vast majority of these endlines are associated with the lobster fishery, but also include crab traps and other trap or pot gear. Conducted in 2011, the endline survey combined examination of federal lobster permit holder information and interviews with New England state fisheries management personnel knowledge about the lobster fishery. Because of different lobster gear configuration used in New England, this map does not provide a trap density estimate. However, it does provide a useful display of relative lobster fishing activity in New England.

  - Island Institute Tuna: The Island Institute mapped tuna fishing areas in the Gulf of Maine, with a primary focus on bluefin tuna. Work occurred primarily with Maine fishermen and as such, there may be areas in the southern part of the Gulf of Maine or off of Cape Cod that are not well represented. Other species of tuna and fishing areas for fishermen from Cape Cod and Southern New England are not shown on this map. Recognizing that tuna are a pelagic species and their location in New England waters can vary greatly depending on environmental factors, the method for identifying and mapping habitat was based on industry identified locations where fishermen typically catch tuna, or frequently catch tuna each year. It also denotes “hotspots” that are particularly important to the fishery.

E. Inclusion of Data Caveats

As noted elsewhere in this report, it is critically important to display caveats and other contextual information with project's map products. To avoid misinterpretation, users should be made aware of outlined limitations.

One method of displaying metadata is to employ a "pop up" message that is too large to ignore and opens when maps are viewed electronically. However, the project team believes this method may annoy users. An alternative would be to place a small text box/line at the bottom or edge of each map with a message explaining how to access the metadata. An example is:

> Fishery data used to create this map spans a finite number of years, may not fully portray a fishery, or may be misleading in other ways. Users should view the metadata (root information) used to produce this map, available at: **www.nrocmaps.metadata.com**

This type of cautionary label should be placed on each NROC map image in a visible but unobtrusive way to urge users to view the abbreviated metadata and caveats.

Additional general caveats that NROC should include are:

- These maps were produced as part of an ocean planning process and attempt to broadly characterize the region's fisheries. The quality of data for other uses was not determined.

- The absence of data does not indicate an absence of fishing activity, or an area that is unimportant. There is a significant temptation to assume that if important areas are identified, other areas may not be important. This inference that cannot be supported by the maps. For further information, please read the accompanying report in its entirety.

- Data sets are only available for limited time periods.

- Historical data sets are not available; as such, the maps reflect only a small portion of a fishery's history. For this reason, caution must be used to not ascribe patterns shown on the maps as describing a fishery beyond the time period for which data sets are available.

- Maps are derived from various data sources and may have different scales. Comparisons across maps should be made carefully.

Beyond these general caveats, specific limitations of available data and the caveats discussed in the VMS and VTR sections of this report must be clearly expressed.

F. VMS Maps

Vessel Monitoring System (VMS) maps proved to be the most accurate source material for the project's data collection and analysis efforts, since they provided the precise location of fishing boats in certain fisheries at regular intervals. VMS data sets are available for some (although not all) federally permitted commercial fisheries, including the Northeast multispecies fishery (groundfish), monkfish, Atlantic herring, sea scallop, and surf clam/ocean quahog. The VMS maps cannot be compared across fisheries as each map has a color scale that only shows relative fishing activity on that map. For example red on the herring map represents a different level of vessel activity than red does on the groundfish map.

VMS maps are complicated by the fact that VMS is not required for all fishermen in some fisheries. For example, in the monkfish fishery, mid-Atlantic monkfish vessels do not have a VMS requirement and in the Grey Zone, an area shared by the United States and Canada off Down East Maine, VMS data underrepresents fishing activity because it doesn't show Canadian boats also fishing those waters.

VMS data is complicated by the fact that the data does not distinguish between fishing vessel activity directed towards a particular species and fishing activity that is directed towards a separate species but one that is reported through the same VMS declaration. For instance, fishermen participating in the skate, bait skate, and dogfish fisheries may appear as being engaged in the groundfish or monkfish fisheries. Separating out these fisheries may be important to the accurate representation of specific communities or groups of fishermen.

While at first glance the VMS maps seem very detailed, they have some significant limitations. They do not show the amount of fish caught in a particular location; rather, they show the presence of a fishing boat. For ocean planning purposes, it may be suitable to show the relative use of a particular ocean area by the fishing industry. However, this information does not indicate type of catch for that same area. There are reasons beyond the mere presence of fish that drive why fishing activity occurs in a given area.

At the time of this mapping project, VMS data sets were only available from 2006 to 2010, which limits the scope of examining fishing patterns. VMS data sets now exist for 2011 and 2012. The lack of more recent data limited the team's ability to map fishing activity relative to the 2010 implementation of the groundfish fishery's sector management system.

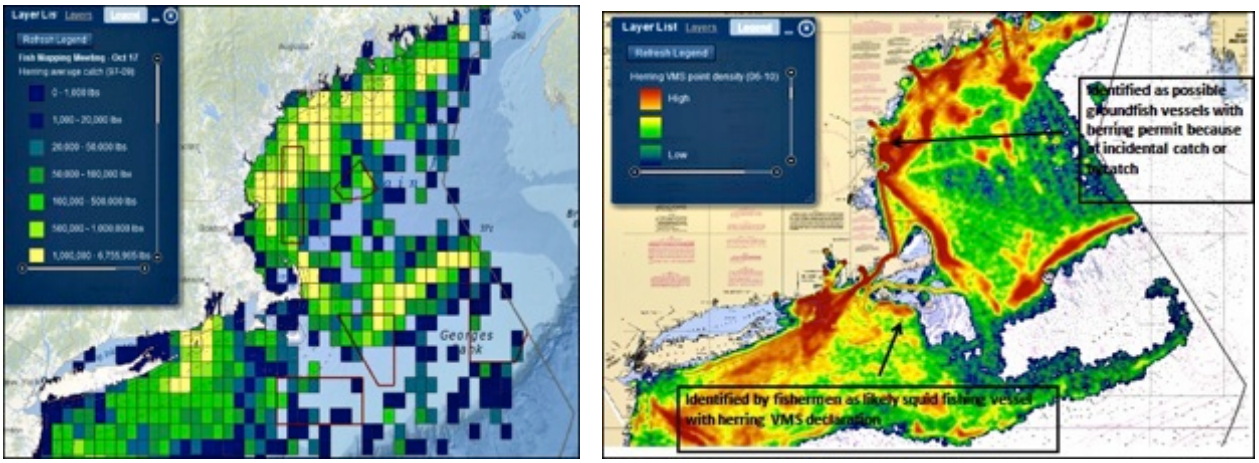
One of the main comments received was that the maps did not distinguish between steaming, transit and fishing activity. Separating these distinct movements would lend credibility to a map that purports to show fishing activity – instead of showing overall fishing vessel activity. With the presence of a date/time stamp and vessel ID, steaming and could be separated from fishing activity. Further work to differentiate steaming and transit is proposed below.

Another important issue with project VMS maps is that as processed, they lack the resolution to adequately display areas with lower density levels of fishing activity. The ability to see individual harbors, communities, or sub-regions and how ocean space is used at the community scale may be as important to the regional planning process as the broad overview. In considering alternative processing methods for the raw VMS data, date set size, processing time, and memory are all important technical constraints to consider.

1. Separating False Signals

A number of industry members commented that certain VMS maps "looked wrong." Upon further investigation, the team discovered that source data includes different categories of permits which are weighted in the same manner. This creates an issue with resulting maps from these source data as they do not differentiate between VMS vessels engaged full-time in a specific fishery, versus vessels from other fisheries that hold an incidental or bycatch permit and have VMS turned on to comply with regulations. Examples of this are areas on herring maps that may be fished for squid by vessels that also have VMS and a herring permit, or groundfish vessels that have incidental or bycatch herring permits. **Map 16** illustrates areas where this may have occurred.

Similar issues likely exist in other fisheries that utilize VMS. The relationship between VMS data created by the monkfish and groundfish fisheries one that the team feels merits further exploration, since their management is closely related.



Map 16: Herring VTR catch (left) and VMS (right) show potential "false signals from vessels from other fisheries that hold an incidental or bycatch herring permit.

The recommendation below represents the team's attempt to determine how NROC should address the issue of false VMS signals. Further targeted conversations on this subject may indicate that the solution outlined here does not adequately address the problem.

To better portray maps for a particular fishery, VMS data for vessels specifically engaged in pursuit of that species should be separated from data for vessels that hold permits at a very low (incidental or bycatch) level. For example, herring VMS data should be segregated into three categories (directed herring vessels; groundfish vessels with herring bycatch permits, and squid, mackerel and butterfish vessels with herring incidental bycatch permits), then mapped to see if different patterns of herring fishing activity are evident. Similar analyses could be conducted for other fisheries with VMS requirements.

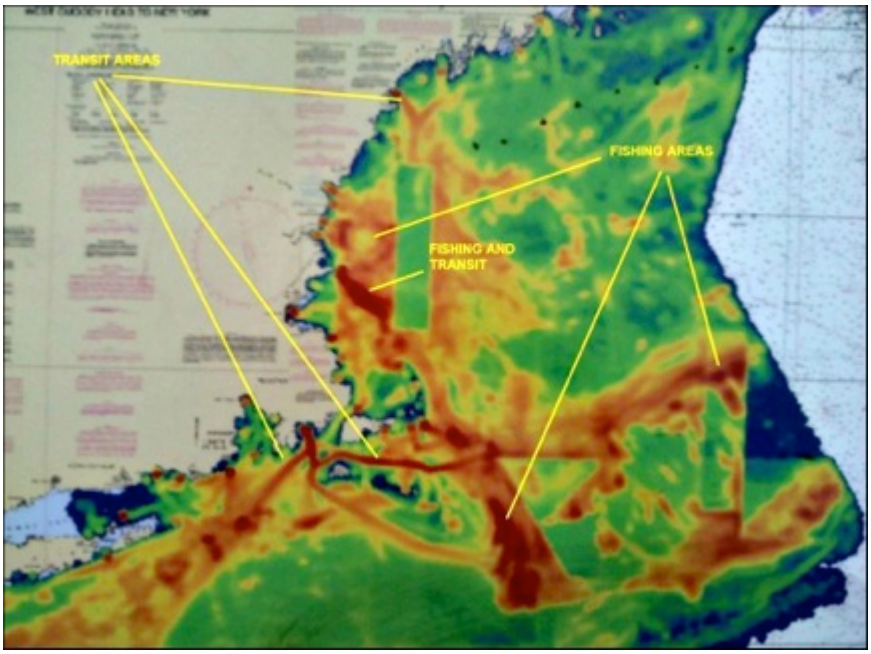
2. Distinguishing Transit Time from Fishing Time

An issue mentioned frequently when users viewed NROC's VMS maps for groundfish, monkfish, herring, scallops, and surf clams/ocean quahogs, as well as the composite map (groundfish, monkfish, herring, scallops, and surf clams/ocean quahogs) is that none of the maps separate fishing activity from transit activity (**Map 17**). The distinction is an important one.

As it stands now, maps purporting to show "fishing activity," clearly contain transit activity. They not only look "wrong," they are spatially incorrect, and viewing them may lead users to question the accuracy of the other data portrayed. In order to

accurately characterize pure fishing activity within New England, NROC should separate transit activity on these maps.

Numerous fishermen suggested using vessel speed to differentiate between transit time and fishing activity. Meeting participants stated that fin fishing typically occurs from 2.8 to 3.5 knots (maybe as low as 2.2 knots for some vessels) and scallop dredging occurs at up to 4.0 knots. They felt vessel speeds above 6 knots represents transit time. Due to confidentiality concerns, attributes needed to determine vessel speed were removed from the data by NMFS so these calculations could not be done during this project.



Map 17: Groundfish VMS map with transit, fishing, and transit/fishing areas identified.

Meetings with staff members from the New England Fishery Management Council and Northeast Fishery Science Center revealed other ideas about segregating transit time from fishing activity. These included:

a. Establish a minimum fishing speed to segregate fishing activity from non-movement times for shucking, sorting, rest, etc. It was suggested that 1 knot be used as a minimum speed for fishing.

b. Other suggested maximum speeds for segregating fishing from steam/transit were 5.0 knots, 5.5 knots, 6 knots, and 7.0 knots.

Various views on what VMS vessel speeds indicate idle (non-movement) time, fishing activity, and transit time suggest that a common definition or standard would benefit future map users, as well as other users of collected VMS data.

One way to move the discussion toward a more standardized approach of segregating transit time from fishing activity would be to convene a group of people and/or organizations that have used VMS data in the past (e.g., New England Fishery Management Council, Northeast Fishery Science Center, Northeast Regional Office, NROC) to discuss different approaches to separating steaming/transit time from fishing activity by:

a. fishery;

b. gear; and

c. other factors identified through ongoing conversations.

It was also suggested that NROC conduct a sensitivity analysis of VMS data to different speeds and different gears. This would help determine if there is a significant difference between speed breakdowns used in the past (e.g., 4.5, 5, or 6+ knots) and how fishing activity is portrayed on current maps. Differences in the speed cutoff between transit time and fishing activity may or may not result in meaningful changes on future map iterations.

Following the meeting and sensitivity analysis recommended above, the team suggests that NROC should produce additional, separate maps for transit time and fishing activity. This could be done asking NMFS for VMS data that contains associated date/time specifics. Mapping such data would allow for spatial display above and below the 6.0 knot threshold, and clearly show areas that are transit, fishing, or some combination thereof.

3. Specific Caveats for VMS Maps

The following caveats should be posted with any of the VMS maps:

- VMS maps are available for a limited number of New England fisheries, including groundfish, monkfish, Atlantic herring, scallops, and surf clams/ocean quahogs. Other fisheries are regionally important, but lack this type of data.

- VMS data sets used reflect the period from 2006 to 2010. Although more recent VMS data sets exist, 2010 was the terminal year for made available for this project.

- Due to confidentiality concerns, certain fields (vessel identifiers, date and time stamps) were removed from VMS data sets before they were provided to NROC. This prevents a clear separation of transit time from fishing activity and significant transit activity is still portrayed on these maps.

- VMS is not required for all fishermen in some fisheries.

- Processing of VMS map data doesn't show how important lower fishing intensity areas are to local fleets or fishermen.

- VMS maps may show false signals. A vessel permitted in one fishery may actually show as fishing in another fishery, but is still required to have the VMS turned on.

- VMS data are raster density grid with resolution of 250m and some edges overlap the shoreline and closed area; based on their GPS-derived nature, they are generally accurate to within 100 meters (personal communication, NOAA staff, August 22, 2013).

G. Vessel Trip Report Maps

Vessel Trip Reports (VTRs) were the most extensive data sets analyzed for this project, providing information at a species level and including data related to catch and effort. NMFS requires VTR data for all federal fisheries, except from those individuals solely engaged in the federal lobster fishery. VTR data sets include home port, port sailed from, days out, pounds/species caught, and location caught. VTRs are completed by fishermen and then most are transcribed by a NMFS employee. Some fields, such as species and pounds caught are more likely to be accurate, while location appears to be less accurate. There are multiple instances in the process where long strings of numbers such as Latitude and Longitude can be keyed incorrectly.

Comments from different industry segments reiterated that VTR data from these maps should not be used to map fine scale fishing activity without further addressing the issues raised by fishermen and contained in this report.

Fishermen the team spoke with evinced significant distrust in VTR data. VTRs should be completed each time there is a change in the area where fishing occurs. However, standard practice is to complete one VTR per trip, even if fishing activity took place over a span of 100 miles, or at the beginning of a trawl tow. In some fisheries it is common practice to use the same Latitude/Longitude numbers for each VTR, even if fishing activity took place elsewhere. Finally, the VTR form itself provides a significant limitation in that it has only one spot to list a

"VTR's are only marginally accurate."

"VTR data has been off by 30 percent and isn't useful in fisheries management."

"VTR data is not necessarily accurate about fishing locations. Some groundfish boats mis-report where fish are actually caught to avoid hitting quotas of choke species."

— Examples of concerns voiced during meetings regarding the limitations of VTR data

location and is self reported.

The primary data fields analyzed in this project were catch and number of trips. Maps displaying the number of trips taken to a particular location tend to show more activity inshore, while maps displaying pounds of fish caught tend to highlight the importance of offshore fishing areas to the region's fisheries. The methods of processing the data are equally insightful but say different things about how ocean space is utilized. Those viewing the maps should make sure they understand the context as well as the content.

Even with concerns about the accuracy of underlying data, the VTR maps seem useful in showing broad patterns at a scale significantly larger than the 10' squares on NROC's maps. They provide good, contextual, general information about the fisheries at a regional level, including rough estimates of catch and how fisheries change over time. Frequently, VTR data is the only spatially referenced data that exists for a fishery.

Other projects in the region have used VTR data to display spatial information; for example, Kevin St. Martin of Rutgers University successfully mapped community fishing territories and use of ocean space by a particular group of fishermen. The key is to such efforts is to work closely with the fishermen to learn about the symbiotic relationship between VTR completion and what happens on the water.

VTR maps should be employed carefully and with the understanding that they are most helpful in showing broad, regional, spatial use patterns. They are also effective tools to illustrate the efficacy of different management measures, or how fisheries generally operate.

1. Specific Caveats for VTR Maps

The following caveats should be included with any VTR map NROC posts on the data portal.

- VTR data sets are available for the years 1997 to 2009. Although more recent data sets exist, that is terminal year for access made available for this project.

- The display of catch categories shown in map legends is roughly based on feedback from fishermen about what might comprise meaningful distinctions in catch size. Likewise, the display of different trip categories roughly correlates to the number of trips in a particular fishery that would indicate a small, medium, high, or very high amount of fishing activity. These numbers are not exact, but rather, should be seen as guides to help regional scale patterns emerge.

- The VTR maps are useful to show broad scale, regional spatial patterns. They should not be used for fine scale mapping purposes.

- Specific locations for individual VTR trips are imprecise due to lack of compliance with location recording regulations. For example, some fishermen do not report when they move from one area to another; others may mark one location for an entire trip. In multiple cases, fishermen stated that they marked one location for an entire fishing season.

- VTR data is displayed in 10' squares.

- VTR data for 10' squares beyond the Exclusive Economic Zone and landlocked 10' squares were removed from project maps.

- VTR data sets are available for all fisheries that reported landings. They are limited in how the data can be used or interpreted. For fisheries with a low number of records or businesses involved in the fishery, there were significant limitations that prevented that data from being displayed.

H. Other Maps

In addition to the VTR and VMS maps mentioned above, the team recommends that NROC post the NMFS Protected Species Division endline lobster map and the Island Institute tuna map to the data portal, accompanied by this report. While not definitive in their own right, access to these maps will help acknowledge fishermen's concerns about the lack of representation that currently exists in the VTR maps, and will aid NROC in continuing conversations with these important groups.

1. Specific Caveats for the Lobster Map

- The NMFS Protected Species Division lobster map portrays lobster pot endline density throughout New England waters, which can be used as a proxy for lobster fishing intensity. However, it is also important to note that endline density can vary significantly by area fished, and by fishing regulations that restrict gear configuration.

- The NMFS Protected Species lobster map was produced as part of a process attempting to minimize the impact of the lobster fishery on the region's whales.

As such, it does not purport to show fishing effort or lobster catch but rather, the number of vertical lines present in a particular part of the ocean. This is the best regional representation of the lobster fishery, although some areas have significantly better data than portrayed.

- VTR reports for the lobster fishery are limited to federally permitted vessels in other fisheries, e.g., groundfish. Federally permitted lobster vessels that do not hold other federal licenses are not required to report via the VTR system. Because VTR reporting is not required for a large segment of the lobster fishery, the VTR based lobster map is highly misleading.

2. Specific Caveats for the Tuna Map

- The Island Institute tuna map is based on a series of interviews with seven Maine fishermen conducted in fall 2011 and winter 2012. Fishermen identified areas of low (yellow), medium (light green), and high (dark green) levels of tuna fishing. The map reflects those locations, rather than other data sources such as catch records.

- Comments from New Hampshire and Massachusetts fishermen suggested additional areas of tuna fishing activity in the southern Gulf of Maine. They indicated that the map may need to be refined to reflect additional areas of medium and high levels of tuna fishing activity based on their knowledge and fishing experience.

- The Island Institute tuna map displayed tuna fishing activity off the Maine coast. Tuna fishing certainly occurs outside the Gulf of Maine, and such activity should be documented in future iterations of the map.

- Since the Island Institute tuna map lacks other data sources to accurately characterize its spatial distribution, gathering additional information about the New England tuna fishery should be a top priority in future mapping efforts.

I. Revisions to Current Maps

There are number of steps NROC can take to make the VMS data more useful. These include:

- Break down VMS data by year – this would allow users to view single as well as aggregate years of data. Consider the feasibility of displaying monthly VMS data.
- Develop an additional set of VMS maps that standardizes the color ramp across the maps to ensure that the same color represents the same number of "pings" in a certain area. This would allow users to compare fisheries relative to the time spent in a particular part of the ocean.

- Enable users to turn specific fishery layers on and off on the All VMS map. This would allow direct data comparison and/or overlay (e.g., herring and groundfish).

- Develop a composite VTR with 1) all trips and 2) all catch for all fisheries. It should show removal from the sea, which is helpful from a regional planning perspective.

- Consider altering the color ramp on the VTR Herring Catch map and VTR SNE Catch map to show more differences at the high end of the ranges.

NROC should request additional VMS data from NOAA. Current VMS data would be the most valuable, as it would best reflect commercial fishing activity under current management:

- Data received from NOAA should be processed using the same methods as existing VMS maps. Data sets should be added together.

- In the data portal, metadata and map titles should be updated to reflect new data received and processed.

- For the Groundfish VMS map, NROC should display all groundfish data in a single map as well as dividing it into two categories – prior to May 1, 2010, and post May 1, 2010 – to recognize the significant shift in management that occurred at that time.

- NROC should develop a data sharing MOU that allows NMFS data to be processed as quickly as possible.

J. Outreach and Follow-Up Meetings

The project team compiled their findings on characterization of New England fisheries in this report. It is recommended that NROC follow the actions outlined below.

- Upload the project maps and associated caveats to the data portal.

- Promote their availability through active outreach.
- Communicate results of the mapping study through ongoing dialogue with the region's fishermen and other ocean use stakeholders.

- Refer to this project as Phase I and the subsequent project as Phase II. This will increase the connection between them, and should reduce some of the confusion and other issues raised in the participation section.

- Continue to utilize tools successfully employed throughout this project's course – email, web postings, articles in relevant papers, and meeting presentations.

Within that context, specific recommended action items include:

- Present the project summary to the Regional Planning Body (RPB) and the Northeast Regional Ocean Council. A priority presentation should also be made to state fisheries managers.

- Post the project results and report on the NROC website and the Ocean Data Portal.

- Send an email from the project team to all participants – thank them for their participation, and provide a summary of major findings and recommendations.

- Publish a follow-up article to the October 2012 article in *Commercial Fisheries News*.

- Submit a similar project summary article to *National Fishermen*.

- Develop a standard PowerPoint project summary presentation, complete with recommendations and a Frequently Asked Questions (FAQ) section. Present it to various appropriate audiences including, but not limited to, fishing associations and events.

- Prioritize giving presentations to groups with whom the project team met.

- Present the project summary at the next New England Fisheries Management Council meeting.

NROC should develop a process to capture, if not address, comments submitted after the maps are posted to the portal, since they will only inform planning and implementation for Phase II work.

Further engagement with the fishing industry should be focused and well-articulated. In any ongoing communications, NROC should take the actions outlined below.

- Define which issues will and will not be undertaken in Phase II work.
- Identify expected outcomes before Phase II work commences (guided by the goals of the regional planning body).
- Share information regarding the process for Phase II work.
- Outline a timeline for Phase II work.

Following these four guidelines will help NROC communicate well with the fishing industry.

VI. RECOMMENDATIONS FOR FUTURE WORK

There are a number of recommendations for NROC to consider as it pursues further fisheries mapping work. Recognizing that resources are limited, these ideas represent priorities for filling critical data gaps. In particular, significant consideration should be given to: 1) what questions current data answers; 2) what questions future data needs to answer; and 3) what kinds of questions are data able to answer. Using these criteria as a guide will allow NROC to better prioritize the direction and scope of future projects.

Recommendations for future mapping work are broken down into two categories. The first is a series of small, targeted, meetings whose goal would be to further explore unresolved questions/issues that emerged from Phase I of this project.

- Address misleading (“false”) VMS signals (see VMS section)
- Delineate transit time from fishing activity (see VMS section)
- Define the value of continuing to work with VTR data
- Include additional, non-catch, fisheries-related data sets
- Address shifts in the ecosystem
- Determine the role and value of working waterfront infrastructure

The team also recommends creating new data sets to address four critical, existing data gaps:

- Lobster
- Tuna
- Charter boats
- Community

A. Small Meeting Recommendation

A number of concerns important to the fishing community were repeatedly raised during Phase I meetings. Addressing some of these requires further work by a small, targeted group of individuals who can provide specific insight into the issues being addressed. A goal of each meeting should be resolve the issues, or determine if further work by NROC is needed. Meeting participants should be chosen with several criteria in mind: cross-representation of individuals/groups affected, available time, knowledge of the NROC process and commitment to the task at hand.

B. Value of Continuing to Work with VTR Data

NROC should convene a meeting with thought leaders in the fishing industry, scientists, fisheries managers, and ocean planners to consider how and whether NROC should move forward with developing additional VTR data. As this report indicates, VTR data provides important information for some fisheries and indeed, may be the only source of information for others. However, maps based on VTR data are viewed with great skepticism by the fishing community. At a minimum, this meeting about VTR should cover the following topics:

- Review VTR criticism/comments contained in this report.
- Examine fields contained in VTR data in order to determine if needed information is adequately portrayed (for example: catch data = pounds of fish removed from the ocean; trip data = number of visits to a particular area). Gear type is an additional data type that might be worth further consideration.
- Compare VTR and VMS data for fisheries that have both – note that trips taken or pounds caught are different measures than presence of a fishing vessel.

- Superimpose different data sets to determine if they show similar patterns. The degree of statistically significant differences would be an interesting conversation starter for this meeting.

- Consider revising VTR maps to look more like heat density maps. Blur some of the precision that seems to stem from displaying VTR maps in 10' squares. This might help VTR maps look less precise and more realistic.

- Determine whether the deeply held distrust of VTR data by the industry presents a large enough obstacle for ocean planning that continued work with VTR data is not advisable.

C. Identifying and Incorporating Non-VTR/VMS Data

The goal of this mapping project was to characterize fishing efforts in New England using VTR and VMS data. Stakeholder feedback made it apparent that other existing data sets could enhance and improve both accuracy and content current maps.

Other regional mapping efforts are underway or were recently completed by NROC. Incorporating that data would aid in broadening the scope and information included in the Phase I maps.

The Ocean Data Portal can serve as a venue to unite various NROC efforts, as well as efforts by others in the region. NROC should discuss ways to gather and incorporate external data sets into the portal in a manner that supports the goals and objectives of the comprehensive mapping process. Where NROC has this or similar data already available in the data viewer, it should be cross-referenced and easily comparable with the fisheries maps.

Below is a list of data sets that stakeholders would find useful to access:

- Trawl survey data from each New England state;

- SMAST and NMFS study fleet data;

- Water temperature data (NOAA and other research efforts);

- NOAA observer data;

- Data that reflects the effects of management measures on fishing activity (i.e., sector landings database, pre- and post- major NEFMC decisions, etc.).

Incorporating external data into the ocean portal should be done with caution, since numerous challenges (scale, compatibility, confidentiality/privacy, etc.) can arise when combining data sets. Housing a comprehensive catalogue of existing data sources and mapping efforts may be a valuable way to track data sets without necessarily having to incorporate each one into the data portal.

Allowing users to make comparisons across data sets would be most helpful. For instance, one participant stated that he would like to be able to compare fisheries data from certain months against oceanographic or climatic data from the same time period. This might help answer questions about why a month in 2004 had an odd set of landings in a certain industry segment, or allow members to have additional data at their disposal when asking NMFS for an experimental fishing permit. It might also show that haddock aren't caught in a particular location when the water temperature is above a certain level. This could prompt fishermen to use a different type of gear, or fish that locale at times when assumed bycatch wouldn't limit their ability to access the primary resource.

D. Role and Value of Working Waterfronts

Working waterfronts provide a critical link between commercial fishing industries, land-based infrastructure, and markets where fishermen obtain bait and fuel, as well as land their catch. The presence or absence of working waterfronts can significantly influence distribution of commercial fishing activities. As communities across New England have seen, a decline in the fishing industry can have large and often negative consequences for the adjacent communities.

NROC should consider working waterfronts to be an integral piece of the marine spatial planning process. It should create a regional inventory of working waterfront infrastructure, particularly that which is public or has received public funding. For the purposes of this report, that should be focused on public investment in the continued viability of the commercial fishing fleet.

Beyond mapping physical infrastructure, NROC should also map the use of ocean space emanating from the region's working waterfront communities, this is similar to the mapping by community recommendation below and could be combined with those data collection efforts.

To help address issues related to working waterfronts, NROC should consider partnering with the National Working Waterfront Network (NWWN) to host a meeting with leaders of the region's working waterfront communities. Further information about working

waterfronts, including their economic value to the New England region, can be found at the National Working Waterfront Network's website. The "Sustainable Working Waterfront Toolkit," may also be downloaded at: http://www.wateraccessus.com/toolkit.html.

E. Addressing Shifts in the Ecosystem

In most meetings, participants expressed concern about mapping fishing activity in the face of shifting ecosystems, climate and fisheries. Cumulative environmental and economic changes will impact how fishermen use ocean space over time. Many are already seeing seasonal changes in various species (e.g., location, new/decreasing stocks, etc.). As noted in the historic data, some of these shifts have been dramatic.

Addressing these constitutes a major challenge for NROC. A regional ocean planning process that doesn't account for change, or at the very least, acknowledge it, is likely to face increased resistance from fishing industry members. Making decisions based on outdated data will further decrease stakeholder confidence in the process.

The project team proposes that NROC work closely with the RPB and NEFMC to develop mechanisms to help address ocean planning challenges outlined in this report, using the following four-pronged approach.

- Document shifts fishermen are seeing in the ecosystem (seasons, climate change, species range, species mix, and others) as they occur. NROC should design or partner with other organizations to create a publicly accessible, curated, spatially referenced database of real time or near real time observational data provided by fishermen.

- Compile the best available, current information (data, research, maps) about the shifting ocean ecosystem off New England. Make it easily accessible to users in a single location. Similar to the data collection recommendation above, this focuses on a specific, pressing issue.

- Continue to explore means of displaying spatial changes in species abundance, distribution and catch patterns. Work to display shifts in protected resources such as whales, turtles, and endangered species of fish that could interact with the region's main fisheries. These efforts should be conducted collaboratively with the fishing and research communities. Such maps may be difficult to produce but would provide a very powerful tool to assist with ocean planning and public awareness efforts. NROC may want to start by mapping a few key regional species, and explain why future shifts may occur due to

climate, ecosystem, or other influencing factors. It may help to display these trends in graph format, rather than as exact or seemingly exact spatially referenced data.

- Consulting with the fishing and scientific communities, review data, information, and science for gaps. Identify key priorities that need to be addressed to create a better understanding of the region's shifting ecosystem. Filling these gaps should be a priority for the Regional Planning Body and in particular, for the federal partners.

- Attempt to quantify the relationship between coastal communities and use of ocean space. To what extent are they interdependent? Where are they most interdependent? What factors influence the dependence of particular coastal communities on nearby ocean space? NROC should further explore and document the connection between working waterfronts, the fishing industry, fisheries resources, and shifting ecosystems.

F. Creating New Maps

Four significant data gaps (lobster, tuna, charter boats and community sensitivity) were identified as maps took shape during Phase I of this project. Full characterization of New England's commercial fishing activity is impossible without the missing information. If NROC does not take steps to include these key industry sectors, there is a legitimate concern that the organization will suffer a lack of credibility and backlash from fishermen who feel excluded or underrepresented in the decision-making process.

Recognizing that NROC will likely move forward before these data gaps are fully addressed, the team recommends that existing maps of the lobster and tuna fishery be published on the portal. This will show NROC's intentions to include those fisheries in the process.

Publishing the lobster and tuna maps will almost inevitably elicit feedback, which in turn would be an excellent start to collecting additional lobster and tuna data. Gathering data is expensive and time consuming, yet necessary to accurately characterize commercial fishing activity in the region. Again, the team encourages NROC to utilize existing/external data sources/resources.

G. Lobster Activity Mapping

Lobster is a very important regional species. However, despite its historic and economic value, there is little data about spatial distribution of the lobster industry. This project identified a number of possible data sources that portray different aspects of the lobster fishery. They include:

- NMFS VTR (incomplete, only records lobster catch by vessels also permitted for other federal fisheries);
- NMFS map of lobster catch based on VTRs;
- NMFS Protected Species Division Map of lobster trap endline densities;
- Keene State/Maine Lobsterman's Association 2012 data on lobster trap density by month;
- Island Institute's Mapping Working Waters lobster pilot map;
- NH lobster reporting data;
- Massachusetts landings and sea sampling data;
- Rhode Island landings reports and sea sampling data;
- Connecticut landings reports and sea sampling data;
- Fixed Gear Map from the Ocean SAMP process in Rhode Island; and
- MA Department of Marine Fisheries data from the Ocean Management Plan.

NROC should prioritize obtaining information about spatial distribution of the lobster fishery. To refine the regional map of lobster fishing, we make the following recommendations.

- Color portrayal on the NMFS map should be modified to the color scale used on the VMS maps (i.e., lowest endline density would be shown in blue and range to highest endline density shown in red).
- The value and contributions of different types of data hold in the ocean planning process should be identified prior to the meeting. For example, endline density is not a direct correlation to fishing activity. Rather, it says how many endlines appear in a single location. The number of traps on attached to an endline can vary greatly by fisherman, bottom type, and region. Pounds of lobster landed or lobster landings by port may not indicate where those lobsters are caught.

- Lobster industry stakeholders, state fisheries management agencies, and the Atlantic States Marine Fisheries Commission should have the opportunity to view and comment on the accuracy of activity portrayed on the current lobster fishing map.

- The regional lobster endline density map should be compared with other available lobster mapping information to determine if discrepancies exist. Disparities should then be discussed at future stakeholder meetings and included in associated map metadata.

- NROC should consider whether the lobster fishery should be mapped by community, pounds landed, trips taken, gear in the water, trap hauls, or location of fishing activity.

A longer-term recommendation to refine the map of lobster fishing activity is to sponsor a project that would gather vessel plotter records or data similar to VMS data from willing representatives of the New England lobster fishermen. Logistics (i.e., selecting a representative, regional sample of lobster vessels and obtaining permission to use individual plotter records) should be taken into consideration when weighing objectives of the expected project outcome. Given the variety of fishing patterns present in the lobster industry, a large sample size with strong regional and fishing practice diversity would likely be needed.

H. Tuna Mapping Activity

The tuna fishing activity map should be expanded beyond the Gulf of Maine efforts and include information from the Massachusetts and Southern New England fleets. Methods of identifying fishing activity used in the current Island Institute tuna map (important and high catch areas) appears to be a good construct for this effort. Updating and expanding the existing data set would allow NROC to leverage existing work in the region.

I. Charter/Party Vessel Mapping Activity

As noted above, the party/charter fleet is underrepresented in existing data sets. The extensive range of fisheries covered, coupled with the potential for fishing activity to occur in numerous locations on a single trip, makes the party/charter fleet a priority for additional data collection. Pilot projects underway in the region, such as that being conducted by the Rhode Island Charter Boat Association, should be reviewed for their utility in such work.

In developing maps with the party/charter boat industries, decisions about methodologies and specific data collection should be done in collaboration with fleet members. It is likely that a VMS type map, or one based off chart plotters (if available from a wide enough industry segment to ensure confidentiality) would be useful to indicate geographic distribution of

fishing activity. Given the nature of how the fleet tends to operate, this information is more representative of where fishing activity takes place than a disaggregated species-by-species view.

It should be noted that the New England party/charter fleet is well organized and politically active. These associations are used to participating in and influencing the management process, and many members the team spoke with recognized that a lack of data has often had a negative economic impact. Working cooperatively to collect this information could be mutually beneficial to both the industry and NROC.

J. Community Engagement

The need to display maps by community, rather than catch, effort, or presence of fishing vessels was a common theme across the region. As outlined above with the party/charter fleet, many New England fishermen follow multiple fisheries over the course of the year, and their use of the ocean space is not well represented in a map portraying a specific species or fishery.

Fishermen and scientists who focused on a particular fishery tended to be more pleased with the maps for that fishery than fishermen who participated in multiple fisheries. As such, some fishermen who fish in different fisheries struggled to relate to four or five different fisheries maps because none were fully representative of what they see. They tended to identify themselves more as "fishermen who fish" as opposed to a fisherman who participates in a specific fishery.

Additionally, stakeholders looking at the VMS fisheries maps also commented that areas locally important to fishermen often do not show up as "medium" or "high" use because of their relatively small contribution to an entire fishery. However, these locally important areas sustain some coastal communities.

As NROC pursues additional work mapping fishing areas by community, it should consider whether it also makes sense to gather demographic information that provides important community context – e.g., what percentage of the population depends upon fishing. This is similar to work done by Steering Committee member Kevin St. Martin, who mapped fishing areas that are important to specific communities or harbors.

Mapping by community and community sensitivity to change would likely help NROC start to address a number of the participation issues raised earlier. Mapping by community would also help some fishermen relate better to the process.

K. Long Term Considerations

Going forward, as NROC's work on subsequent phases of this project continues, NROC should ensure the issues identified in the participation section above are thoughtfully addressed. Timing, stakeholder participation, expected outcomes, concrete impact of the work, unknown applications, and confusion with other projects should all be clarified well in advance.

Future conversations – whether they are with stakeholders, NROC partners, or RPB members – should commence where this project left off. Learning from and utilizing the information fishermen have already presented would be an important step forward for NROC. Federal agencies involved in the RPB process should pay particular attention to comments made about participation; fishermen already wonder why the government is asking them for the same or similar information multiple times.

1. Stakeholder Input Through Chart Revisions

As discussed in the Results section above, stakeholders typically chose to draw their perspectives on paper charts. While the team subsequently photographed those maps, a more concerted strategy for future work is recommended to better capture, incorporate and archive revisions.

Many of the most valuable comments were less about re-drawing a map and more about explaining a specific feature of the map, particularly as it relates to a community's use of ocean space. Having the ability to capture this context will be invaluable for NROC and regional policymakers involved in future marine spatial planning efforts.

Data from paper maps may be digitized through ArcGIS, then added to the data portal as a separate layer. This may prove time consuming, and such an effort should be built into the budget from the beginning. It will be important that project partners understand this plan, as they should be able to clearly articulate to stakeholders how their information will be incorporated, thus ensuring no one has unrealistic expectations.

2. Stakeholder Data Submission Process

Some fisheries groups in the region have collected spatial data for their own operational purposes. Others have collected data related to "micro-siting" of offshore

energy facilities. To the extent that they are willing, NROC should allow these groups to submit their data to the ocean portal, making sure the source is appropriately cited.

NROC should also create a process that allows fishing map feedback to be provided online or on paper in a format that can be easily digitized. A data layer that captures spatially-related comments to provide context will ultimately help users viewing map content. Stakeholders should also have the ability to submit anecdotal information such as pictures, videos, oral histories, or other stories about how fishermen use or have used ocean space.

Free software applications like Google Earth are available online for download. They allow individuals to draw on maps and/or provide specific feedback. Google Earth users can even pin virtual 'tacks' on places and connect lines between tacks to represent the use of space. There are easy to use labeling features, and all information can be shared via email.

This type of feature may appeal to technology savvy stakeholders when linked to the data portal. However, any software use should be accompanied by a set of data collection standards and a clear protocol, including descriptions of how the data will be incorporated. If planned and activated properly, a tool like Google Earth could allow industry members and/or their associations to submit of data about past, current, and projected future ocean space uses.

NROC
Northeast Regional Ocean Council

Fisheries Mapping Project

Stakeholder Meeting Agenda

NOTE: This is only a guide for our conversation and not a fixed agenda. We encourage and hope for an open-ended discussion and welcome an opportunity to take a different direction, address additional topics, and converse about other concerns you might have.

Date/Time/Location:

Participants:

1. Overview of NROC and the fisheries mapping project:
    a. Distribute project brochure
    b. Explain relevance of VMS and VTR data
    c. Explain need for stakeholder input to inform, adjust, and validate spatial fishing data on maps

2. Overview of NROC maps (selection will vary based on the audience) and NOAA chart area maps (for reference and general comments)
    a. NROC Map A
    b. NROC Map B
    c. NROC Map C

3. Personal perspectives:
    a. Who do your comments represent – You? An association? Your peers?
    b. Significance of past and current use, as well as importance of future trends
        i. Factors that have contributed to changes over time in how/when/where you fish
        ii. Impact of loss of access and necessary adaptations
        iii. Compatible and conflicting uses of areas
    c. Do you feel you are represented accurately on these maps?
    d. Detail areas that are valued (habitat, proximity to home, markets, etc.)
    e. Explore what's important and why – economic/social/cultural aspects of areas

4. VTR data comments:
    a. Fishing effort displayed better as "fishing trips" or "days fished?"
    b. What is the data accuracy? How can data be improved?

5. VMS data comments:
    a. How can levels of use (i.e. seasonal, intermittent, and heavy) be better represented?

6. Other issues:
    a. Suggested improvements/additions to these maps
        i. Category breakdowns, color scheme and other aesthetics, other thoughts
    b. How to best represent fisheries not covered by VTR and VMS
    c. Recommendations of others to contact