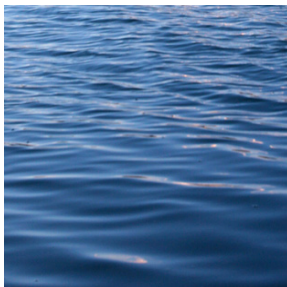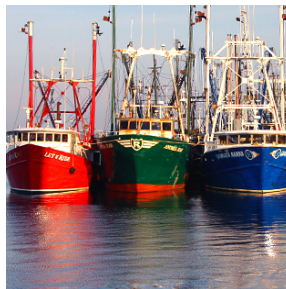# CREATING AND USING DATA PORTALS TO SUPPORT OCEAN PLANNING

Challenges and Best Practices from the Northeast United States and Elsewhere

November 2016

Prepared by:
Kate Longley-Wood, *Senior Project Manager*

SeaPlan
VIBRANT ECONOMIES · HEALTHY OCEANS

ABSTRACT

As more ocean plans are developed and adopted around the world, the importance of accessible, up-to-date spatial data in the planning process has become increasingly apparent. Many ocean planning efforts in the United States and Canada rely on a companion data portal–a curated catalog of spatial datasets characterizing the ocean uses and natural resources considered as part of ocean planning and management decision-making.

Data portals designed to meet ocean planning needs tend to share three basic characteristics. They are: ocean-focused, map-based, and publicly-accessible. This enables planners, managers, and stakeholders to access common sets of sector-specific, place-based information that help to visualize spatial relationships (e.g., overlap) among various uses and the marine environment and analyze potential interactions (e.g., synergies or conflicts) among those uses and natural resources. This data accessibility also enhances the transparency of the planning process, arguably an essential factor for its overall success.

This paper explores key challenges, considerations, and best practices for developing and maintaining a data portal. By observing the relationship between data portals and key principles of ocean planning, we posit three overarching themes for data portal best practices: accommodation of diverse users, data vetting and review by stakeholders, and integration with the planning process. The discussion draws primarily from the use of the Northeast Ocean Data Portal to support development of the Northeast Ocean Management Plan, with additional examples from other portals in the U.S. and Canada.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

I. INTRODUCTION

As more ocean plans are developed and adopted around the world, the importance of accessible, up-to-date spatial data in the planning process has become increasingly apparent. Many ocean planning efforts in the United States and Canada rely on a companion data portal--a curated catalog of spatial datasets characterizing the ocean uses and natural resources considered as part of ocean planning and management decision-making.

Data portals designed to meet ocean planning purposes tend to share three basic characteristics. They are: ocean-focused, map-based, and publically-accessible. This enables planners, managers, and stakeholders to access common sets of sector-specific, place-based information that help to visualize and analyze spatial relationships (e.g., overlap) and potential interactions (e.g., synergies or conflicts) among various uses and the marine environment. This data accessibility also enhances the transparency of the planning process, arguably an essential factor for its overall success.

This paper explore key challenges, considerations, and best practices for developing and maintaining a data portal. By observing the relationship between data portals and key principles of ocean planning, we posit three overarching themes for data portal best practices: accommodation of diverse users, data vetting and review by stakeholders, and integration with the planning process. The discussion draws primarily from the use of the Northeast Ocean Data Portal to support development of the Northeast Ocean Plan, with additional examples from other portals in the U.S. and Canada.

BACKGROUND AND CONTEXT

OCEAN PLANNING OVERVIEW

Ocean planning is a set of methodologies, processes, and tools intended to guide decision-

makers as they address interactions between human uses and the ocean's natural environment. In recent years, ocean planning has gained traction in the U.S. as the 2010 National Ocean Policy calls for ocean planning at the regional scale.[1] At the time of writing, planning bodies from both the Northeast and Mid-Atlantic will have submitted regional ocean plans for certification by the National Ocean Council. At the state level, Massachusetts, Rhode Island, Oregon, and Washington have also completed, or will soon complete, ocean plans. While this paper focuses on the U.S. and Canada, ocean planning has also become widely used internationally, including in Australia and Europe, where it pre-dates efforts in the U.S., and more recently in Canada, the Middle East and Asia. Because ocean planning is, by nature, a science-based approach to evaluating the often complex interactions among human uses and the biological and physical environment, the success of an ocean planning effort depends on the availability of detailed, timely, and trusted data, located within a centralized data repository.

OCEAN DATA PORTALS

Centralized repositories of ocean planning data are referred to in the National Ocean Policy Implementation Plan as "data portals." In the U.S., data portals have been established at the state, regional, and federal levels to accompany ocean planning efforts which are either nascent or underway. Similarly, in Canada, data portals have aggregated information on national, regional, and sub-regional scales.

PURPOSE AND USE

The primary purpose of an ocean data portal is to serve as a decision support tool. Portals are typically designed so that planners, managers, and other stakeholders can have easy access to sector-specific information, and can begin to visualize and analyze how sectors may interact with one another,

---

1 Exec. Order No. 13547, (19 July 2010)

or with the environment. A portal also enables a number of conditions necessary for the success of an ocean planning effort. These include establishing and enhancing transparency for the process and ensuring that stakeholders and decision-makers can easily access and use a common set of baseline information. In addition to these uses, a portal may also be used for other purposes, some of which are described in Supplementary Topic 1.

COMMON CHARACTERISTICS AND FEATURES

When data portals are designed around ocean planning needs, they tend to have a number of common characteristics, tools, and features. While there is variation among existing data portals in terms of their technical platforms, tools, and features, in general, these data portals share a number of essential characteristics:

•**Ocean-focused:** Data portals are curated to include coastal and ocean datasets that pertain to or can be used to address specific ocean planning goals and objectives.

•**Map-based**: The majority of data found in a data portal are spatial, or map-based in nature, depicting the spatial "footprint" of ocean uses and resources relative to one another via a map or series of maps.

•**Publically-accessible**: Data on the portal can be accessed by anyone, including decision-makers, stakeholders, and members of the general public.

Within these characteristics, there may be some exceptions. A data portal may include some contextual land-based data or supplementary materials that are not explicitly spatial in nature but which accompany available datasets or data themes. Under some circumstances, certain sensitive datasets may be restricted through password protections to restrict their viewing to specific stakeholder groups.

In addition to these characteristics, we have observed that ocean planning data portals also tend to share common features and functions. In general, the data portals described in this paper all have the following:

•**Interactive Maps**: Users can view specific data or combinations of data on a map, zoom to areas of interest, and use tools or supplementary information to learn about map features.

•**Shareable Data**: Most datasets on ocean planning portals are downloadable and/or available as a web service so that they can be used in Geographic Information System (GIS) software such as ArcMap or Google Earth.

•**Data Organized by Theme**: Data are organized by themes and subthemes. Broadly, datasets fall under the categories of human uses and natural resources, but are most often parsed into more specific and fine-scale themes.

Addressing ocean planning principles may take a number of forms. In some cases, a portal may simply serve as a map-based ocean data repository or clearinghouse. In other portals, developers may create more advanced tools and user experiences to further facilitate the ocean planning process. More details about specific portals' functionalities and tools will be discussed in Section III.

THE NORTHEAST OCEAN DATA PORTAL

As this paper details some of the processes and considerations that are part of creating and maintaining an ocean data portal, we will be primarily drawing examples from the Northeast Ocean Data Portal. The Northeast Ocean Data Portal was developed in support of the first regional ocean plan in the U.S., which was submitted to the National Ocean Council for certification in Fall 2016. This paper draws from the first hand experiences of the Northeast Ocean Data Portal working group to describe

and reflect on challenges and best practices that have shaped the data portal as it stands today.

PAPER OVERVIEW

This paper is organized into four major sections:

•**Inventory of Data Portals** – This section identifies the criteria needed for a data portal to be included in this paper and presents a figure showing the geographic scale of data portals in the United States and Canada at the state, regional, and national level. The purpose of this section is to provide a visual overview of the portals referenced in the subsequent section.

•**Data Portal Components** – This section begins by identifying three overarching ocean planning best practice themes which drive some of the considerations and best practices involved in developing and maintaining an ocean data portal, and links them to six specific data portal components. This section goes on to describe these components and their challenges and considerations in more detail, and describes how these overarching best practices manifest to address these challenges.

•**Phases of Development** – This section and accompanying figure describe how data portal development occurred through three phases, starting with the formation of the working group, up to the most recent milestone of submission of the Northeast Ocean Plan to the National Ocean Council.

•**The Northeast Ocean Data Portal: Future Directions** – This section reflects on how the data portal and its role in ocean planning will continue to evolve now that the Northeast Ocean Plan has been submitted to the National Ocean Council.

OTHER POTENTIAL USES FOR OCEAN DATA PORTALS

The user-friendly interfaces of data portals can also lend themselves to uses beyond the realm of ocean planning. Some potential uses of portal resources that are not explicitly tied to ocean planning include:

1. Sector-based advocacy: Sector or cause-specific stakeholders could use the information in data portals to demonstrate the importance of their sector, a biological resource, or other uses, using the map to emphasize the extent of a specific activity or resource within a geographical area.

2. Education: Educators, particularly at the high school or college level, could use data portals to visualize information about specific sectors or natural resources. Data found in the portal could also potentially be used as part of a GIS-based curriculum for spatial analysis and mapping exercises.

3. Research: Researchers and scientists may be interested in using data portal resources when looking for background information on a particular topic for a literature review or data inventory. They may also be interested in integrating portal data into their own analyses or data collection efforts.

4. Consulting: Consultants could use portal data for a variety of purposes, including permit applications, site selection, and aggregation of data resources at a specific scale.

See Figure 18 for specific, known examples of how the Northeast Ocean Data Portal has been used by these, and other sectors.

Figure 1. Other potential uses for data portals.

II. INVENTORY OF OCEAN DATA PORTALS

In this section, we use Figure 2 to present a brief visual overview of ocean data portals at three geographic scales (i.e., national, regional, and state) in North America. While this paper primarily focuses on the Northeast Ocean Data Portal, Section III also highlights specific features and examples from other portals in the U.S. and Canada and Figure 2, along with the information in Appendix A, is intended to serve as a reference for information in that section. For the purpose of this paper, we identified three criteria for inclusion in Figure 2. In addition to the characteristics described above, the portal will do the following:

1. Either directly support a coastal or ocean planning effort or contain a dedicated section(s) for coastal and ocean data that can be leveraged for ocean planning.[2]

2. Be active at the time of the paper's publication (Fall 2016).

3. Contain the range of data types associated with ocean planning (i.e., both human uses and natural resources) and are organized thematically according to their utility in ocean management or planning.[3]

---

2 For example, the Massachusetts Ocean Resource Information System (MO-RIS) contains some ocean and coastal data that may not be relevant to an ocean planning effort; however, it does have a section which catalogs data layers included in the Massachusetts Ocean Plan. Similarly, while the New York State Geographic Information Gateway is a data portal for both land-based and ocean data, the site contains a dedicated page and/or map for ocean data, with links to other ocean planning resources. However, this inventory would exclude sites that are simply data clearinghouses.

3 For example, this inventory excludes sites that are very narrow in focus and limited to data from a specific project (e.g., climate change vulnerability studies) or topic area (e.g., oceanographic observations).
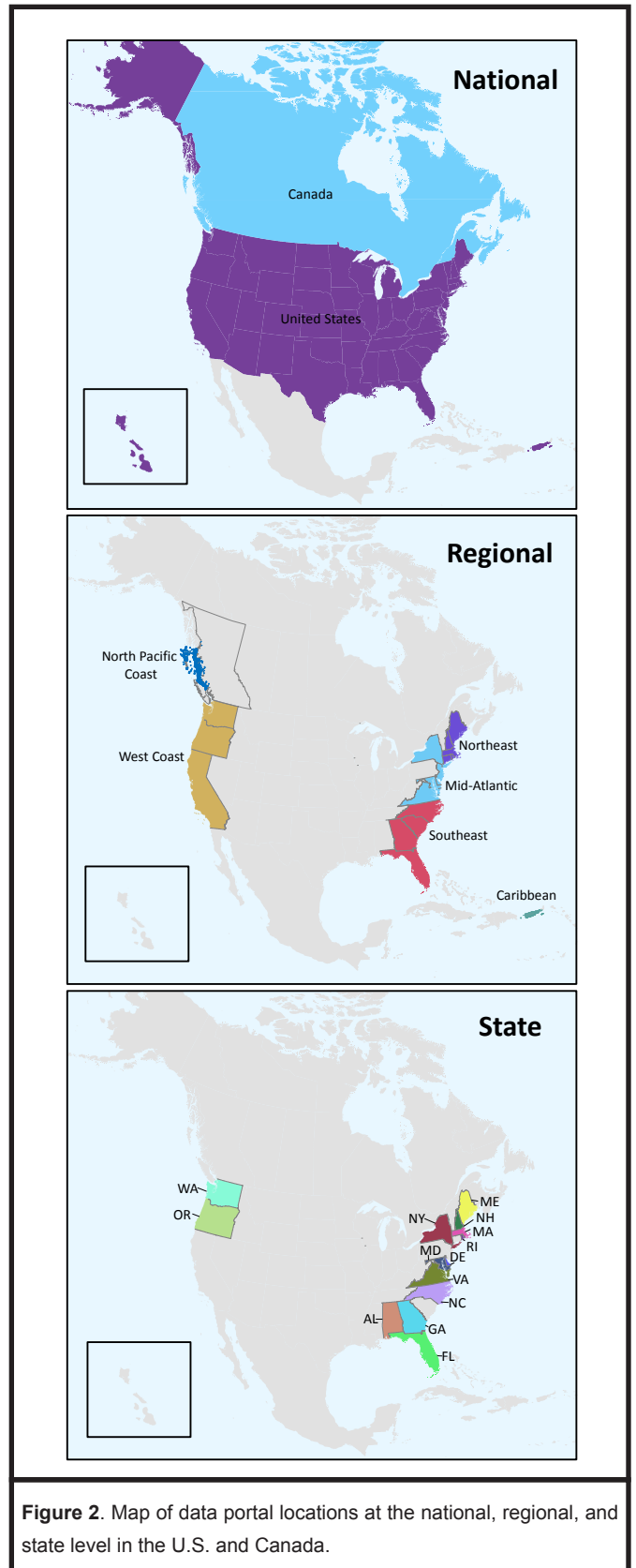

Figure 2. Map of data portal locations at the national, regional, and state level in the U.S. and Canada.

WHY HAVE DATA PORTALS AT DIFFERENT SCALES?

Because planning efforts are initiated by organizations operating at a variety of geographic scales, their associated portals reflect this geographic variation. This variation in scale results in a number of additional benefits, including:

1) Utility in ecosystem-based management (EBM): EBM is a discipline closely tied to the principles of ocean planning. EBM best practices suggest considering ecosystems at different scales as nested within one another.[1] Having data available at varying scales lends itself to this approach.

2) Data resolution and extent: While it is not always the case, there is often a trade-off between a dataset's extent and its resolution. Depending on its intended use, it can be helpful to have data that are very fine scale or data that cover a large extent. Having data at varying scales can offer this flexibility.

3) Geographic priorities: Planning and management goals and objectives are often scale-specific. A dataset that represents a state planning priority is not necessarily applicable at a national scale.

4) Resources and capacity: Data portals at various scales may have access to varying financial and personnel resources. A state data portal may not have the capacity to build a particular dataset, but may depend on the efforts of a regional portal to pull together a dataset at a regional scale which could then be brought into the state portal.

5) Connections to stakeholders: As described later in the paper, data vetting by stakeholders is a critical component of data portal development. However, data portals operating at broader geographic scales might not have access to stakeholders who can comment on datasets at those scales. Regional and state-based portals are much more likely to have connections to local stakeholders who can provide input at appropriate scales.

[1] http://www.unep.org/pdf/EBM_Manual_r15_Final.pdf

Figure 3. Why have data portals at different scales?

III. DATA PORTAL COMPONENTS

In this section, we detail major components and sub-components of a typical data portal. For each component, we identify some of the challenges, considerations, and best practices. These are summarized at the beginning of each section, and are followed by a brief discussion of how the Northeast Ocean Data Portal addresses these challenges in each sub-component. Throughout this section, we also highlight select examples of how other data portals approach these sub-components in a unique, useful, or otherwise notable way.

We posit that the majority of specific best practices associated with each component are driven by major principles of ocean planning, including organization around planning priorities and widespread stakeholder inclusion and engagement. These principles are mirrored by the three overarching best practice themes that we have observed influencing the decisions and approaches associated with each data portal component.

The best practice themes are as follows:

1. Accomodating a wide range of users: A primary goal in designing the portal and its user interface is that it can be useful to a wide range of users, including planners, managers, researchers, educators, stakeholders, and members of the general public. By accommodating users with a range of backgrounds and interests, the portal helps the planning process achieve a high of level of transparency.

2. Data vetting and peer review: While any scientific data (e.g., marine life or habitat) will have gone through a scientific peer review process before reaching the portal, data vetting and peer review in the portal's context includes stakeholder review of data representation, classification and documentation. Stakeholders can include the scientific community, managers who will be using the data to make decisions, stakeholders within an industry or who participate in a particular activity, and any other party with a vested interest in the data products and their applications. Involving stakeholders in the data vetting process has the added benefit of engaging them in the ocean planning effort as a whole.

3. Integration with the planning effort: The Northeast Ocean Data Portal is considered the backbone of the Northeast Regional Ocean Planning effort. Regular coordination with the Northeast Regional Ocean Council and the Northeast Regional Planning Body ensured that the data portal was designed and refined to reflect and respond to planning priorities and objectives as the plan was being developed. The plan refers to the data portal throughout, emphasizing the link between high quality spatial data and effective planning and decision-making.

These themes and their relationships to the components described in this chapter can be found in Figure 4.

Figure 4. Data portal components linked to relevent best practice themes.
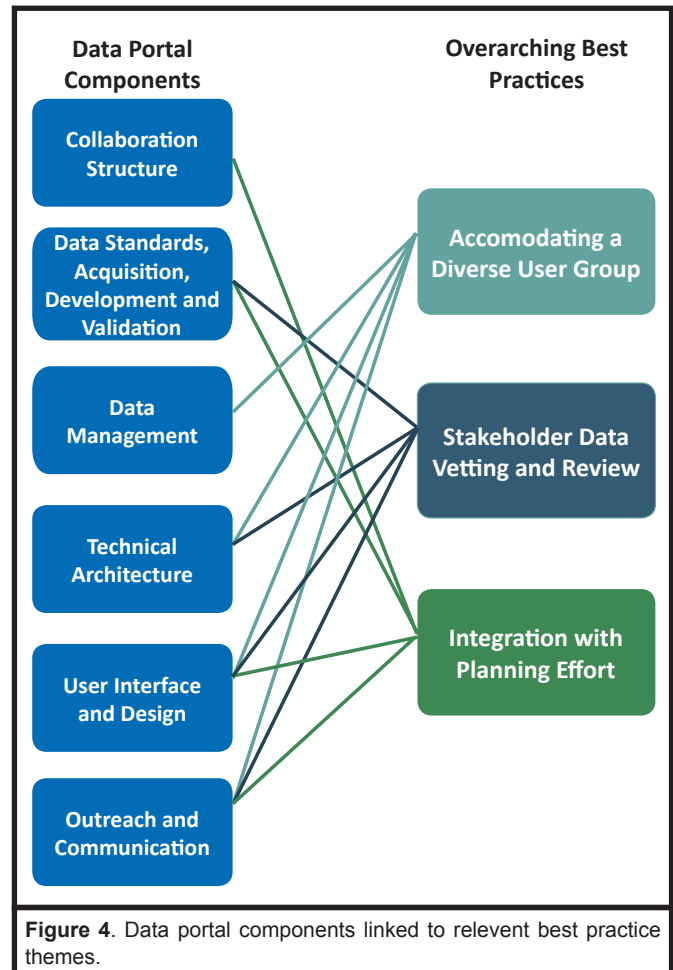
COMPONENT 1: COLLABORATION STRUCTURE

The Northeast Ocean Data Portal has established a working group tasked with development and maintenance of the portal's tools and features. For the purpose of this paper, we will refer to any team of organizations or individuals tasked with the development and maintenance of a data portal as a working group, although portals may use different names (e.g., project team) to describe their organizational structure.

CHALLENGES

•Establish and manage an interdisciplinary team with the appropriate range of technical skills and topical expertise

•Maintain effective communication and collaboration among the team and with the planning authority

•Ensure that the portal is responsive to planning objectives

BEST PRACTICES

•Identify and define needed roles

•Identify organizations that can fullfill multiple roles, where possible

•Facilitate communication among working group members

•Coordinate with planning authority to align data portal priorities and tools with planning goals

COLLABORATION STRUCTURE: *ROLES AND RESPONSIBILITIES*

An ocean data portal requires collaboration among organizations encompassing a diverse set of expertise and technical skills. When forming the working group, a major challenge is ensuring that a range of disciplines are represented. Data portal working groups typically include organizations that can provide technical and professional expertise in the following areas:

Ocean planning: Organizations specializing in the ocean planning process ensure that the portal's functionality is consistent with ocean planning objectives. These organizations also typically direct stakeholder outreach and the data peer review process.

Data development/analysis: Organization tasked with acquiring or developing spatial data for the portal. This task typically includes engagement with data providers, developing or verifying metadata, developing symbology and other cartographic components, and testing data using quality control and quality assurance protocols.

Information Technology and Support: Organization that develops the technical infrastructure to host data, including the web mapping application, and integrates spatial data into the application. They also develop tools and other functionalities, provide ongoing technical support, and maintain and update the website and its components as necessary.

Communication and outreach: Organization responsible for the outward facing aspects of the portal. They generally provide graphic and web-design skills, and often work closely with the
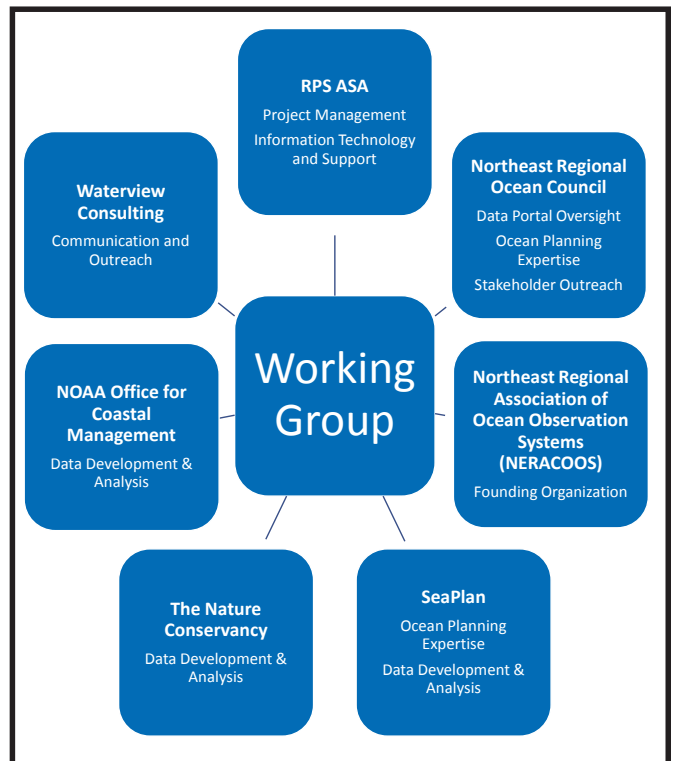

Figure 5. The Northeast Ocean Data Portal working group organizations and their respective roles.

web-development team to ensure a user-friendly experience. They may also be in charge of communicating information about the portal to its audience, social media updates, news items, press releases and tutorials.

Project management: Organization is responsible for ensuring that data portal projects and their milestones are adhering to timelines that correspond with overarching portal and ocean management goals, and that there is a high level of communication and collaboration within the working group.

The Northeast Ocean Data Portal working group includes members from federal agencies, NGOs, and consulting firms. Figure 5 depicts roles and responsibilities within this working group.

The exact configuration of a working group may vary depending on the goals and resources of the planning process. Some roles may be filled by planning agency staff or partners, while others may necessitate the hiring of contractors.

EXAMPLE FROM ANOTHER PORTAL

The West Coast Ocean Data Network is comprised of three different working groups: Data, IT, and Outreach. Each working group has its own lead. Working groups convene via monthly calls, which are summarized on the West Coast Ocean Data Network's website.

COLLABORATION STRUCTURE: *PROJECT AND TEAM MANAGEMENT*

Once the working group is formed, an additional challenge becomes managing a team which spans multiple organizations and sometimes geographic areas. In order to keep data portal projects on track, and to ensure internal communication, it is important to have strong project management within the

working group. Best practices for addressing this challenge include assigning a project manager who is responsible for maintaining a high level of consistent communication and collaboration within the working group. For example, the Northeast Ocean Data Portal working group's project manager convenes team meetings via conference call every 1 to 2 weeks, and also holds longer, in-person meetings several times a year. Collaborative file-sharing services such as Dropbox and Google Drive also provide a means for working group members to access and contribute to project management documents, such as data maintenance plans.

COLLABORATION STRUCTURE: *COLLABORATION WITH PLANNING AUTHORITIES*

Fostering effective communication and coordination between the working group and the planning authority ensures that data portal tasks and projects align with ocean planning goals. Best practices to encourage collaboration include having one or more members of the planning authority in the working group and inviting additional members of the planning body to periodically join calls or weigh in on specific projects of interest. Members of the Northeast Ocean Data Portal working group also routinely attend planning meetings and events to demonstrate and field questions on the data portal. These best practices ensure that the data portal is responsive to planning priorities and objectives as they evolve throughout a planning process.

An important early step in this collaborative process is identifying data priorities. The Northeast Ocean Data Portal was launched before the formation of the Regional Planning Body (RPB). However, once the RPB was formed in 2012, the working group began to collaborate with them to identify more specific priority themes as they emerged from the planning process, and redesigned the web page around these themes. Since then, it has worked closely with the RPB to ensure that the data portal

is responsive to planning goals and objectives as they evolve throughout a planning process, and that data themes on the site reflect planning priorities.

COMPONENT 2:
DATA STANDARDS, ACQUISITION, DEVELOPMENT, AND VALIDATION

Once the working group and the planning body have identified data priorities, the challenge becomes acquiring or developing data which address these priorities. There are three primary methods for acquiring data to include on an ocean data portal:

• Incorporating existing datasets

• Modifying existing data

• Developing new data

All datasets need to meet a set of data quality and priority standards. These standards, as well as methods of data acquisition will be discussed in detail in the following sections, with specific examples found in Figure 6. In this section we will also discuss the role of stakeholders in the data collection, development, and verification processes.

CHALLENGES

• Identify, procure, and develop datasets that address planning goals

• Ensure data are relevant and trusted

• Ensure that the portal is responsive to planning objectives

BEST PRACTICES

• Define data standards and criteria

• Use or modify existing data where possible

• Identify data gaps and develop new data to fill gaps, resources permitting

• Involve stakeholders in data review and validation

DATA STANDARDS, ACQUISITION, DEVELOPMENT, AND VALIDATION: *DATA STANDARDS*

Because of the large volume of datasets available, one challenge is narrowing down which datasets to incorporate. One way to address this challenge is to determine and apply a set of data quality and priority standards. For the Northeast Ocean Data Portal, this means that it pulls in data sources that are comprehensive, authoritative, timely, and available at a regional scale.

Early in the Northeast Ocean Data Portal development cycle, the working group also undertook a requirements study and then conducted a "data readiness" analysis. This resulted in data profiles that identified the desired data product, the condition of the existing product, and what level of effort would be needed to fill any readiness gaps.

EXAMPLES FROM OTHER PORTALS

The Mid-Atlantic Ocean Data Portal evaluates data according to five criteria: 1) Relevance to ocean planning; 2) Methodological rigor; 3) Data and metadata standards; 4) Geographic extent; and 5) Currency

The West Coast Ocean Data Portal page contains a mechanism and guidelines for data contributors to register their data on the portal.

DATA STANDARDS, ACQUISITION, DEVELOPMENT, AND VALIDATION: *ACQUIRING EXISTING DATA*

Ready-to-use spatial datasets can often be found on state or federal agency websites and GIS clearinghouses. As a best practice, datasets are pulled into a data portal as a web service where possible. The advantage of using a web service is that when the data source or originator updates the data, the updated dataset appears in the portal automatically.

Many of the datasets available through the Northeast Ocean Data Portal are web services hosted by federal agencies such as the Bureau of Ocean Energy Management (BOEM), by NGOs such as The Nature Conservancy, or by the Marine Cadastre, which is a portal hosting datasets at the national scale (see Figure 6 for examples).

DATA STANDARDS, ACQUISITION, DEVELOPMENT, AND VALIDATION: *MODIFYING EXISTING DATA*

In some cases, the data needed to populate a portal's data theme or to address an ocean planning goal exist, but are not in a spatial data format,

---

EXAMPLES OF DATASETS ACQUIRED THROUGH VARIOUS METHODS

EXISTING DATA

- **Danger Zones and Restricted Areas** (NOAA/Marine Cadastre)

- **Impaired Water Bodies** (EPA)

- **Chlorophyll a Concentrations** (The Nature Conservancy)

MODIFIED DATA

- **Pilot Boarding Areas** - Working group mined coordinates of pilot boarding areas from U.S. Coast Pilot[1] and applied a 0.5 nautical mile buffer.

- **AIS Vessel Density** - Working group performed a density analysis on tracklines derived from shipboard automatic identification system (AIS) data.

- **Aquaculture** - Working group integrated state-based aquaculture into a regional dataset by generalizing existing information across datasets so that there was consistent information throughout.

DEVELOPED DATA

- **2012 Northeast Recreational Boater Study** - Contracting team surveyed registered boaters in the region who mapped their routes and locations of related activities.

- **2015 Coastal and Marine Recreational Study** - Contracting team used a variety of participatory mapping technicques to collect data on whale watching, SCUBA diving, marine events, kayaking, sightseeing, and other coastal and marine recreational activities.

- **Marine Life Data and Analysis Team (MDAT) Products** - The contracting team produced a suite of modeled data products characterizing the predicted distribution and abundance of 29 marine mammal species or species guilds, 40 bird species, and the surveyed biomass of 82 fish species in the Northeast.

---

1 U.S. Coast Pilot is a resource containing a variety of information important to navigators of coastal and intracoastal waters. http://www.nauticalcharts.noaa.gov/nsd/cpdownload.htm

Figure 6. Examples of Northeast Ocean Data Portal datasets acquired through various methods.

require additional data cleaning or spatial analysis, or do not exist at an appropriate scale. Under these circumstances, a GIS analyst on the working group will either modify existing data (i.e., through digitization, geoprocessing, or editing) or create a new dataset, which matches data portal goals and spatial scale (see Figure 6 for examples). As a best practice, these datasets are then reviewed and validated by stakeholders, as discussed later in this sub-section.

DATA STANDARDS, ACQUISITION, DEVELOPMENT, AND VALIDATION: *DEVELOPING NEW DATA*

In some cases, it may not be possible to fill data gaps by using or modifying existing data. In these cases, it may be appropriate to undertake projects which specifically address data priorities identified by the planning process (see Figure 6 for examples). Because of the time, resources, and expertise needed to implement these projects, work on these projects is often carried out through dedicated contracting teams. These teams work closely with the planning authority and the data portal team to ensure that resulting products meet planning and data needs. In some cases, there may be overlap between the contracting team and the data portal working group to facilitate integration of final data products into the portal. As a best practice, these projects also involve collaboration with stakeholder and expert working groups to validate data development methodologies and final data outputs, as discussed later in this sub-section.

DATA STANDARDS, ACQUISITION, DEVELOPMENT, AND VALIDATION: *STAKEHOLDER-INFORMED AND VALIDATED PRODUCT DEVELOPMENT*

Engaging stakeholders is a critical component of ocean planning and seeking stakeholder input on data portal products can be a highly effective way to increase stakeholder involvement in the

"INSIGHTS ON INDUSTRY ENGAGE-MENT FROM MARINE RECREATIONAL USE STUDIES IN THE U.S."
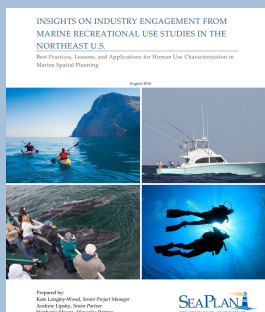
This white paper provides an in-depth look at some of the best practices associated with character-izing marine recreational industries, using examples from stakeholder-informed data collection and mapping efforts in the Northeast. The collaborative data collection and engagement model proposed in this paper includes two strategies for characterizing marine human uses. The first strategy emphasizes data as a shared asset, where information is intentionally developed to meet a wide range of goals. The second strategy encourages engagement approaches which are tailored toward unique industry characteristics. Collecting data directly from stakeholders has the benefit of engaging a large number of stakeholders in the ocean planning process, and creating data that are trusted by stakeholder groups.

Figure 7. "Insights on Industry Engagement From Marine Recreational Use Studies in the U.S." (SeaPlan 2016).

ocean planning process as a whole, while ensuring that data products are up-to-date, authoritative, relevant, accurate, and trusted. As mentioned above, datasets that are modified or developed for inclusion in the Northeast Ocean Data Portal go through a stakeholder review and validation process as a standard best practice. Increasingly, as a best practice, the Northeast Ocean Data Portal is using SeaSketch[4] as platform for stakeholder data vetting and review. Engaging stakeholders by soliciting feedback is a first necessary

---

4 *SeaSketch* is a collaborative web-based mapping and data sharing platform that allows users to view, edit, add, and comment on datasets posted on the site. This tool has many functionalities, including surveys and forums which enable feedback from stakeholders, and is customizable depending on the goals of the project.

step before wider outreach and engagement activities (see Component 6) can take place.

For the purpose of this discussion, the term *stakeholder* can be broadly defined, depending on the type of data being discussed. Stakeholders may include scientists or researchers with expertise in a particular topic, individuals who participate in an activity either as part of their livelihood or recreationally, managers who will be using data to inform decision-making, members of NGOs who advocate for specific causes or actions, or members of the general public with an interest in or knowledge of a particular topic.

There are a number of ways to engage stakeholders to ensure that final data product reflect a high

SELECTED METHODOLOGIES FOR STAKEHOLDER ENGAGEMENT

EXPERT WORKING GROUPS

•Used when developing products that require a high level of knowledge and expertise

•Convenes formally and regularly to review interim products or to assist with other tasks

•**Best practice**: Establish committment early, providing realistic expectations for timeline and level of effort

EXISTING STAKEHOLDER MEETINGS

•Used when convening stakeholders at a dedicated meeting is difficult

•Typically involves a presentation or presence at an academic or industry-specific conference, trade show or meeting

•**Best practice**: Present draft or interim data for stakeholders to begin conversation and gather feedback

PARTICIPATORY MAPPING WORKSHOPS

•Used when new data are required

•Various methodologies, such as online survey tools or in-person mapping workshops, may be used

•**Best practice**:Tailor data collection methodologies to unique stakeholder characteristics

ONLINE FORUMS

•Used when convening stakeholders at a dedicated meeting is difficult

•Various methodologies, such as SeaSketch, can be used to distribute draft data online and can be configured to acquire feedback via polls, fora, and comments

•**Best practice**: Introduce data and SeaSketch or online forum format to stakeholders via a webinar

Figure 8. Selected methodologies for stakeholder engagement.

standard of quality and accuracy. Figure 7 provides a link and a summary of a paper describing a model for using stakeholder-derived data in ocean planning.Engagement methods may range from formal to informal, depending on the time and interest of relevant stakeholders (see Figure 8 for examples).

EXAMPLE FROM ANOTHER PORTAL

The Mid-Atlantic Ocean Data Portal allows stakeholders to join Map Groups. Map Groups are a series of online forums which provide an opportunity for stakeholders to identify important areas on maps and hold discussions surrounding existing data. They also hold a monthly online stakeholder forum called "How Tuesdays" to showcase new data, answer questions, and ask for feedback.

COMPONENT 3: DATA MANAGEMENT

Once data have been acquired, modified or developed, a key function of the working group is to

---

CHALLENGES

- Manage data and data updates from diverse sources

- Maintain data quality and accuracy

- Ensure user understanding of data characteristics and limitations

BEST PRACTICES

- Provide data in variety of formats

- Provide thorough technical documentation

- Review data using QA/QC protocols

- Encourage data updates that are streamlined with data portal protocols

---

manage and maintain data, ensuring timeliness and accuracy and adherence to spatial data standards.

DATA MANAGEMENT: *DATA STORAGE AND FORMATS*

The majority of the data products on the Northeast Ocean Data Portal are available as both web services and downloadable feature classes. Using both formats is a best practice to ensure maximum flexibility, depending on the users' needs. Web services are web-based datasets that can be integrated directly into ArcMap or into other web-based mapping applications. Using a web service preserves a data layer's symbology and updates automatically when the data originator updates the data; however, users cannot directly alter a web service. Most of the data are also available as downloadable feature classes, which are ArcMap-compatible spatial data files. This format has the added benefit of allowing a user to use the data offline, to do additional analysis on the dataset, to view the data's attributes, or to reassign symbology in a custom map. Feature classes are organized in geodatabases, which correspond to the portal's data themes, so that a user has access to additional relevant contextual data.

DATA MANAGEMENT: *METADATA AND TECHNICAL DOCUMENTATION*

When a dataset is incorporated into a data portal, it is necessary to provide a user with key contextual information about that dataset so that the users understand its uses and limitations. Metadata, or documentation of the content, quality, condition, origin, data analysis steps, and caveats associated with a dataset, is a critical component of quality spatial data. As a best practice, data originators should create metadata according to an accepted metadata standard. Data produced by the Northeast Ocean Data Portal working group follows FGDC standards[5] and is presented in a narrative

---

5 Federal Geographic Data Committee. *https://www.fgdc.gov/metadata/geospatial-metadata-standards*

format as a pdf. Under select instances where the working group was unable to obtain an appropriately-formatted metadata document, the site links to technical reports or other methodological overviews in lieu of a metadata document. Datasets that are ingested into the portal via web services are also accompanied by a web-based metadata file.

In the case of extremely summarized, synthesized, or otherwise complex datasets, such as the MDAT products (see Figure 6), it is considered a best practice for the data originators to provide more detailed technical documentation. The documentation for the MDAT products is far more detailed than what is typically required for a metadata document and provides an explanation of the data inputs and the model considerations, coverage, assumptions, and gaps. It also explains much of the background behind the summary products, such as the ecologically-based species groups, providing context for the decision-making that went into developing these summary products. These technical documents can be an important tool for communicating with agencies and stakeholders about the nature of the data, and providing transparency about the modeling methodology.

Data portals typically offer summary data descriptions which are less technical in nature to accommodate users looking for a broader overview of a dataset (see Component 5).

EXAMPLE FROM OTHER PORTAL

The West Coast Ocean Data Portal permits several different metadata standards on its site, including ISO 19115-2, ISO 19115:2003(E), FGDC CSDGM, Dublin Core, and EML

DATA MANAGEMENT: *QA/QC AND DATA STANDARDS*

One of the challenges associated with maintaining a data portal is ensuring that all data on the portal are of best available quality. In addition to being timely, comprehensive, and authoritative (see Component 2), datasets must also undergo a rigorous quality assurance and quality control (QA/QC) review. In addition to the stakeholder review process described above, the data portal working group has a specific QA/QC procedure in place, which includes checking geometry (i.e., drawing errors such as self-intersections); topology (i.e., gaps between polygons that should be adjacent); and attribute data, including ensuring information is consistent, among features, in the proper format (e.g., numerical, string), and spelled correctly; and that there are no duplicate features.

This is particularly important for datasets that have been modified or created specifically for the data portal, as datasets that are already in existence and served through other authoritative sources have already been subject to review.

DATA MANAGMENT: *DATA SOURCES, MAINTENANCE, AND MANAGEMENT*

As described above, many of the datasets on the data portal are sourced via web services hosted by federal agencies, NGOs, or national-scale data portals such as the Marine Cadastre and are therefore updated automatically. However, when there is no existing web service to bring in, the data portal working group is responsible for updating the dataset manually by returning to the data originator.

One of the challenges associated with these manual updates is when a data update requires input from multiple sources (e.g., state agencies). Variations in data update timelines and protocols among data providers can result in a lengthy

update process, requiring extensive coordination between the working group and individual data providers. A best practice that the working group is trying to achieve moving forward is for federal and state agencies to take on the responsibility of maintaining their datasets in a way that is more compatible with data portal procedures so that these updates can be more streamlined.

The Northeast Ocean Data Portal working group uses several tools to assist with data maintenance challenges. The team maintains a data maintenance spreadsheet, accessible to all members of the working group. The spreadsheet contains information on dataset sources, update frequencies, and responsible agencies. The working group also uses Basecamp, a web-based project management platform, to keep track of and communicate data update progress among team members.

Generalized workflows for incorporating existing data and modified or developed data into the portal can be found in Figure 9.

EXAMPLE FROM ANOTHER PORTAL

The Marine Cadastre's data requirements for contributors include standards for themes, metadata, scale, supporting information, format, and distribution restrictions. The Marine Cadastre updates its REST services every 3 months.

COMPONENT 4: TECHNICAL ARCHITECTURE

This section describes some of the challenges and best practices associated with hosting data on a website, and ensuring functionality of these datasets and tools. Choosing a platform that ensures stability and long-term functionality while allowing for flexibility is a major consideration when building a data portal.

CHALLENGES

- •Incorporate data from remote web service providers

- •Manage the update and data access needs across the development, staging and production tiers

BEST PRACTICES

- •Choose an affordable, scalable, stable platform that can be shared by team members and a flexible and long-lasting application and client service suite

- •Use multiple tiers to store and present data

- •Test data on staging and develoment sites after software and data updates

---

TECHNICAL ARCHITECTURE: *HOSTING AND STORAGE*

The Northeast Ocean Data Portal has addressed the challenges associated with choosing a platform by using multiple tiers to store and present data and maps (see Figure 9). The storage tier includes Amazon S3 hardware; the application tier is driven by a large Amazon machine instance and ArcGIS Server Enterprise; and the presentation tier is composed of JavaScript map clients. Map services, described in previous sections, are hosted in the cloud account and used to populate the map viewers. The website is built using a WordPress-based framework and content management system.

EXAMPLES FROM OTHER PORTALS

The Massachusetts Ocean Resource Information System (MORIS) is built on an open source mapping engine (Geoserver) and uses a JavaScript-based web application that uses GeoExt, a toolkit used in mapping applications.

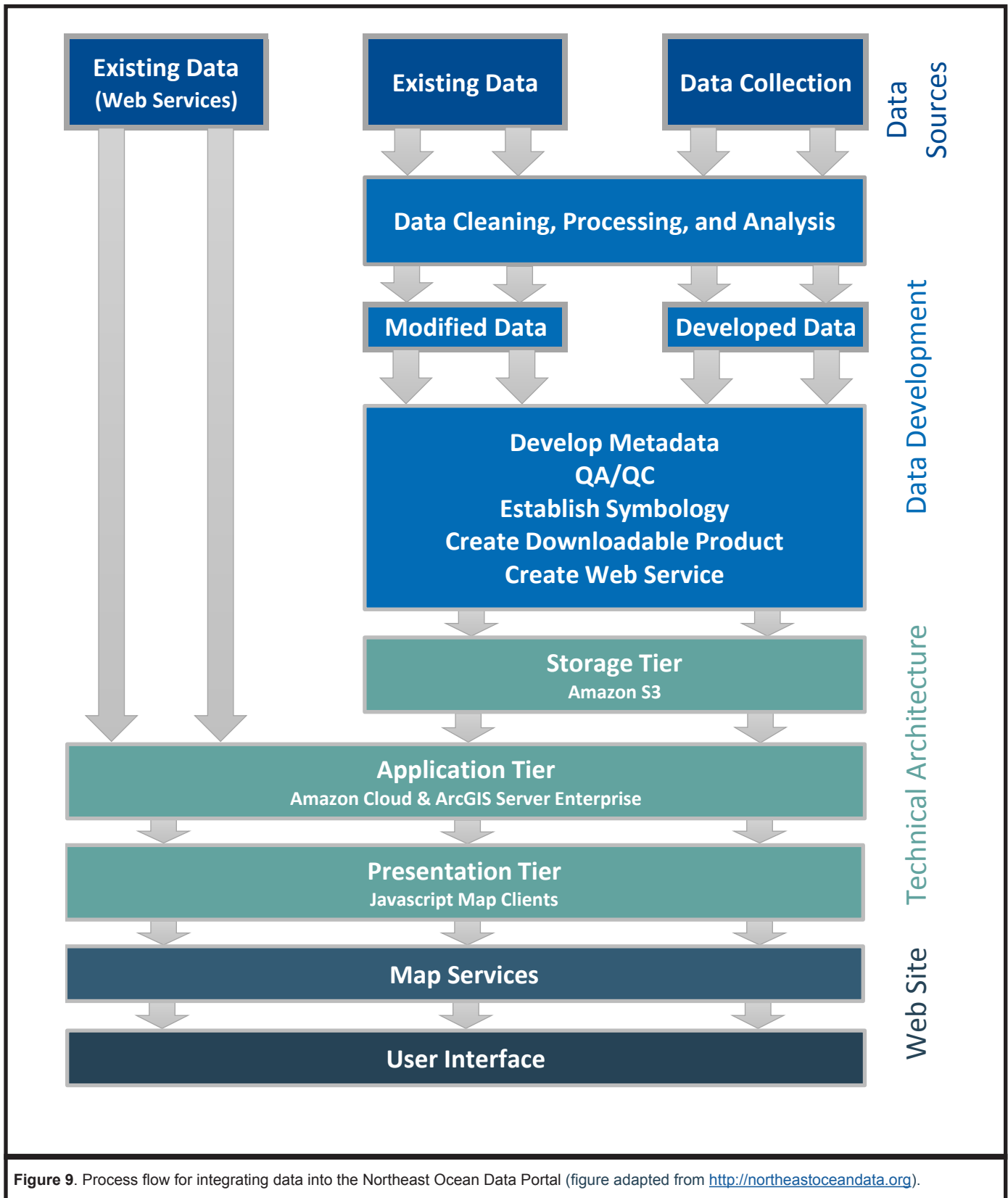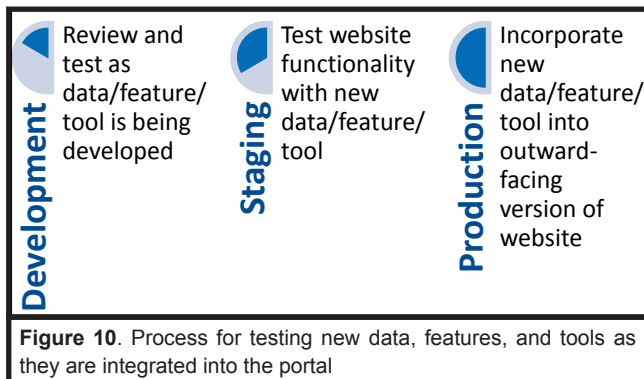 MaPP Marine Planning Portal uses SeaSketch as its interface.

Figure 9. Process flow for integrating data into the Northeast Ocean Data Portal (figure adapted from http://northeastoceandata.org).

TECHNICAL ARCHITECTURE: *TESTING AND DEVELOPMENT*

When a new tool or dataset is being introduced into the portal, or when the site undergoes other technical updates, testing takes place at successive stages of the site's architecture to ensure site functionality. See Figure 10 for a depiction of this process.

Development: Review and test as data/feature/tool is being developed

Staging: Test website functionality with new data/feature/tool

Production: Incorporate new data/feature/tool into outward-facing version of website

Figure 10. Process for testing new data, features, and tools as they are integrated into the portal

COMPONENT 5:
USER INTERFACE AND DESIGN

In creating a user experience that is accessible to users with a wide range of interests and abilities, it is useful to consider the organization of data themes, levels of user control, and additional tools and features that will increase flexibility and utility.

CHALLENGES

• Balance user flexibility and ease of use with maintenance and upkeep costs

• Achieve usability across a range of disciplinary and mapping expertise

BEST PRACTICES

• Reflect planning goals in the site's design

• Use hierarchical information layers with varying levels of flexibility

• Direct users to focus on relevant geographic scales, accompanied by easily-accessible data descriptions

---

USER INTERFACE AND DESIGN: *INFORMATION ARCHITECTURE*

While the data portals mentioned in this paper all contain similar types of information, the themes may vary slightly depending on planning, management, and stakeholder preferences and priorities specific to the geography and scale of the planning area. On the Northeast Ocean Data Portal, the most eye-catching elements of the home page are thematic maps, which largely align with the themes and priorities outlined in the Northeast Ocean Plan (see Figure 11). Within each thematic map are sub-themes, containing individual and grouped data layers. Data that are hosted on the site are stored in downloadable geodatabases, organized by theme. These levels of organization help to provide users with quick access to contextual data, as well as target datasets.

EXAMPLE FROM ANOTHER PORTAL

MORIS has map browsers which are dedicated to specific topics and projects. For example, there are browsers dedicated to ocean planning data, shoreline change, and others.

USER INTERFACE AND DESIGN: *USER CONTROL*

In addition to the organizational structure described above, as a best practice the working group builds restrictions into the user interface to keep users focused on important geographic and thematic elements of the map and data. The Northeast Ocean Data Portal is designed for users with varying levels of experience using map-based data, and has created two primary ways of viewing data in order to accommodate that range of experience and interest:

1) Theme maps (Figure 12a) are designed for individuals who may not have a lot of experience
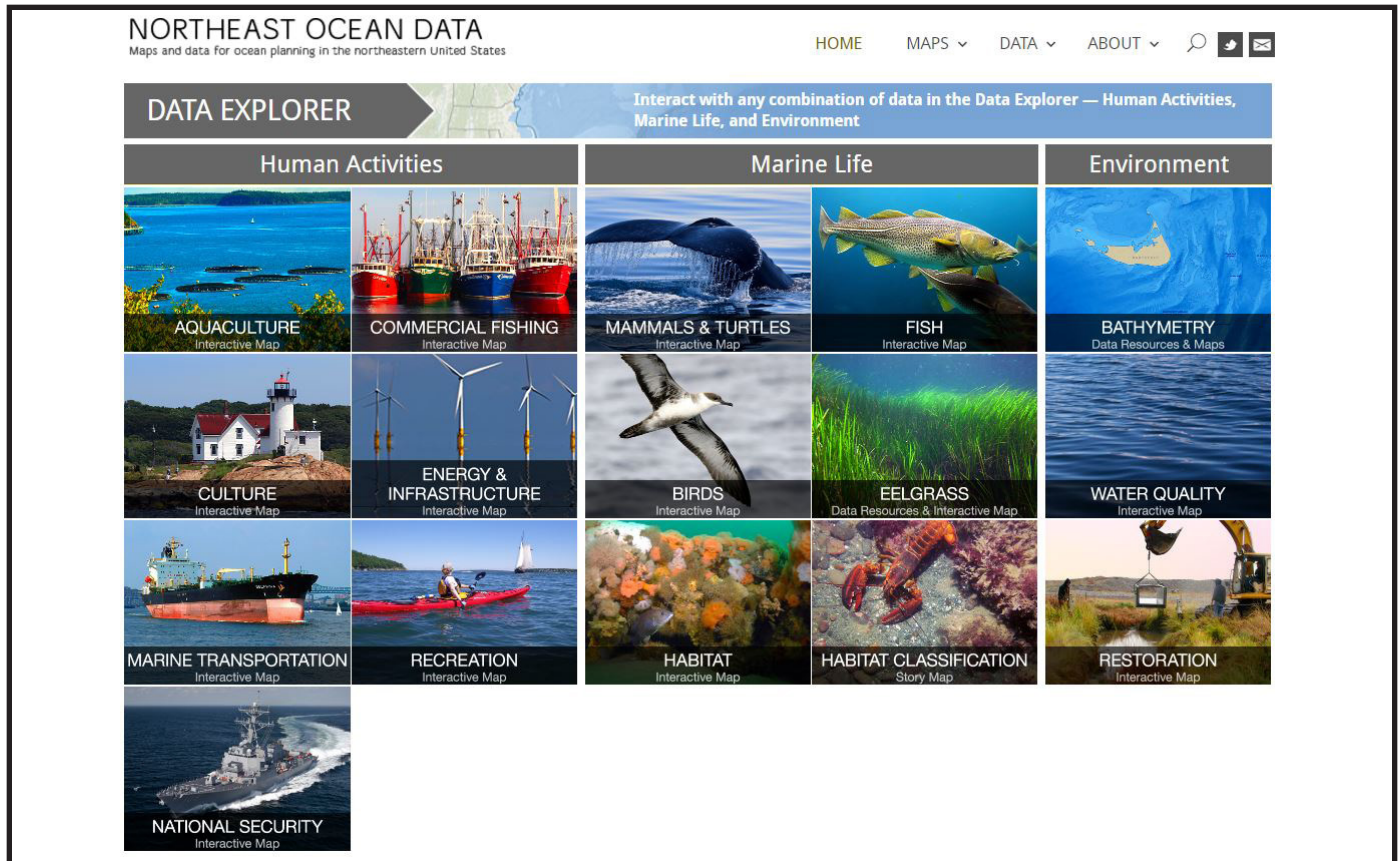
Figure 11. The Northeast Ocean Data Portal homepage. Each tile represents a link to a thematic map, which largely correspond to data priorities identified in the plan.

using or interacting with spatial data, and/or individuals who are primarily interested in one particular topic.

2) Data explorer (Figure 12b) is designed for users who want to explore in more detail how datasets from different themes overlap.

Other ways that a data portal may direct user experience is by limiting zoom scales for specific datasets so that a user can only view data at a relevant scale, or by limiting the number of datasets that can be included in a map.

USER INTERFACE AND DESIGN: *DATA DESCRIPTIONS*

Avoiding situations where data portal users misunderstand or misinterpret data is a common concern when posting datasets. In addition to the metadata (see Component 3), the Northeast Ocean Data Portal working group creates short, summary explanatory text for each thematic map, its component sub-themes, and each data layer so that a casual user will be able to quickly access important information about each dataset without delving into longer, sometimes more complex metadata documents. For datasets that contain information that is politically sensitive or complex in nature, the data portal team has these summary items pop-up automatically to increase the likelihood that users will understand the nature of the data. Figure 13 summarizes the types of data descriptions found in the Northeast Ocean Data Portal.

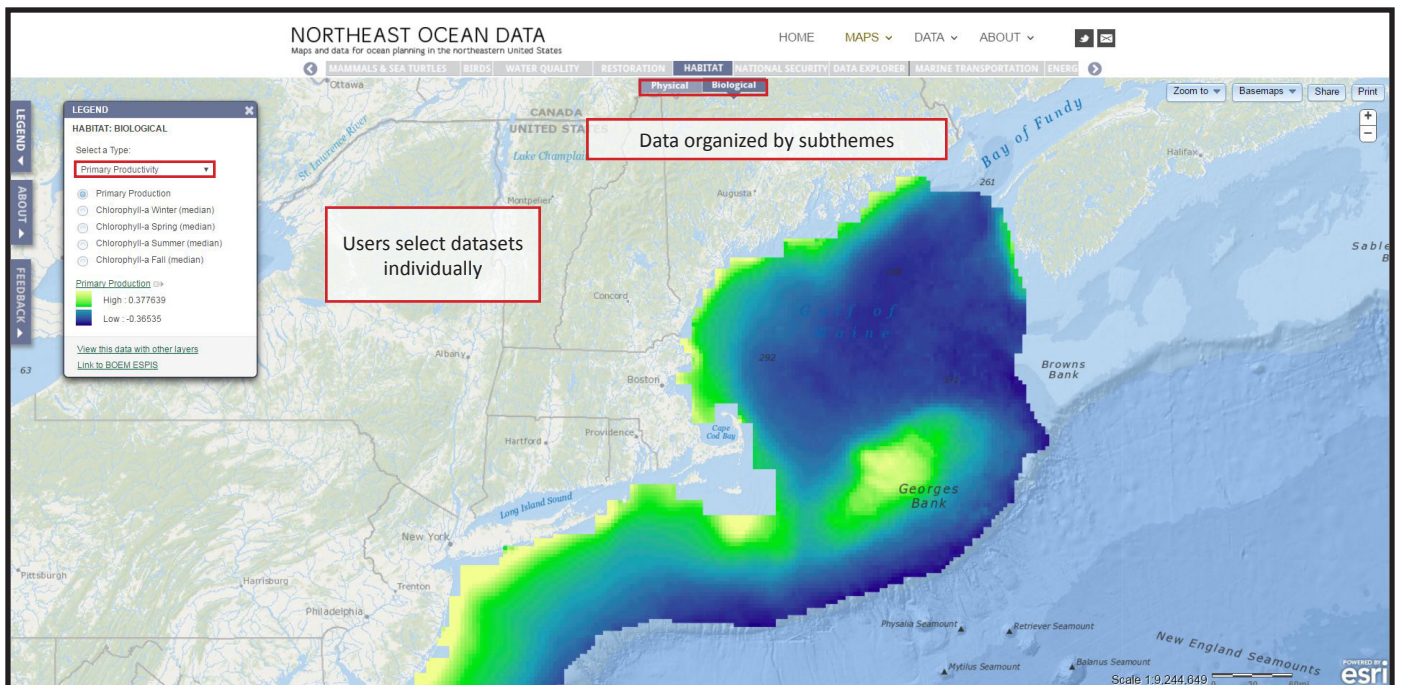**Figure 12a**. Example of a theme map from the Northeast Ocean Data Portal. Users select datasets to view individually, or, in some cases, a pre-determined combination of datasets. Datasets are organized by sub-theme.
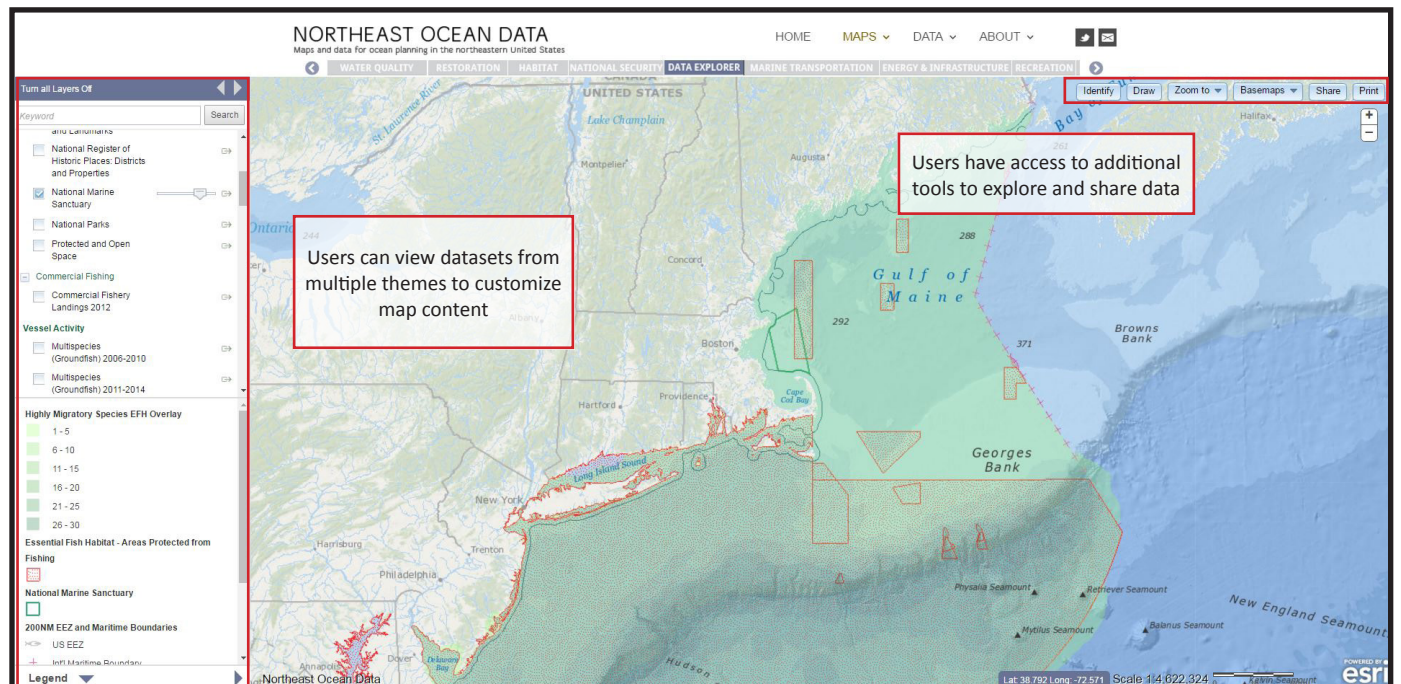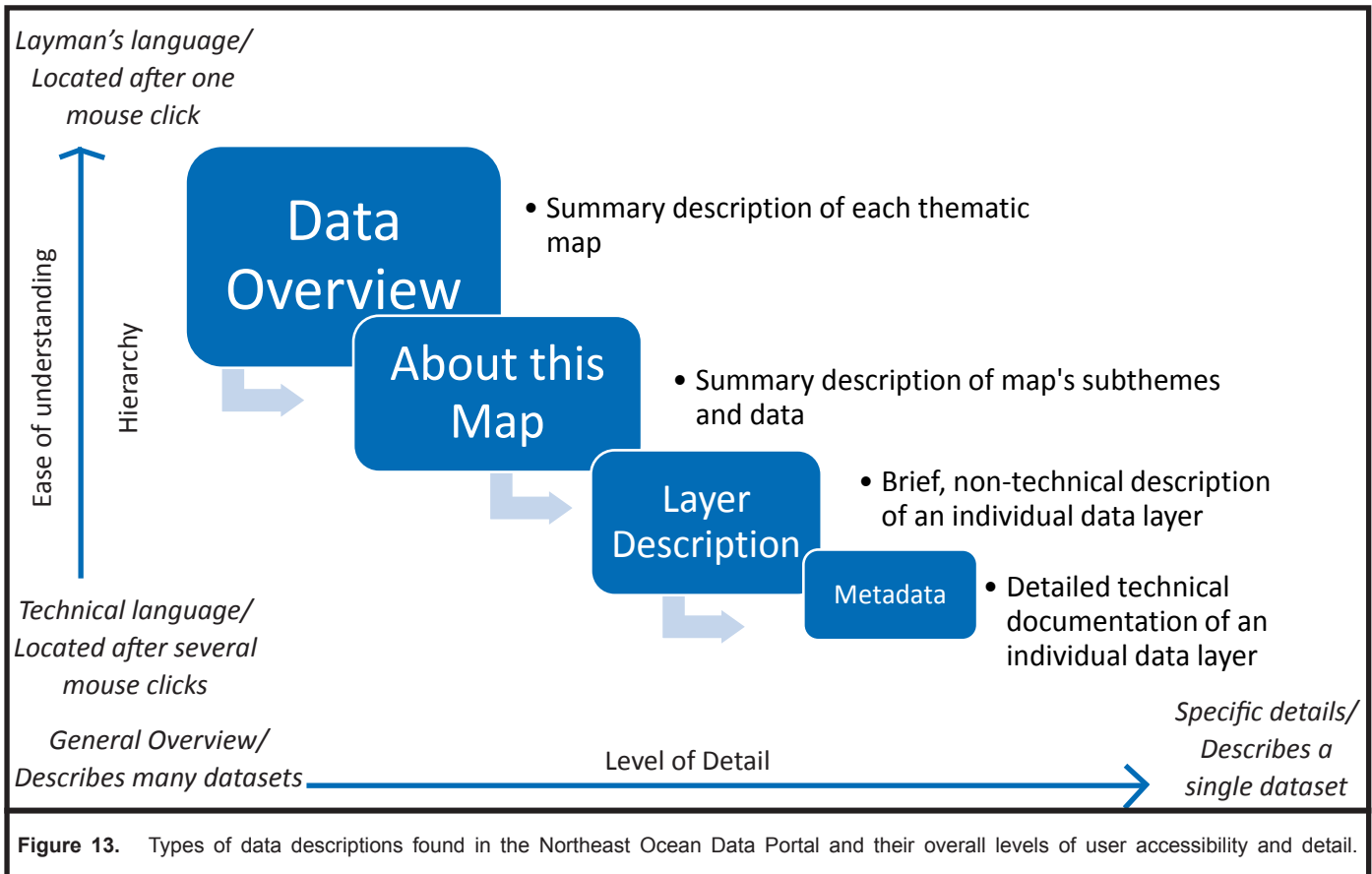

Figure 12b. Screenshot from the Northeast Ocean Data Portal data explorer. Users can choose to view any combination of datasets on the map, and have access to additional tools to explore and share data.

USER INTERFACE AND DESIGN: *CARTOGRAPHIC REPRESENTATION*

When modifying or creating data for the portal, members of the working group aim to use cartographic best practices, such as using established symbols (e.g. an established symbology for shipping lanes), colors (e.g. red to denote hazards) or color ramps (e.g. light to dark blue to indicate depth). Cartographic considerations also include how the data layers will look with each other and when juxtaposed with the available basemap.

USER INTERFACE AND DESIGN: *TOOLS AND FEATURES*

The Northeast Ocean Data Portal, as well as many of the other portals identified in Figure 2, contain a number of different tools and features which allow users to interact with the data and identify topics and locations of interest. These tools increase overall flexibility for the user, and are sometimes customized or created based on feedback from the planning authority or from stakeholders. Figure 14 describes some of the features commonly found throughout most ocean data portals, while Figure 15 highlights more unique user interface characteristics used by only one or several portals.

Layman's language/ Located after one mouse click

Ease of understanding

Hierarchy

Data Overview
• Summary description of each thematic map

About this Map
• Summary description of map's subthemes and data

Layer Description
• Brief, non-technical description of an individual data layer

Metadata
• Detailed technical documentation of an individual data layer

Technical language/ Located after several mouse clicks

General Overview/ Describes many datasets

Level of Detail

Specific details/ Describes a single dataset

Figure 13. Types of data descriptions found in the Northeast Ocean Data Portal and their overall levels of user accessibility and detail.

COMMON TOOLS AND FEATURES IN OCEAN DATA PORTALS

•**Customized Maps** - Users can add data layers of their choice from the portal's data library, or, sometimes from external sources, to create a custom map.

•**Search** - Users can search for datasets, topics, and/or geographic locations. Search filters may include data orginator, geographic region, and/or data format.

•**Basemaps** - Users can select to view data over different basemaps such as the Esri Oceans basemap, NOAA nautical charts, satellite imagery, and Google Maps.

•**Zoom/Pan** - Users can zoom in to see a detailed view of an area, zoom out to a wider area of interest, or pan within the map by holding down the mouse and dragging. Some sites allow a user to jump to pre-determined locations and scales.

•**Feature Identification** - Users can click on or hover over a feature with the mouse to access some or all of the attribute data and to learn more about the feature.

•**Drawing Tools** - Users can draw points, lines, and polygons directly on a customized map, helping the user draw attention to a specific feature or otherwise annotate the map.

•**Sharing/Printing** - After creating a customized map, a user can print the map or generate a unique link to share the map.

Figure 14. Common tools and features in ocean data portals.

OTHER SELECTED DATA PORTAL FEATURES

•**The Northeast Ocean Data Portal** uses data resource pages (e.g. Eelgrass and Bathymetry) to to provide users with a compendium of data and technical reports on a specific topic It also used a Story Map to describe a specific ocean planning project.

•**The Marine Cadastre** integrates web-based search tools into the site's interface. Users can search an Ocean Law database and search for global data using BOEM's Environmental Studies Program Information System (ESPIS).

•**The Mid-Atlantic Ocean Data Portal** incorporates a Regional Ocean Assessment, providing user-friendly access to selected, specific topics relevant to ocean planning, which are distilled and summarized for easy access. By linking data from the portal with ocean planning information, the Regional Ocean Assessment provides a different pathway for people to discover, access, and use the data that is in the portal.

•**MORIS** has a suite of interactive tools allowing users to draw a buffer around specific features, customize symbology, and measure distances.

•**The Caribbean Regional Ocean Partnership** allows user-generated design features to be shared with other users through the tool's built-in sharing functionality.

•**The Mid-Atlantic Ocean Data Portal** contains Ocean Stories, which explore applications of portal data by combining and maps with multimedia via maps, videos, photos, and personal perspectives from around the region.

Figure 15. Other selected data portal features.

COMPONENT 6:
OUTREACH AND COMMUNICATION

As described previously in this paper, data portals are necessary engagement tools in ocean planning as a whole. After the initial phase of engaging stakeholders in developing and vetting data, portals face additional challenges when it comes to making sure that a wider range of target portal users know about the portal and its content, functionality, and applications. The Northeast Ocean Data Portal working group conducts a variety of outreach activities to stakeholders, planning and management agencies, and other target portal audiences to encourage its use and to keep existing users informed of updated data, features, and tools. These outreach activities have evolved over time, beginning with basic awareness-raising about the portal as it was being developed and are now expanding into more in-depth education about the portal's data, features, and applications as the portal has matured.

CHALLENGES

•Engage and educate target portal users on the portal's content, functionality and applications

•Identify and address changes in outreach/ communication needs as portal's status and role develop over time

BEST PRACTICES

•Reach out to users through a wide range of online and in-person engagement tools

OUTREACH AND COMMUNICATION: *SOCIAL MEDIA*

The Northeast Ocean Data Portal maintains an active Twitter account. The working group uses the account to announce new maps, features, and
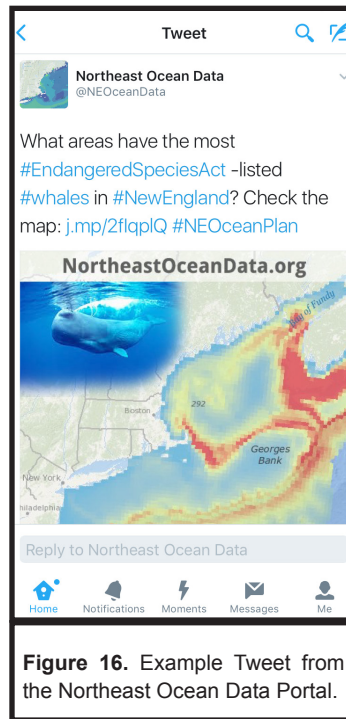

Figure 16. Example Tweet from the Northeast Ocean Data Portal.

tools and to publicize ocean planning events or conferences where portal data and tools may be of interest (Figure 16). Twitter content can also include links to articles related to ocean planning or data portal content. The team chose Twitter as its sole social media outlet as it was the most effective means of building visibility among potential users. Currently, the portal's twitter account has more than 1,000 followers. The working group actively built its Twitter audience by following and engaging with stakeholders and journalists who have Twitter accounts. The focus on journalists has paid off in news articles featuring the portal.

OUTREACH AND COMMUNICATION: *EMAIL LISTS*

Email lists complement social media as a way to announce new features. The Northeast Ocean Data Portal working group maintains mailing lists targeting agency staff, stakeholders, journalists, and organizations that publish relevant newsletters.

OUTREACH AND COMMUNICATION: *NEWS ITEMS*

The Northeast Ocean Data Portal contains a section dedicated to news items related to the portal. Generally, the team posts a news item every time new data, data themes, tools or features are added to the portal. News items related to ocean planning milestones are also part of the

content. As is the case with an active social media account, having a frequently-updated news feature demonstrates to users that the portal is being maintained frequently, is responsive to stakeholder feedback, and contains up-to-date information.

OUTREACH AND COMMUNICATION: *LIVE DEMONSTRATIONS AND PRESENTATIONS*

Members of the working group frequently travel to conferences and events to give live demonstrations of the portal. These events include Regional Planning Body meetings, where the working group can gather feedback from the planning community to ensure continued alignment with planning objectives. The working group also presents the portal at conferences that are not specific to ocean planning, but which include academic researchers, non-profits, educators, GIS professionals, and others who may be able to leverage the portal in their work. This also gives the working group an opportunity to connect with other groups who are developing similar tools, and to generate ideas for future updates and tool development.

EXAMPLE FROM ANOTHER PORTAL

The Mid-Atlantic Ocean Data Portal has a portable demonstration kiosk that can be set up easily at any event, either stakeholder-specific or for the general public.

IV. WHAT DOES IT TAKE TO CREATE A DATA PORTAL?

The challenges and considerations described in the previous section can be translated into a general process flow for the development of the Northeast Ocean Data Portal. This process can be summarized into three phases, outlined in Figure 17, beginning with the formation of the working group in 2010 and ending with the submission of the Northeast Regional Ocean Plan to the National Ocean Council in 2016.

Many of the tasks associated with developing and maintaining a data portal are ongoing. The working group responds to evolving planning priorities, stakeholder feedback, and availability of new data to constantly update and refine the data and tools

Phase I

2010 - 2012

- Formation of Working Group
- Establish web site
- Identify initial data themes and priorities
- Acquire existing data and identify gaps (*ongoing*)

Phase II

2012 - 2014

- Formation of RPB
- Tie specific data themes to planning priorities
- Develop data to fill gaps (*ongoing*)
- Begin stakeholder engagement (*ongoing*)
- Develop additional site functionality, including thematic maps

Phase III

2014 - 2016

- Refine site to support development of plan
- Establish working groups for specific data themes
- Finalize datasets tied to planning goals
- Update web design
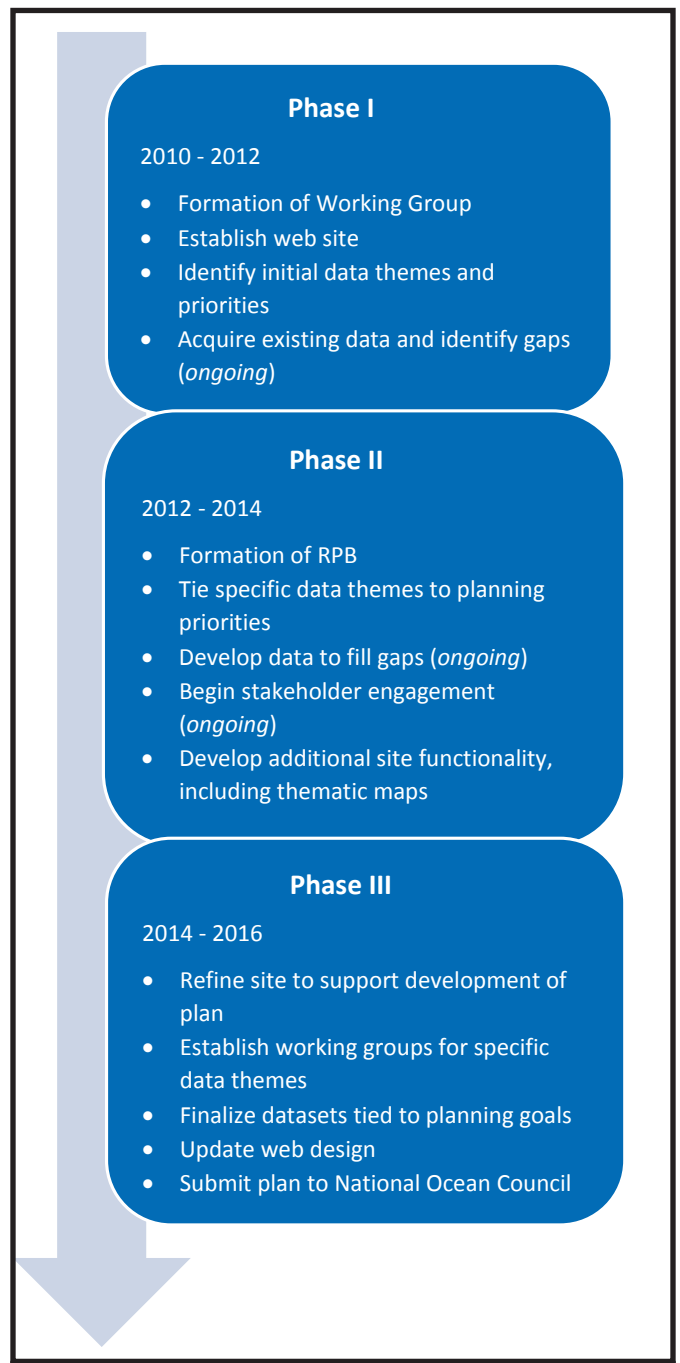- Submit plan to National Ocean Council

Figure 17. Phases of Northeast Ocean Data Portal Development.

available on the portal. This range of applications suggests an evolving role for the portal beyond strictly marine planning-oriented processes.

SELECTED KNOWN APPLICATIONS OF THE NORTHEAST OCEAN DATA PORTAL

Largely due the broad utility of the portal, the working group regularly hears from users who have employed the data portal both within and outside the ocean planning context for a variety of uses ranging from day-to-day management to data aggregation projects. Some of these examples include:

•The North Atlantic Fisheries Management Council referring to Vessel Monitoring System (VMS) fishing effort data on the portal as a reference during its meetings

•Members of the scallop industry using VMS data to demonstrate potential conflicts with proposed liquid natural gas (LNG) terminal locations

•Identifying possible locations for a new wind turbine in Maine waters

•Siting a new ocean observation buoy in Cape Cod Bay

•Consultants using bathymetry data to update other data repositories and for other projects

•Siting blue mussel aquaculture sites in federal waters

•USCG determining needs for mariner aids to navigation

Refer to Figure 1 for other potential uses of ocean data portals.

Figure 18. Selected known applications of the Northeast Ocean Data Portal.

V. THE NORTHEAST OCEAN DATA PORTAL: FUTURE DIRECTIONS

The submission of the Northeast Regional Ocean Plan to the National Ocean Council was a significant milestone for both the data portal and the Northeast ocean planning process as a whole. It also raised many questions about the future of the portal, including both short and long-term next steps. Next steps include the following:

•**Ensuring data commitments** – Many of the current data portal products require significant time and effort on the part of the working group to maintain the data. This effort can include tracking down data sources, cleaning and modifying the data, and ensuring that it is up to date. One goal moving forward is to shift some of these responsibilities from the working group to the data providers. The intention is to increase the overall efficiency of the data portal working group and its workflow.

•**Additional functionality to support decision-making** – As described in previous sections, most portals integrate a number of tools and features that are meant to support planning and decision-making. While the portal already incorporates a number of these tools, there will likely be future opportunities to add to the suite of functionality based on feedback from planners, managers and stakeholders. One idea currently in development is to incorporate a tool into the portal that provides information to stakeholders about proposed ocean-based projects.

•**Managing increasing technological complexity -** As the site and its associated tools and datasets become more complex, maintaining the site becomes increasingly more challenging, especially as site updates are rolled out. The portal team is developing strategies to manage this increasing complexity.

•**Enhanced outreach and communication** – Once the plan is certified by the National Ocean Council, there will be many opportunities to broaden outreach about the portal, and to encourage its use. To this end, the Northeast Ocean Data Portal working group plans to create a series of video tutorials about specific features so that users will have another way of learning about the portal and its functionality. The working group will be doing webinars now that the portal is "done" and the plan has been released. This is an example of adapting to the changing communications and outreach needs. The working group will be presenting webinars for public, agency, and research audiences.

VI. CONCLUSION

The rise of ocean data portals, either retrofitted or newly designed specifically to support the needs of ocean planning, demonstrates the integral role of spatial data in the ocean planning process. More than simple information respositories, the stakeholder interface, technical features, and collaborative management of these data portals deliberately reflect ocean planning principles, allowing the portal to play a key role in the overall planning process.

The Northeast Ocean Data Portal and other portals referenced in this paper have helped establish a common set of ocean use and natural resource data upon which planning discussions and decisions can be based. They have also facilitated greater transparency and stakeholder engagement in their associated ocean planning processes. Planning authorities and stakeholders recognize that a well-designed, utilized, and maintained ocean data portal is an important asset for successful marine planning in the long term.

APPENDIX A. INVENTORY OF DATA PORTALS IN THE UNITED STATES AND CANADA

Site	Umbrella Organization(s)	Area of Focus
National Data Portals		
Marine Cadastre	National Oceanic and Atmospheric Administration Office of Coastal Management (NOAA OCS) Bureau of Ocean Energy Management (BOEM)	U.S., emphasis on federal waters; limited data coverage for Great Lakes, Alaska, Hawaii and U.S. Pacific Island territories
Canada/WWF	World Wildlife Fund (WWF) Canada	Canadian waters, with emphases on featured regions in each ocean
Regional Data Portals		
Northeast Ocean Data Portal (NEODP)	Northeast Regional Ocean Council (NROC) Northeast Regional Planning Body (NE RPB)	Northeast (Long Island Sound to Maine)
Mid-Atlantic Data Portal (MARCO Portal)	Mid-Atlantic Regional Council on the Ocean (MARCO) Mid-Atlantic Regional Planning Body (MidA RPB)	Mid-Atlantic (Virginia to New York)
West Coast Ocean Data Portal	West Coast Governors Alliance on Ocean Health	West Coast (Coastal Waters of Washington, Oregon, and California)
Caribbean Regional Ocean Partnership Marine Planner	Caribbean Reginal Ocean Partnership (CROP)	Waters surrounding Puerto Rico and US Virgin Islands
Governor's South Atlantic Alliance Coast and Ocean Portal	Governor's South Atlantic Alliance	Southeast US (Florida to North Carolina)
MaPP Marine Planning Portal	Marine Planning Partnership for the North Pacific Coast	Waters off of British Columbia; contains data for four distinct subregional plans
State Data Portals		
Massachusetts Ocean Resource Information System (MORIS)	Massachusetts Office of Coastal Zone Management (MA CZM)	Massachusetts state waters
Washington State	Washington State Department of Natural Resources	State of Washington's coastal waters
Oregon MarineMap	Oregon Department of Land Conservation and Development	Oregon state waters
RI Ocean Special Area Management Plan (OSAMP) Web Viewer	Rhode Island Coastal Resources Management Council (RI CRMC) University of Rhode Island (URI)	Rhode Island state waters
NYS Geographic Information Gateway	New York State Department of State	New York state and offshore waters. Will soon incorporate Long Island Sound data for LIS planning effort
Maine Coastal Atlas	Maine Department of Agriculture, Conservation and Forestry	Maine state waters
Virginia Coastal Gems	Virginia Coastal Zone Management Program	Virginia state waters
Delware Coastal Programs Bay and Ocean Planner	Delaware Department of Natural Resources and Environmental Control	Delaware River, Bay, and state waters
Maryland Coastal Atlas	Maryland Department of Natural Resources	Maryland state waters
North Carolina Coastal Atlas	East Carolina University	North Carolina state waters
Georgia Coastal and Marine Planner	Georgia Department of Natural Resources Coastal Resources Division	Georgia state waters
Map Direct: Marine Spatial Planning Map	Florida Department of Environmental Protection	Florida state waters
Alabama Coastal Marine Planning Tool	Mobile Bay National Estuary Program	Alabama state waters

APPENDIX B. GLOSSARY OF GIS TERMINOLOGY

ArcMap - GIS software used to view, edit, create, and analyze spatial data.

Attributes - Nonspatial information about a geographic feature in a GIS, usually stored in a table and linked to the map feature. For example, attributes of a river might include its name, length, and sediment load at a gauging station.

Feature Class - In ArcGIS software, a collection of geographic features with the same geometry type (such as point, line, or polygon), the same attributes, and the same spatial reference. Feature classes can be stored in geodatabases, shapefiles, coverages, or other data formats. Feature classes allow homogeneous features to be grouped into a single unit for data storage purposes. For example, highways, primary roads, and secondary roads can be grouped into a line feature class named "roads." In a geodatabase, feature classes can also store annotation and dimensions.

Geodatabase - A database or file structure used primarily to store, query, and manipulate spatial data. Geodatabases store geometry, a spatial reference system, attributes, and behavioral rules for data.

Geoprocessing - A GIS operation used to manipulate GIS data. A typical geoprocessing operation takes an input dataset, performs an operation on that dataset, and returns the result of the operation as an output dataset. Geoprocessing allows for definition, management, and analysis of information used to form decisions.

GIS (Geographic Information System) - Software or tool designed to capture, manage, analyze, and display all forms of geographically referenced information. GIS allows users to view, understand, question, interpret, and visualize our world in ways that reveal relationships, patterns, and trends, in the form of maps, globes, reports, and charts.

Metadata - Information that describes the content, quality, condition, origin, and other characteristics of data or other pieces of information. Metadata for spatial data may describe and document its subject matter; how, when, where, and by whom the data was collected; availability and distribution information; its projection, scale, resolution, and accuracy; and its reliability with regard to some standard. Metadata consists of properties and documentation. Properties are derived from the data source (for example, the coordinate system and projection of the data), while documentation is entered by a person (for example, keywords used to describe the data).

REST - Acronym for Representational State Transfer. An architecture for exchanging information between peers in a decentralized, distributed environment. REST allows programs on different computers to communicate independently of an operating system or platform by sending a Hypertext Transfer Protocol (HTTP) request to a uniform resource locator (URL) and getting back data in some format—for example, XML, or inside a URL. REST is used in Web services.

Spatial Analysis - The process of examining the locations, attributes, and relationships of features in spatial data through overlay and other analytical techniques in order to address a question or gain useful knowledge. Spatial analysis extracts or creates new information from spatial data.

Story Map - A web application that lets map authors combine maps with narrative text, images, and multimedia, including video. They are designed to be accessible and usable by anyone.

Symbology - The definition of how geographic features are represented with symbols on a map, including size, color, and shape of the symbol.

Web Service - A software component accessible over the World Wide Web for use in other applications. The type of web service discussed in this paper generates maps.

Definitions adapted from: http://support.esri.com/ sitecore/content/support/Home/other-resources/ gis-dictionary/term/giscience