A study of the use of data provided by coastal atlases in coastal policy and decision-making

by

Shelby Paige Stewart McLean

Submitted in partial fulfillment of the requirements for the degree
of
Master of Marine Management

at

Dalhousie University
Halifax, Nova Scotia

November 2014

Acknowledgements

"However beautiful the strategy, you should occasionally look at the results"
– Winston Churchill

There are many people that I would like to thank, but none more than my supervisor Bertrum MacDonald. I appreciated his support and encouragement throughout this project and my internship. Under his guidance and mentorship I learned an incredible amount and I am forever grateful. I would also like to thank the EIUI research team for their advice and insight and, in particular, Sarah Chamberlain for proof reading with me, brainstorming with me, and driving me around when I sprained my ankle.

I would like to thank Emily Rideout and Bill Whitman at the Nova Scotia Department of Fisheries and Aquaculture for their support and guidance throughout the project. I would also like to thank Dr. David Gray, the Dalhousie Dean of Agriculture, as he was helpful in the initial stages of setting up interviews with individuals associated with the Scottish Atlas. Similarly, I would like to thank all the individuals who were interviewed for this research. Without their participation this research would not have been possible.

Lastly, I would like to acknowledge the professors in the Marine Affairs program for their ongoing support and guidance. I would also like to give a huge thanks to my friends and family, in particular, Celene Burnell and everyone in my Marine Affairs cohort.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

McLean, S. (2014). A study of the use of data provided by coastal atlases in coastal policy and decision-making [graduate project]. Halifax, NS: Dalhousie University.

ABSTRACT

Every 20 seconds a new journal article is published, emphasizing the fact that an incredibly large volume of data an information is being generated, yet most of it remains under utilized or overlooked. Information plays a key role in evidence based policy making, but many barriers may prevent decision-makers from using environmental information. Nova Scotia is a coastal province with many different activities and resources occurring in its marine areas. Correspondingly, many different stakeholders are involved in generating marine data and information around the province. A lack of a tool to amalgamate a wide variety of data and information, in particular information generated by different governmental departments, is a current management problem. Digital coastal atlas tools have been suggested to aid with information management as well as coastal policy and decision-making. By interviewing users and developers associated with four coastal web atlases in different jurisdictions (Maryland, Massachusetts, Scotland, and British Columbia), this research addressed the following question: are coastal web atlases proving to be a useful for data management as well as coastal policy and decision-making? The results from this study indicate that users and developers in the different jurisdictions find their respective atlases useful for several reasons, including increased transparency, increased decision-making confidence, and ability to easily access a wide variety of credible information in a single location. Recommendations for the government of Nova Scotia and areas for future research are discussed.

Keywords: Coastal web atlases, Data management, Information management, Decision-making, Policy-making.

GLOSSARY

Coastal Web Atlas: "A collection of digital maps and datasets with supplementary tables illustrations and information that systematically illustrate the coast, often times with cartographic and decision-support tools, and all of which are accessible via the internet" (O'Dea, Dwyer, Cummins, & Wright, 2011, p. 608).

Credible information: Information that is perceived by the user to be accurate, valid, and of high quality (McNie, 2007; Mitchell et al., 2006)

Data management: Is the process of collecting and maintaining information that is generated during a research project (Penn State University, 2014).

Evidence-based policy making: The idea that policies must be informed by research and implemented policies should be adaptive and therefore evaluated rigorously in light of new evidence (Nutley, Walter, & Davis, 2007; Sanderson, 2002).

Information management: "A discipline that directs and supports effective and efficient management of information in an organization, from planning and systems development to disposal or long-term preservation" (Treasury Board of Canada Secretariat, 2009, Appendix A: Definitions).

Legitimate information: Information that is perceived by users to be produced or transmitted in an open and unbiased way (McNie, 2007).

Marine spatial planning: A planning process that informs the spatial distribution of marine activities by bringing together multiple stakeholders to understand existing uses, conflicting uses, and ecosystem health and services with the goal of reducing conflict and increasing sustainable marine use (Foley et al., 2010).

Salient information: Information that is useful or relevant to the users' needs, meaning the information is context-relevant (Jacobson, Lisle, Carter, & Hocking, 2013; McNie, 2007).

LIST OF ABBREVIATIONS

BC – British Columbia

CCS - Chesapeake and Coastal Service

CWA – Coastal web atlas

NSDFA – Nova Scotia Department of Fisheries and Aquaculture

EBM – Ecosystem-based management

ESRI - Environmental Systems Research Institute

GIS – Geographical Information Systems

MaPP – Marine Planning Partnership (BC)

MSP – Marine spatial planning

NMP – National Marine Plan

NMPi – National Marine Planning interactive

OGC – Open Geospatial Consortium

1. Introduction

It has been estimated that a new journal article is published every 20 seconds (Munro, 2013). Speculations such as this emphasize the fact that an incredibly large volume of data and information is available to us, yet much of it is under-utilized or overlooked. Information can play a vital role in understanding and mitigating environmental issues and despite the rapidly increasing volume of information being generated, our ability to solve pressing environmental issues appears to be decreasing.

With over 8,000 km of coastline of Nova Scotia is undeniably a coastal province (Government of Nova Scotia, 2009). Numerous activities occur within the coastal zone making it a valuable area for most Nova Scotians. For this reason, many different stakeholders are involved in studying various aspects of activities that occur in the coastal zone. These activities include: fishing, tourism, coastal development, managing coastal biodiversity, shipping, and other economic developments. Research, completed by numerous stakeholders, is undertaken regarding how these various activities impact the coastal zone. In Nova Scotia, no single data management tool currently brings all the government data together for easy use. As a consequence, a serious management problem exists that is increasingly hampering effective decision making by both government departments and agencies and the wider stakeholder community. Effects from activities that occur along the coast are not independent from one another; for example, a particular fishing area may overlap with a whale watching tour as well as a shipping lane. Therefore, assembling information generated from various coastal activities and making it accessible through a single digital tool could increase both communication among stakeholders, as well as, increase the comprehensiveness and efficiency of policy and decision making. Evaluating the types of tools that could be used to bring a large body of data and information together is an important initial step in creating such a resource.

A recent study, on the dissemination of information, found that visualization is ranked as an important feature of decision-support tools by managers and other information users (Miriam et al., 2014). Furthermore, in the same study, mapping tools were specifically highlighted as very useful (Miriam et al., 2014). Digital coastal atlases are typically publicly available, web-based interactive mapping systems that display many different layers of geo-referenced data. Numerous jurisdictions worldwide have implemented coastal atlases (approximately 40 exist) and it is thought that they are very useful for information dissemination and planning, particularly in policy and decision-making contexts (Rideout, 2014). Therefore, the aim of this research was to investigate the usefulness of coastal atlases as decision support tools in four selected locations – Maryland, Massachusetts, Scotland, and British Columbia. Are coastal web atlases proving to be useful for coastal policy and decision-making in these jurisdictions and what practices and what practices did they follow for importing the data into the atlases?

The outcome of this research will provide recommendations to the Nova Scotia Departments of Fisheries and Aquaculture (DFA), which is a partner to the Environmental Information: Use and Influence research program within which this study was undertaken. Currently, the Department is in the early stages of gathering information about coastal atlases and their uses and this research was undertaken to provide information and insight about:

1. Why each coastal atlas was implemented in the four different jurisdictions;

2. How each atlas is used by stakeholders in each jurisdiction, particularly with respect to coastal policy and decision-making; and

3. Whether each atlas provides a suitable mechanism and interface for data and information management.

The next three subsections of this report provide the context for this study: subsection 1.1 discusses the characteristics of information and "usefulness."

subsection 1.2 discusses general coastal atlas information and their potential uses and subsection 1.3 provides background information on each atlas selected for this research. Subsequent sections of this report present the methodology (Section 2), results (Section 3), discussion and conclusions (Section 4 and 5), and recommendations (Section 6).

1.1 Characteristics of useful information: Salience, credibility, and legitimacy

Useful information is a critical component of policy and decision-making, but it is often unclear what qualities "useful" information contains. McNie states that "Ideally, useful information expands alternatives, clarifies choice and enables policy makers to achieve desired outcomes" (2007, p.17). Usefulness often is determined by the values that individual decision-makers consider important and three categories common among many managers and decision makers are salience, credibility, and legitimacy (McNie, 2007; Nutley, Walter, & Davis, 2007). Information is useful if it is salient or relevant to the users needs, meaning the information must be context-relevant (Jacobson, Lisle, Carter, Hocking, 2013; McNie, 2007). Salience can be challenging to determine in advance especially when the information aims to influence a wider audience, as an increase in users corresponds with an increase in the various uses of information. Salient information also considers temporal and spatial scales (McNie, 2007; Mitchell, Clark, & Cash, 2006), as the information must be created and available prior to the completion of a decision-maker's policy or plan if it is to be used and the scale of the information must be jurisdictionally appropriate. For example, if a decision-maker was focusing on a policy or report for Nova Scotia, information at the scale of the continent North America is not spatially appropriate or useful for that decision maker. Salient information can decrease another common barrier to evidence-based policy making by decision-makers, namely, the appropriateness of the information (Jacobson et al., 2013; Steiner-Davis, Tenopir, Allard, & Frame, 2014). Useful information must also be credible, which in the context of information use means that that information should be perceived by the user to be

accurate, valid, and of high quality (McNie, 2007; Mitchell et al., 2006). Peer-reviewed literature is often considered the most credible, but other information such as governmentally generated information, industry sponsored research, and collaborative research also meet users' criteria for credibility (McNie, 2007; Mitchell et al., 2006). The currency of data can also be a determining factor of information credibility. A barrier to evidence-based policy making arises when users cannot determine the currency of data, making them less likely to use that data in decision-making (Jacobson et al., 2013; Steiner-Davis et al., 2014). The last commonly discussed category for determining whether information is useful is legitimacy. Legitimacy is the perception that information creators are free from political or other biases and that in creating information their primary consideration is for the end user, as opposed to personal motives (Bottcher, 2003; McNie, 2007). Legitimacy is closely connected to the principal of transparency as users are more likely to consider information that is produced or transmitted in an open way to be unbiased, and thus legitimate (McNie, 2007). Decision-makers are also more likely to use information that is easily accessible and digestible suggesting that legitimate information can decrease another common barrier to evidence-based policy making, which is the limited time policy and decision-makers are able to sort through large amounts of data (Jacobson et al., 2013; Steiner-Davis et al., 2014). It is important to note that although the three categories discussed (salience, credibility, and legitimacy) are by definition different, they must be considered equally when creating useful information. An increase in focus on one of the categories can lead to a decrease in another, ultimately decreasing the usefulness of the information (McNie, 2007).

1.2 Background on mapping and coastal atlas tools

Recently, coastal web atlases (CWA) are being developed more frequently and are being used by policy makers to address a wide range of complex coastal policy issues, such as climate change and increased population pressure (Wright Cummins, & Dwyer, 2011). A coastal web atlas can be defined as "a collection of

digital maps and datasets with supplementary tables illustrations and information that systematically illustrate the coast, often times with cartographic and decision-support tools, and all of which are accessible via the internet" (O'Dea, Dwyer, Cummins, & Wright, 2011, p. 608). Web atlases can be static or interactive (Maelfait & Belpaeme, 2010). Static web atlases consist of a collection of online maps that are open to the public; however, the process of assembling static online map is not usually interactive and collaborative in nature. In contrast, interactive online maps are driven by geographic information systems (GIS) and typically require a combination of institutes and organizations to participate in their development (Maelfait & Belpaeme, 2010). The four different coastal web atlases, also referred to as digital coastal atlases, studied in this research are interactive as opposed to static.

Coastal web atlases are designed as a way to effectively communicate different spatial information in a visual format to wide audiences with varying technical capabilities. Although atlases can look different, several common features can be observed across most digital coastal atlases (O'Dea et al., 2011). Every CWA has a map area prominently featured, which displays geospatial data where users can zoom in to specific areas. Coastal web atlases also feature various tools, which allow users to click on different buttons to zoom and search for specific datasets. Some atlases also provide tools that allow users to perform spatial analysis, although few web applications enable analysis beyond overlay and buffers.. Another key feature on CWAs is a legend, which uses different colours and symbols to identify the different data or information presented on the map area. Alternatively, some CWAs use a layer list instead of a legend. A layer list allows the user to observe the different datasets within the tool. Users can also display the layers they would like to view on the map area by clicking on different data sets and more than one layer can be viewed at a time on the map area. Metadata, another general feature accessible through CWAs, are an important component that informs users about the source of the information, the date the dataset was created, and the scale at which the datasets were created. Metadata are a crucial feature of CWAs because they allow a user to evaluate the quality of the

information, which helps users to determine if the information is credible and thus useful for their needs (O'Dea et al., 2011). Digital coastal atlases can also provide additional information to the user, which can include details on the datasets or general themes of the tool. Additional information can be displayed on the atlas interface or on an associated webpage. Digital coastal atlases encourage many uses, some of which include data or information management, decision-making, marine spatial planning, information dissemination, and education of users about coastal activities, resources, and potential conflicts (Wright et al., 2011).

1.2.1 Marine spatial planning

Previously the management of marine resources often focused on a single species, activity, or resource; however, in a past decade a paradigm shift towards an ecosystem based management approach has occurred, which includes the full multitude of interactions within an ecosystem, including humans (Communications Branch, 2007). Marine spatial planning is promoted as a method that will aid with an ecosystem based management approach. Marine spatial planning is "a way of improving decision making and delivering an eco-system based approach to managing human activities in the marine environment. It is a planning process that enables integrated, forward looking, and consistent decision making on the human uses of the sea" (Pomeroy & Douvere, 2008, p.816). In practice, marine spatial planning is a public process, which aims to achieve sustainable (ecological, economic, and societal) objectives through the process of analyzing and subsequently allocating the distribution of human activities or uses in the marine realm (Katsanevakis, Stelzenmüller, South, Kirk, Sørensen, et al., 2011). Coastal web atlases are an effective tool that can complement the implementation of marine spatial planning because of their visual and interdisciplinary, centralized display of information. Coastal policy and decision makers can efficiently view coastal conflicts by layering different datasets on the map area in a digital coastal atlas. Rosenberg and Sandifer explain this idea by stating "Datasets covering as many aspects of the natural system as possible, as well as human activities within

that system, must be geographically specific with well-accepted and documented procedures for interpolation to provide a clear picture of ecosystems in time and space. A dynamic atlas of each ecosystem will ultimately need to be assembled in order to support EBM" (2009, p.26).

1.2.2 Decision-making

Coastal web atlases are useful for many types of users including coastal managers and planners as they provide access to maps and spatial data pertaining to coastal zone areas. It has been suggested that approximately 38 percent of the world's population lives within 50 kilometers of a coast (Kay & Alder, 2005); consequently, many different activities take place in coastal zones. Activities occurring in these zones include recreation, transportation, fishing, tourism, natural resource development, and ecological and environmental activities. The nature of coastal atlases provides decision makers with a large volume of information and data to aid in comprehensive decision-making regarding resource management, hazard assessment, and coastal hazards (O'Dea et al., 2011). Geographic Information Systems (GIS) are advantageous in comparison to other information providing methods because their visual capability allows decision makers to see: differences between regions, trends and patterns, and relationships between different activities through layering of data sets (Maelfait & Belpaeme, 2010). Furthermore, these atlases allow decision-makers and planners who do not have GIS capabilities to perform spatial analysis and non-technical users are better able to understand the information presented in comparison to the outputs from other tools e.g., tables and graphs.

1.2.3 Data or information management

The numbers of datasets or data layers in coastal web atlases can vary. Anywhere from tens of data layers to hundreds can be accommodated. Data collection is completed collaboratively and in most cases data is provided for

different levels of government, industry, academia, and non-governmental organizations, and in some cases traditional or local knowledge is also included. Implementing a collaborative coastal web atlas is a beneficial way to develop understanding of the types of information made available and the types of research being completed across a state, province, nation, etc. Compiling data from many different organizations and entering it into a centralized and publically accessible source like a CWA allows not only increased information accessibility but also allow more efficient data or information management. Information management can be defined as "a discipline that directs and supports effective and efficient management of information in an organization, from planning and systems development to disposal or long-term preservation" (Treasury Board of Canada Secretariat, 2009, Appendix A: Definitions).

When different information sources are entered into a digital coastal atlas, metadata about that geographic data are usually also created. Varying levels of metadata are possible: abstract, discovery, and full. Abstract metadata contains a minimal overview of the data contents, including data name, owner, and year of creation. Discovery metadata includes a more detailed summary of the data and includes keywords, data scale, and bounding coordinates. Lastly, full metadata is the highest quality of the three options and provides the complete documentation for a geographical dataset. Full metadata allows more advanced CWA users to find and work with data that is specific to their needs (O'Dea, Haddad, Dunne, & Walsh, 2011b). High quality metadata leads to high quality information management. Users from a variety of audiences can understand where the geographic data came from and thus be better able to determine its credibility and relevance to their work (O'Dea et al., 2011b).

1.2.4 Information dissemination, public engagement, and transparency

Most coastal atlases are publically accessible, meaning citizens can access digital coastal atlas data at no charge. Typically, members of the general public do not even have rudimentary technical GIS or mapping experience. Therefore, it is

important that throughout the creation of a digital coastal atlas developers are conscientious about defining who the end user group will be and the technical requirements the tool should provide in order to match users' needs (Kopke et al., 2011). As previously mentioned, visualization tools are an effective method for information dissemination (Miriam et al., 2014). Coastal atlases not only have the capability of informing a wide audience of users about activities that occur along the coast, by layering different datasets on top of one another, users can also view how different activities and resources interact with one another. By providing free and easy access to information coastal atlases can increase stakeholder understanding about marine environments. Publically or openly accessible data can also increase transparency about the activities of governments and other stakeholders (G8, 2013). Transparency, which is defined by openness, communication, and accountability, makes information both easily accessible and understandable to any stakeholder who may desire access to the information (de Fine Licht, 2013). Since 2011, Canada has made an effort to implement different initiatives that support open government and open data (Government of Canada, 2014). Open data initiatives are an important factor in transparency. When stakeholders have access to information that policy makers use to make decisions they are more likely to accept or at least understand those decisions (de Fine Licht, 2013). A key component of legitimacy is public acceptance of decisions which is typically also a desired goal of decision-makers and politicians (Tyler, 2006).

1.3 The case study coastal atlases

1.3.1 Maryland

The Maryland digital coastal atlas tool can be accessed through the Chesapeake and Coastal Service section on the state Department of Natural Resources website. The Chesapeake and Coastal Service (CCS) is the primary body administrating this coastal atlas. This atlas aims to:

- "Accelerate the recovery of coastal resources through improved water quality;
- Increase the number of State and local governments prepared for the impacts of future storm events, shoreline changes, and sea-level rise;
- Improve Maryland's ability to balance the use of coastal resources with their long-term conservation; and
- Improve environmental literacy and motivate individuals and groups to take actions that benefit Chesapeake, coastal and ocean resources" (Maryland Department of Natural Resources, n.d).

The main purpose for creating a digital coastal atlas for Maryland was to allow different stakeholders to explore and visually analyze data regarding coastal and ocean issues and activities. A specific goal of the Maryland digital coastal atlas is the promotion of better decision making, particularly surrounding the CCS's goals (Maryland's Department of Natural Resources, n.d.b). Many different activities occur along Maryland's shorelines: wind energy generation, commercial fishing, recreational uses, and shipping activities. Visually representing these different activities allows users to quickly identify areas of potential conflict. Furthermore, the digital coastal atlas provides data that can be used for coastal and ocean planning. Structurally, the atlas is unique by being divided into three different sections: ocean, shorelines, and estuaries. Each section allows users to view data about those specific regions of Maryland. The three broad data spheres highlighted in the tool include physical characteristics (e.g., ocean currents, wind direction, and continental shelves), human uses (e.g., shipping lanes, and commercial fishing areas), and ecological resources (e.g., salt marshes, water bird habitat, and aquatic vegetation). The Maryland digital coastal atlas was created as a collaborative effort between the Maryland Department of Natural Resources, the Maryland Energy Administration, Townsend University, the University of Maryland, the Nature Conservancy, and the National Oceanic and Atmospheric Administration (NOAA) (Maryland's Department of Natural Resources, n.d.b).

The Maryland coastal atlas is supported by ESRI (Environmental Systems Research Institute) - a geographic information system (GIS) software company located in California. ESRI provides a suite of GIS software products that can operate online, in a desktop format, on a remote server, or even as a mobile app (ESRI Canada, 2014).

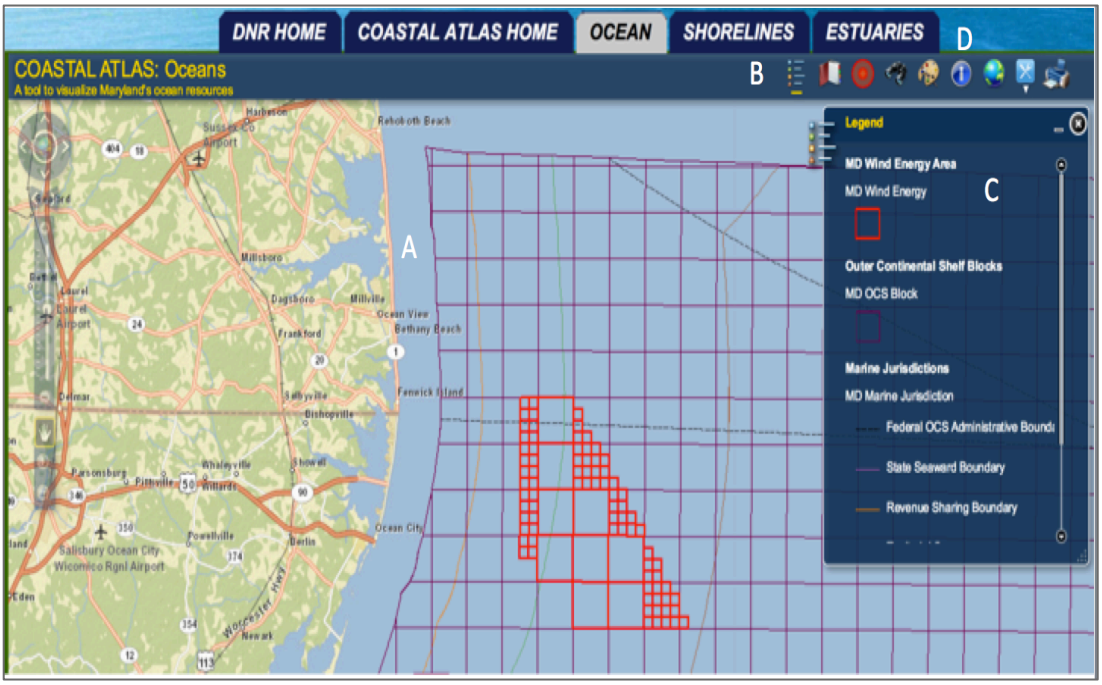

Figure 1: Screenshot of the Oceans section of the Maryland Coastal Atlas, with an example dataset (Wind energy) denoted by the red boxes and lines. (A) map area, (B) atlas tools, (C) Legend, (D) Information button (Maryland Department of Natural Resources, n.d.c).

1.3.2 Massachusetts

The Massachusetts Ocean Resource Information System, commonly referred to as MORIS, is an online mapping tool that is collaboratively administered by the Massachusetts Office of Coastal Zone Management (CZM), SeaPlan, PeopleGIS, the Office of Geographic Information (MassGIS), Applied Science Associates (ASA), and Charlton Galvarino. The primary purpose of MORIS is to display a wide range of spatial data and information pertaining to Massachusetts's coastal zone. MORIS's

homepage states that the tool was designed for coastal management professionals, but can be used by anyone who is interested in the coastal zone (Massachusetts Office of Coastal Zone Management, 2014a). Similar to other coastal web atlases, MORIS allows users to interactively overlay different data layers on a variety of base maps giving users the ability to view which marine activities and resources overlap. MORIS states that its purpose is to:

- "Provide spatial data that are, to the extent possible, accurate, scientifically sound, and credible;
- Provide information to decision makers, planners, and the general public that can be used to strengthen environmental policy and guide management decisions;
- Use a collaborative, interactive process that involved a variety of partners and data sources. And lastly;
- Ensure that the data are available in an easily accessible and useful manner." (Massachusetts Office of Coastal Zone Management, 2014a).

MORIS was created in 2012, via a public-private partnership between CZM, MassGIS, ASA, and SeaPlan. MORIS contains a variety of data files including federal, state, and local sources. The MORIS webpage states that as of January 2014, 693 data layers were available for display on the tool. MORIS emphasizes the open access nature of its data as users have the ability to print, email, and download any of the data – all for free (Massachusetts Office of Coastal Zone Management, 2014b). Inexperienced users can download the 36-page user manual, which was released at the same time as the atlas. The user guide aims to teach individuals how to use numerous features, some of which include how to navigate the map, add data layers, and download data (Massachusetts Office of Coastal Zone Management, 2012c).

Unlike the Maryland Coastal Atlas, the Massachusetts atlas is developed within a JavaScript web application and MORIS uses a mapping software called GeoServer, which is a mapping platform that presents data according to the

standards developed by the Open Geospatial Consortium (OGC). An advantage of presenting the data using this technique is that the datalayers presented can also be used by other mapping clients including Google Earth™ and ArcMap™ (Massachusetts Office of Coastal Zone Management, 2014a).

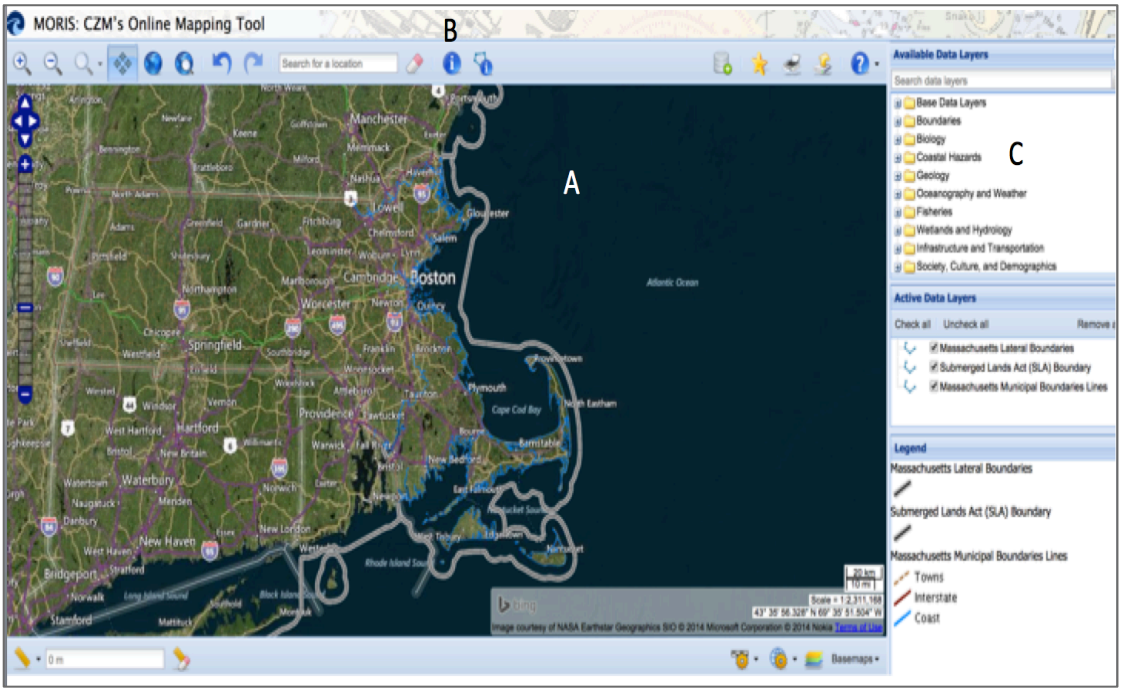

Figure 2: Screenshot of Massachusetts Ocean Resource Information System (MORIS). (A) map area, (B) information tool, (C) data layers. (Retrieved from MORIS: CZM's Online Mapping Tool, n.d).

1.3.3 Scotland

In 2010, the Scottish Marine Act 2010 was introduced, giving Scotland the authority to implement marine planning within its seas. After the approval of the Marine Act, Scotland soon began working on a National Marine Plan (NMP), which aims to properly manage a diverse range of activities that occur within its marine environment. More specifically, the NMP aims to balance economic development with environmental protection and it will also play a role in managing climate change adaptation (The Scottish Government, 2014a). The Scottish atlas, called the National Marine Plan interactive (NMPi), was created as a tool to complement the

development of national and regional marine planning. Like the other digital coastal atlases studied in this research project, the NMPi allows users to view and overlay many layers of information in order to better understand the activities that occur in the Scottish marine environments. Layers are sorted by themes, and some of the themes include physical characteristics, productivity, climate change, regions, administrative layers, and biological diversity. The data housed in the tool is publically available and users are encouraged to register at no charge. Registered users have the ability to download certain layers and add their own information to the tool as a "My Information" layer. Registered users also receive email notifications when new data or statistics are added (The Scottish Government, 2014b).

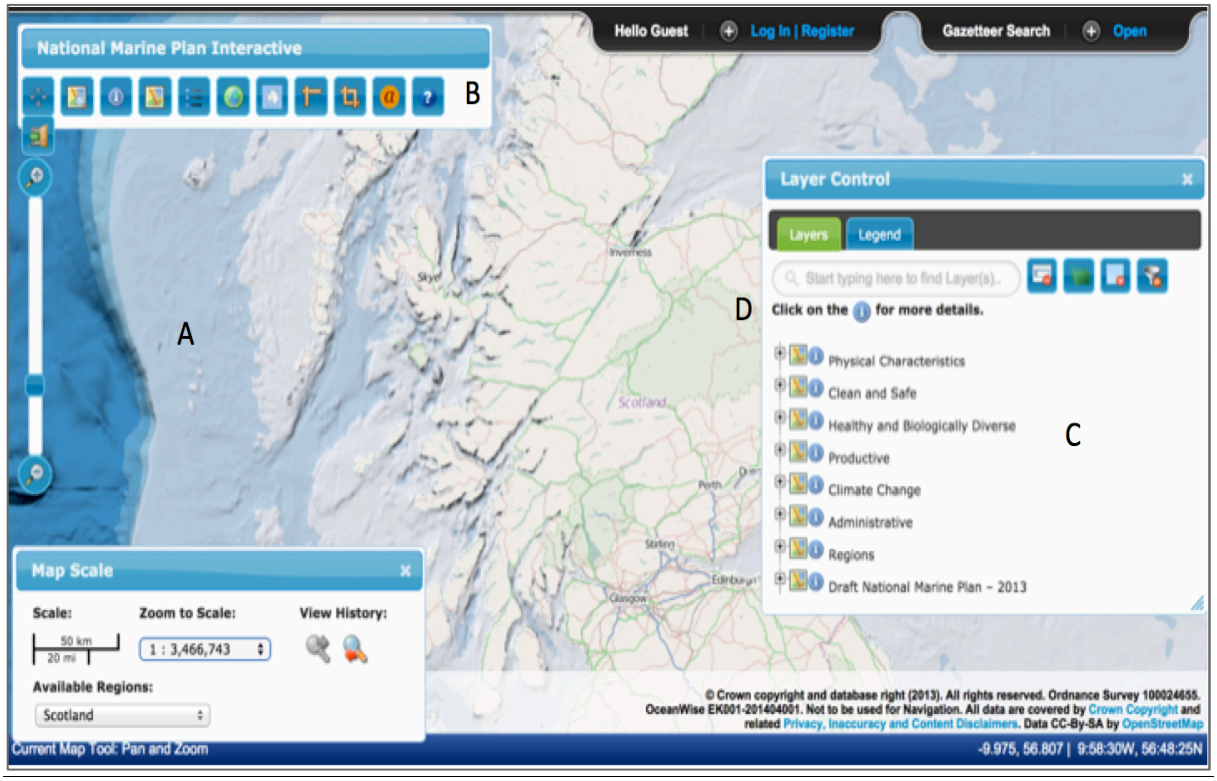

Figure 3: Screenshot of the National Marine Planning interactive (NMPi). (A) Map area, (B) atlas tools, (C) layers and legend, (D) information button. (Retrieved from National Marine Plan Interactive, 2013).

1.3.4 British Columbia

Similar to the NMPi, the SeaSketch Marine Planning Portal was created in British Columbia to complement marine planning; in particular it is used to compliment the Marine Planning Partnership for the North Pacific Coast (MaPP). MaPP is a marine planning initiative between the British Columbia government and 18 member First Nations. There are four sub-regions in the North Pacific Coast: Haida Gwaii, North Coast, Central Coast, and North Vancouver Island. Due to the collaborative nature of the marine plan, the Marine Planning Portal contains both governmentally collected data as well as traditional knowledge. Upon completion, which is scheduled for late 2014, the project aims to provide planning initiatives regarding key uses, activities, and areas to be protected in the marine environment. MaPP aims to provide recommendations on how to best balance economic development and stewardship of the British Columbia marine environment (Marine Planning Partnership for the North Pacific Coast, 2014).

The B.C. Marine Planning Portal's purpose and goals are comprehensively explained on the MaPP webpage. The Marine Planning Portal has over 250 data layers, which allow users to look at data such as administrative boundaries, marine uses, habitats, and species. Referred to as a decision support tool, the Marine Planning Portal displays information that can be used by decision-makers when developing marine spatial plans. The visual nature of the portal allows user to see conflicts between a variety of marine activities and uses by overlaying different datasets (Marine Planning Partnership for the North Pacific Coast, 2014b). General users can also view publically available spatial data layers, read descriptions about the marine spatial layers, save and print high quality maps, and review the available MaPP draft spatial marine plans (Marine Planning Partnership for the North Pacific Coast, 2014b).

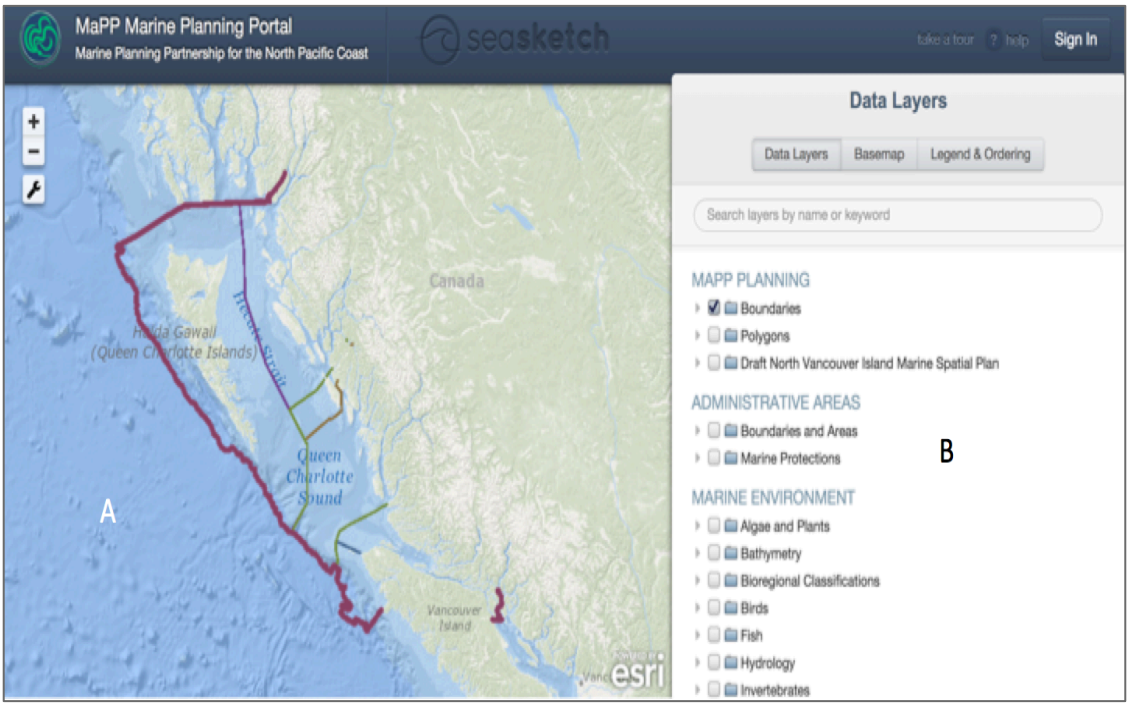

Figure 4: Screenshot of the SeaSketch Marine Planning Portal. Lines highlight the different boundaries created by the Marine Planning Partnership. (A) Map area, (B) atlas layers. (Retrieved from: MaPP Marine Planning Portal, n.d).

2. Methods

This research was conducting during an internship with the Environmental Information: Use and Influence (EIUI) research program, which is located in the School of Information Management at Dalhousie University, Halifax. This initiative studies the use and influence of marine environmental information created by various governmental, non-governmental, and intergovernmental organizations (www.eiui.ca). Methodologies used by this research initiative include: citation analysis, web analytics, detailed interviews, surveys, and literature reviews. Methods for this specific project include a literature review and interviews. The methods selected for this project were discussed by the research team and deemed to be suitable based on the questions the project aims to answer and the time available to complete the project.

Unlike other research conducted by the EIUI initiative, this research did not analyze specific written reports, rather it examined the use of information generated from online geographic information systems (GIS) mapping tools. Four different digital coastal atlases were selected for this study created by governmental units in Maryland, Massachusetts, Scotland, and British Columbia. The atlases were selected based on recommendations from the Nova Scotia Department of Fisheries and Aquaculture (NSDFA), a governmental research partner to the EIUI program, the availability of individuals who use the atlases for interviews, and because these four atlases represent jurisdictions in Canada and other countries, thereby providing breadth to the study.

2.1 Literature review

Searches were conducted in Web of Science, Google Scholar, and the Aquatic Sciences and Fisheries Abstracts to identify relevant publications. The following phrases were searched: "coastal atlas," "digital coastal atlas," "mapping tools," "marine spatial planning tools," and "coastal web atlas." In order to develop an understanding of the information generated by coastal atlases and why they are implemented, it was necessary to read a variety of peer-reviewed and grey literature, such as organizations' newsletters and technical reports created by governments. The coastal atlases themselves were another important source of information, and were studied to develop an understanding of the types of data that are available to users, what the stated goals of each atlas were, and other general background information on each tool. The information and publications identified by these searches were discussed in section one of this report.

2.2 Semi-structured interviews

Semi-structured qualitative interviews were conducted by telephone or other digital means, such as Skype. Participants were recruited by email (see email recruitment form, Appendix 8.1) and an approximately 45-minute interview was

conducted at their convenience. Potential participants were determined by interacting with contacts provided by the DFANS within each of the four jurisdictions (Maryland, Massachusetts, Scotland, and British Colombia). Each contact provided additional names of potential participants.

The participants were divided into two categories: atlas users or atlas developers. Atlas users were a combination of government and non-government employees. A separate set of questions was created for atlas users, which inquired about: users' backgrounds, their general atlas use, their use of the atlases in decision-making contexts, their feedback about the atlas they used, and their recommendations regarding the ongoing development of the atlases (see interview questions in Appendix 8.1, Part A). Atlas developers were individuals who were involved with the creation, implementation, and maintenance of one of the four digital coastal atlases. Developers were asked questions about the rational for creating each atlas, data maintenance of the atlases, atlas users, and lessons learned (see interview questions in Appendix 8.1, Part B).

While the participants were known to the researcher, their identities were treated confidentially. To ensure anonymity of the participants all data contributed by the participants was anonymized. The participants' individual identities were not disclosed in this research report. Names were not identified; instead, individuals were categorized as either an atlas user or an atlas developer and assigned a number. Any quotations used in this report that could reveal an individual's identity were modified so that their organization or name could not be identified. For example, rather than using names, a participant was classified as "User # 1" if the individual was an atlas user, or "Developer # 2" if the individual was an atlas developer.

Interviews were audio recorded and then transcribed and the data collected from the interviews was thematically coded by hand. Analysis of a large volume of transcript data can be broken into several tasks: immersion in the data, coding the data, creating categories from the coded data, and the identification of key points or themes to be discussed (Bazeley, 2007; Green et al., 2007; Ryan & Bernard, 2003).

Once the interview data was coded the data was analyzed for recurring or unique themes found throughout the interviews. This process was also completed by the researcher's supervisor to ensure inter-rater reliability. This step was also undertaken as a way to ensure that the codes assigned to the interview responses by the researcher are clear to an outside reader.

3. Results

Twenty-one individuals agreed to be interviewed for this study (see Table 1). Four developers and eighteen users were interviewed providing perspectives about each of the atlases they were familiar with.

Table 1: Number of developers and users interviewed from each jurisdiction (Maryland, Massachusetts, Scotland, and British Columbia)

Jurisdiction	Developer	User	Total
Maryland	1*	5	5
Massachusetts	1	3	4
Scotland	1	4	5
British Columbia	1	6	7
Total	4	18	21

*Note: One user was also asked some of the developer questions because of their involvement in the development of their respective atlas as well as being a user.

3.1 Responses of atlas users

3.1.1 Background on users

The majority of the atlas users (12 out of 18) were governmental employees; the rest were employees who worked for non-governmental organizations or for consultant firms. Fifty-five percent of the users stated that their major responsibilities involved managing projects or project reviews. The second most common responsibilities included stakeholder engagement/collaboration/ consultation, marine spatial planning, and policy or

permit development surrounding coastal issues. Four out of 18 users stated that their major responsibility was to manage data.

When asked whether they had ever used GIS mapping based tools, fifteen out of 18 atlas users (83 percent) had experience using GIS or mapping tools. Most of atlas users (44 percent) stated that their use of atlas and mapping tools varied depending on the nature of the project they were working on. “There could be times where I use it daily, for days and weeks at a time and there might be a time where I’d go a week or so without having to use it. It’s largely based on tasks associated with the job” (User # 7). In general, users said that they used mapping tools on a daily (33 percent) or weekly (44 percent) basis. Their use of the coastal atlas varied from marine spatial planning, to visually delineating conflicts, and collaborative and engagement use.

Most users were aware of their receptive atlases from the inception of the atlases (72 percent) and 10 of 18 users became aware of the tool internally (within their organization). Other means of awareness included newsletters, emails, blogs, presentations, and workshops. A couple of users were made aware of the atlases because they used previous versions of the tool. As User # 1 noted: “We even had the original maps in hard copy so we have always referred to the maps, the digital age came in and they were able to transcribe the hard copy maps and put the transects on.”

Most users who were interviewed provided a combination of technical (61 percent) and data (67 percent) input in the development of their respective atlases. Some users, however, did not provide input until after the release of the atlas in their jurisdiction; 27 percent of users provided input after the original development. User # 7, for example, stated: “once it came out we were testing how well it works, so we were actually using it, it has a variety of access tools and sharing tools that we were testing to see how well those work and how easy they were.” Only three out of 18 users did not provide any input into an atlas.

3.1.2 General use

All of the users had used their respective coastal atlases. The majority (83 percent) used multiple data layers and only two interviewees used a single layer of their digital coastal atlas. Multiple layer use for decision-making indicates that an atlas is helpful, particularly since many activities interact in a marine area resulting in potential conflict. Layer use varied depending on the number of available data layers in each tool. Overall, the users reported considerable variation in their use of data layers. No type of data layer in the four atlases was used more frequently than others. Twenty-seven percent of the users utilized data layers that are associated with species or biodiversity. Coastal hazard data layers, fisheries data layers, zone or boundary layers, tenure layers, and region specific data layers were used by 22 percent of the participants. Seventeen percent of atlas users looked at vegetation or eelgrass data layers, critical habitat layers, human uses or recreational data layers, oceanography layers, wetland data layers, and historical data layers. Less commonly used data layers (one or two users) included shoreline data layers, conservation or marine protected layers, ecological layers, renewable energy data, estuary layers, and transportation and shipping layers.

Table 2: Visual representation of which atlas layers are used by coastal atlas interviewees.

Atlas layers	Number of Interviewees (18 respondents total)
Species / biodiversity	5
Coastal hazards	4
Fisheries	4
Boundaries	4
Tenure	4
Regions	4
Vegetation/eelgrass	3
Critical habitat	3
Human uses / recreational	3
Oceanography	3
Wetland	3
Historical	3
Coastline / shoreline data	2
Conservation / MPA	2
Ecological	2
Renewable energy	1
Estuary	1
Transportation / shipping	1

Most users (59 percent) stated that in the absence of the coastal atlas they would have to directly contact individuals or organizations to gain access to data available in the respective atlases. Twenty-four percent of users stated that they would not be able to complete their work without their atlas. One user went so far as stating "[completing occupation responsibilities] would actually be pretty much impossible because you have to access too many different organizations within the [jurisdiction] that hold the data. The marine spatial plan that I am doing it would actually be very difficult to point people towards those data layers in order that they could use them to make decisions, something like this would have to had existed in order to be able to do my work" (User # 10). Other users (29 percent) stated that they would go to other existing portals or mapping tools within their jurisdiction. Other types of information users would access to answer questions within their occupation included hard copy maps (18 percent), primary literature

(18 percent), internally collected data (12 percent), and local knowledge (12 percent) and websites (0.5 percent).

Many users were aware of individuals within and external to their organizations who used their respective atlases. These observations indicate that each atlas has a broad range of users, and digital coastal atlases are used in many different occupational contexts. Fifty-three percent of users knew people within their organization who used the coastal atlases. Externally, individuals within non-governmental organizations and other agencies were the second highest percentage of users (47 percent). The third highest at 41 percent were local or community members. The interviewees were also aware of academics and students who used the atlases (12 percent). Nine users out of 17 were not able to state what other people were using the atlases for; however, six of the interviewees noted that other people or organizations were using the atlases for educational or information purposes to develop understanding of different marine resources and activities occurring in coastal zones. Two interviewees stated that others were using the atlases for marine planning or policy development.

All of the users stated that their respective digital coastal atlas did not have an associated mobile app. Overall, there were mixed reviews on whether a mobile app would be a useful. The majority of users (61 percent) either were unsure whether an app would be useful or they did not think it would be useful to them personally. Only three users out of 18 thought that an app would be a useful complementary tool to the atlas. One of these users explained: "I think it would be a really good next step to take the portal and turn it into an app because a lot of the sort of practicality of the information of the tool would be being able to use it when you're out on the water" (User # 13). Even users who did not think that a mobile app would be personally useful could appreciate its usefulness in the field (44 percent); however, two users stated that the location of their fieldwork would render a mobile app inoperable because of limited Internet access. Other interviewees (three out of 18) thought an app could also be useful in stakeholder engagement, public education, and consultation. One user who thought it could be useful in engaging the public said: "I would say for the purposes that we used it for,

it probably wasn't necessary. I could see if we were going to use it as a platform for engaging the public or other as sort of a citizen science type tool" (User # 17). Other users thought that a mobile phone interface is too small for a mobile app to be useful (33 percent); however, five people thought that a tablet app might be useful because of the larger interface. User # 10 commented: "To me personally probably not, I think it would be useful if people were just dipping in and out because I think, well on a tablet it might not be so much of an issue, but I think that for the fine scale on some of the maps you are not going to be able to see that detail on a mobile phone and considering the whole purpose of it is a mapping tool I think you might lose some of the benefits of viewing it on a larger screen."

3.1.3 Decision-making use

Forty one percent of the users use the atlas for marine spatial planning to help to answer questions by highlighting which marine areas have multiple and potentially conflicting uses. Some users (18 percent) said that the atlas helps them to answer their questions and make decisions because it provides access to specific data sets or information all in a single location. Interestingly, two users out of 17 stated that the atlas was helpful in bridging the communication gap between technical staff and policy and decision makers. One user noted that: "people know how to use the web, they know how to use online mappers, so they can very easily pull up the data and see for themselves what some of the potential issues would be without having to really have that really technical knowledge. So it really bridges the gap between the technical GIS folks and also the folks that are on the policy side trying to make decisions" (User # 5). Two users stated that the atlases are either a helpful starting point for data collection or conversely a helpful end point as a way to fill in potential gaps in their knowledge. Lastly, one or two other users responded that regarding the types of decisions they make using the tool included project review, resource planning or management, and educating non-policy makers.

All of the participants stated that their respective coastal atlases allow them to access a diverse range of information. Twenty two percent of users stated that their atlases increased their awareness about different types of available information or activities occurring in coastal zones. User # 2, for example, stated: "I was not aware prior to coming here just exactly what types of data were being collected around the state and how many different people are involved." Unique responses (1 out of 17) indicated that the atlas provided access to a diverse range of information because of the centralized and visual nature of the data, the coastal focus of the information, and the presence of both qualitative and quantitative data.

When asked if their ability to answer questions changed after the implementation of their respective atlases, the most frequent responses were as follows:

Firstly, five out of sixteen users who responded to the question stated that after the implementation of their respective atlas tools, they found communication easier or found it easier to increase stakeholder trust due to the transparent and publicly accessible nature of the data. User # 12 summarized this idea by saying: "sometimes when you are working with lots of different stakeholders you need to allow them to have trust in the data that you are using and if it is provided nationally and publically by someone like [government department] I think it could provide more of that type of trust that you would require in the data, or the viability of the data and all of that kind of thing."

Secondly, the different atlases allow quicker understanding of general activities that occurred within coastal zones (25 percent of respondents), thus highlighting potential areas of interest for development, regulation, and marine planning. In connection with the previous idea, 38 percent of the users claimed that based on the coastal scope of the digital atlases they were able to find the relevant information they needed much more quickly. User # 6, for example, discussed how the atlas strengthened the ability to perform project reviews: "It [the atlas] has changed not only being able to get the information but the speed at which you are able to get the information, or how quickly we can actually perform the review and know exactly what we need to focus on."

Lastly, one user pointed out that their respective coastal atlas allows users without GIS capabilities to make informed marine spatial planning and management decisions. In the words of user # 13: "It has allowed me to take information that would have been kept or would have required GIS analysis and allowed me to do some rudimentary analysis on my own without requiring their [GIS] assistance, so it has helped in the development of the resource plan."

The users believed that the availability of a coastal atlas enhanced their ability to make decisions for a number of reasons. Eight out of 16 respondents (50 percent) believed access to a coastal atlas increased their confidence in their decisions because they were able to access a large volume of accurate data in a central location, thus increasing their efficiency and confidence in their decisions. For example, user # 7 stated: "I have a high degree in confidence as to the accuracy of the information that is provided. So if I'm using a tool that I have confidence in the information of, I feel more confident in being able to ground in reference and defend a decision-making process."

Six out of 16 respondents (38 percent) believed that because the data is, for the most part, publically accessible the atlases increase transparency making it easier to communicate with various stakeholders. As User # 14 pointed out: "It [the atlas] is really helpful for having multiple people look at one zone and very clearly know they are looking at the same things and you can be clear about what specific you are considering or what data you are talking about like, it is really good for sharing information."

Over half of the respondents (56 percent) believed that the atlas they used enhanced their ability to answer questions because it saved them time. Thirty one percent of the users believed that the atlas also reduced their costs. As User # 15 stated: "It [the atlas] definitely saves us time and I guess time is money."

Lastly, two users stated that the atlases enhanced their ability to answer questions because the atlases highlighted knowledge or information gaps in drafted plans/policies. User # 5 pointed out that "often times it will be kind of the point where we'll be able to get so far with a decision, and then there will be

additional follow up needed that will require analysis tools and the atlas will help us direct our focus in a desktop GIS application to do additional work."

When asked if the creation of the atlases led to the development of new policies, many users (35 percent) were unsure whether new policies had been developed; however, six out of 17 respondents thought it was possible but could not think of specific examples. User # 2, for example, stated: "I would have to say that I am 99 percent confident that it has, but … I couldn't give you any specific examples, but I am sure that is has." Four users (25 percent) pointed out that policy informs the atlases or that the atlases can aid policy development but that new policy is not a direct result from the information generated by an atlas. User # 11 put it this way: "Not yet, it is actually been developed on the back of policies, but it will in time contribute to regional and local planning policies." Another user stated: "it certainly assisted the drafting of policy certainly in my case when we are relying on the fact that it is going to be available when we are drafting our policies and we are pointing people to it. But the policies themselves are not based on the tool. So it is supporting the drafting of policies I would say" (User # 9). Renewable energy was the only sector where new policy may have been developed directly as a result of the information generated by an atlas and five out of 16 users that responded to the question stated that their CWA aided in renewable policy planning.

3.1.4 Feedback/challenges

Fifty six percent (10 out of 18) users experienced some type of technical challenge while using their respective atlas. Common technical glitches included: loading difficulties, bandwidth issues, printing issues, problems with loading different layers, etc. Other users (five out of 18) experienced data challenges while using their respective atlases including: data redundancies, metadata issues, too much data, etc. Only three users did not experience any technical or data challenges. When they experienced any type of challenge, users typically (44 percent) contacted the atlas administrator directly. Users who pursued this method of feedback said that the atlas administrators were effective in providing support.

One user said that having a live feedback section within the atlas would be useful, as emailing the contact person for support and waiting to receive a response was not as effective as an immediate response. This user noted: "If I was having those kind of technical challenges, a really important thing, would be to in real time say I can't do this… can you help me?" (User # 16) Another user (User # 15) stated that it would be helpful if two separate feedback mechanisms were available, one for technical challenges and another for data questions. "The comment on the tool then goes to the tool software developer and not really to the right person if you have a question about data. So it needs to be split – comment on the tool for the operation of the atlas or the comment is on a particular data layer" (User # 15). User # 14 suggested: "The greatest challenge is that it's often too complex for what we use it for on a day to day basis or for what most people log on to use it for need. It makes it confusing, it makes it confusing to explain to people how they can use it and what they can do with it." This observation indicates that the challenge with the atlas is that it is too complicated for this individual's needs and possibly other stakeholders' needs too.

When asked if the data was easily useable, a mix of responses were received. Thirty three percent (6 out of 18) stated that the data was easily useable for the decisions that they needed to make. Another 33 percent stated a mix of usable and non-usable data were available for their needs and most often the resolution of the data dictated its usability. User # 9, for example, noted: "it depended on what the layers consisted of, some of them are quite complicated and once you start switching them all on sometimes they aren't as helpful as they could be." Another user (User # 8) pointed out that "sometimes the data for copyright reasons is simply not available at that higher resolution [and] that is an issue." Even though challenges were outlined, no interviewee suggested that any data was in an unusable format to match their needs.

The interviewees in the user group were asked to place the atlas they used on a scale from 1 to 5 terms of technical requirements (1 being easy to use, 5 being challenging to use). Although each atlas provided different interfaces, all users believed that the atlas they accessed was relatively easy to use. For this question,

the users interviewed in this study were classified as experience users. The interviewees were asked to comment on whether members of the general public (i.e., inexperienced users) would find the atlases to be easy or difficult to use. For the most part, the interviewees found the atlases easy to use (8 selected 1 and 10 selected 2 on the scale) (Table 3). In contrast, the interviewees thought that the technical requirements of the atlases would make the atlases somewhat more difficult to use by inexperienced members of the public. Some of the interviewees did not respond to the questions regarding the technical requirements for general users.

Table 3: Ranking of the technical requirements to use the atlases, with respect to users' own use (experienced user) and the general public (inexperience user)

Ranking (1 easy – 5 challenging)	Experienced User	Inexperienced User
1	8	0
2	10	5
3	0	6
4	0	2
5	0	1

A couple of users stated that with practice challenges with technical requirement could be reduced. According to User #10, "A lot of it is intuitive, it is very easy to use but it does take that few minutes to get settled in and to work out what it is to get what you want out of it. It requires a little bit of playing around but once you've got that it is very easy." User # 3 thought that the sheer volume of information could be overwhelming and increased the technical requirements to use the atlas. "Sometimes the sheer amount of information, which is good and bad, for the average user to come in and answer just one question, it takes a little bit of knowledge to come in and put all the information together." Lastly, three different users stated that the technical requirements really depended on how an atlas was being used and the type of information users were looking for.

Table 4: Currency of information assembled in the respective atlases.

	Currency of Information			
	Current	As Current as Can Be	Not Current	Unsure
Responses (out of 18)	6	11	0	1

As Table 4 shows, the majority of users (61 percent) believe that the information on the atlases they used is current or as up to date as it could be. Two users explained that currency depended on the data layer, as some layers were up to date and others were not. User # 13 explained: "I mean it's a snapshot in time for a lot of that data, so given the nature of the tool and this process not all of the data is being updated. In fact as we proceed along a lot of the data is static so it was updated once but hasn't been updated since. With that said, as we refine and build our zones those are updated regularly, but we were provided information on dive sites so that is going to be a static data set that is not updated regularly and it will change as they discover new data set and new dive sites." No interviewee believed that the atlas they used is completely lacking current data.

Over half of the interview users (65 percent) believed that the information contained within the atlases they used was well rounded, meaning there was not an obvious lack or abundance of a particular type of information. Users would like a variety of types of information to be added to the atlases they are familiar with, which is most likely based on their occupational interests. Data that users would like added included: higher resolution data, better metadata, more local or regional data, qualitative data, and more oceanographic data. Of the types of data that seem more abundant than others, users stated that coastal hazards data were common, and renewable energy data, estuary or wetland data, resource data, economic data, and biology or environmental data were abundant. User # 9 thought that: "At the moment generally speaking the community uses of the marine environment tend to be lacking because we have less information on it, so it is more formal uses like economic, or license activities and knowledge of the moving environment, … and then things like other community uses are not as prevalent." Another user stated

that funding affected which layers were added to the atlas: 'There are biases but that is because we have received grants specifically to focus on things, so we seem to have a lot of information on sea-level rise vulnerability and storm surge vulnerability, and there is a lot of information on wetlands, … and then there is a lot of information on offshore wind energy" (User # 2).

Table 5: Credibility of the data sources in the respective atlases.

	Credibility of Data Source			
	Credible	Not Credible	Unsure	Dependent
Responses (out of 16)	14	0	1	2

The majority of users (88 percent) believed that the source of the information in the atlases that they used is credible. Three of the 14 respondents (21 percent) believed that because the majority of the sources of data in their atlases were governmental, the information was credible. None of the users explicitly stated that they believed the information was from a non-credible source. About a third of the interviewees (6 out of 16 or 38 percent) commented that metadata allow users to determine whether the information is from a credible source. For example, User # 7 stated: "I think it's all credible and pretty well vetted and pretty well documented through the metadata." This statement suggests that high quality metadata helps users to determine the credibility of the information presented in the atlases.

3.1.5 Recommendations

All of the interviewees stated that they would recommend the atlas they used to others both internally and externally to their organization. This perspective implies that all interviewees believe that the atlases are useful or beneficial in some way. The users stated that they would most likely recommend the atlases to local communities or the public (50 percent). The next most common group was non-governmental organizations or other agencies (33 percent). Lastly, four of 18

interviewees stated that they would recommend the atlas they were familiar with to others internally within their organization and four out of 18 interviewees stated they would recommend it to other governmental organizations. These recommendations indicate that coastal atlases are not solely useful for internal governmental purposes, they can also be used and are recommended to local communities and non-governmental organizations. When asked to comment on why they would recommend the atlases to others, the most frequent response was that they are helpful in consultation and education, and provide a broad overview of different activities occurring in coastal zones (40 percent). Secondly, three out of ten respondents said they would recommend the atlas they used because of its easy to understand visual and informative format. Less common responses were: the atlases would be recommended as a way to share information, for marine spatial planning purposes, and for people who do not have GIS capabilities. As User # 9 noted: "It [the atlas] is a good way to get the data and you can view it, as well you don't necessarily need to have GIS then either."

The majority of users (56 percent or 10 out of 18) believed that the greatest benefit of their coastal atlas was the abundance, accessibility, and central location of numerous coastal data sets or information. The second most popular response, with either four or five individuals commenting on each point, was that the coastal atlases save time in locating and using information or increase individual efficiency, users value the visual presentation of the data and user-friendly capabilities of the respective atlases, the users appreciate the transparent nature of data availability, and lastly they felt that the atlases are beneficial for educating the public about coastal issues and resources. Unique responses (only one or two respondents) included the capability to achieve stakeholder cohesiveness, bridging gaps in understanding among stakeholders, increased ability to see potential conflicts by layering different data together, increased communication between stakeholders and planners, decision makers without GIS capabilities are able to complete marine spatial planning, and one user thought the atlas increased the ability to consult with stakeholders and the public.

As a final question, the users were asked if they had other information or recommendations to offer. The responses to this open-ended question varied considerably. Two out of 18 recommended that when an atlas is being conceptualized, developers need a very clear purpose, goals, and data criteria. User # 15 stressed: "having some clear guidelines with what is appropriate to include in the portal or not, especially when you get later in the process and people will question why something is in or why something isn't in." Another two of the 18 users emphasized the importance of high quality metadata. User # 4, for example, noted: "I would just emphasize that if you plan an endeavor like a coastal atlas that there is some key things like metadata." User # 5 stated that metadata is important for explaining how the data was created: "we're constantly trying to find ways to explain how the data was created or make it easily understandable what kind of decisions can be made with some of the data." Other helpful recommendations included: understand the data platform needs from the beginning as it is difficult to go back to change the framework and another user stated that digital tools are useful because as long as the data is updated the atlases stay relevant; however, as soon as the data becomes outdated, people will not rely on the atlases anymore.

3.2 Responses from atlas developers

3.2.1 Rational: Ideas & development

There were both internal and external rationales for creating digital coastal atlases. One atlas developer (out of four) wanted to display data to internal users as a way to help support national and regional marine planning initiatives and on-going projects. Externally, the rational to display data to the public was noted (three out of four users), thus increasing transparency and ability to educate the public about various activities that occur in coastal zones. One atlas developer (25 percent) said that this goal had been achieved, and two others said some of their goals were achieved. The fourth developer did not comment on whether the atlas goals for the atlas were achieved or not.

The developers were asked if they anticipated their coastal atlases would address particular types of questions or aid in decisions. One developer stated the atlas was not expected to deal with specific questions or decisions and elaborated: "none specifically. I view this as a fancy library, it is a place where you can go to, to look at CZM data holding relating to any field that you are interested in. You can lay it over a base data layer, also photos or Google map… So I came into it with no a priorities no thoughts that this particular question will be answered by [the atlas]" (Developer # 2). Two of the three respondents (67 percent) thought their respective atlases increased data availability and awareness. Developer # 1 stated: "Mainly it was a way to get the data out to people, to serve the data out." Two of the three respondents also believed that their respective atlases were useful in visualizing overlapping activities or zones. Lastly, Developer # 4 also believed that the atlas was useful in stakeholder collaboration. "It is [the atlas] consistently used in our planning team, particularly on the coast in looking at the zones that we've created or talking about where we could make adjustments, or what values are where" (Developer # 4).

The developers were next asked who identified the need for a coastal atlas. Two of the three respondents (67 percent) stated that the idea for developing a digital coastal atlas was internal to their governmental departments. "I think the idea would have come internally and someone probably said hey let's put our mapping data up online. It would have been someone from inside our department as opposed to outside it" (Developer # 2). The third respondent was unsure of who had identified the need for the tool.

Table 6: Funding sources for three of the four atlas tools.

	Atlas Funder		
	Solely Government	Solely External Grant/Funding	Both
Number of Respondents (out of three)	0	0	3

Three of the four atlases were funded internally by governments and externally by grants or partner organization in-kind contributions. “A group … which was a non-profit organization saw the need that the state was going to need some resources and hand holding to do marine spatial management in a better way than they could if they did it by themselves. So they got a big grant from the … [named] foundation for a couple of million dollars. And then they used that money, contracted it out on things that we sort of both agreed were necessary elements of ocean management and one of them was to create a data portal” (Developer # 2).

Stakeholder input was not solicited during the initial development of most of the atlases (three out of four), probably because as one developer claimed: “I think that if we had opened this up for everyone’s input and said what do you want to see it do, how do you want to see it work we would have lost the ability to maintain a real tight control over how we thought it would work best” (Developer # 2). This statement indicates that at least in the case of one atlas, adding stakeholder input from the beginning was thought to complicate or alter the goals of the tool. Three of the developers (out of four) said that internal and external stakeholders were asked to test the initial product and to give their feedback/input on technical and usability functions of their respective atlas. As Developer # 3 stated: “We did have stakeholder input as we were testing it. We sent it out to a lot of people and said hey here is the demo try and out and see if you can break it.”

Two of the three respondents stated that templates for their respective atlases were based on modified older versions of printed atlases. When deciding on criteria one atlas developer stated: “we stole ideas from various places. We did mock-ups on paper with everything that we liked from other tools before we even started talking to the coders on it” (Developer # 2). The second respondent said that the template was based on a pre-designed model their contractor used, noting: “the … platform that we have for [named atlas] is not a one-off. It was built on a template already” (Developer # 4).

The majority of the atlases (two out of three) were launched incrementally and more layers and information were added as each tool progressed. One developer also suggested that publicity about the atlas benefited from incremental

development as well. As more layers and more data were added, the atlas could be publicized more. This developer cautioned about publicizing an atlas when it is in infancy as it may receive criticism for its incompleteness. “I guess that initially we wanted it launched, we knew that we didn’t have a high level of content, so we weren’t perhaps giving it as much publicity as you might of done if you’d launched it with 400 layers, and as we reached a stage, we thought actually it’s now a very good representation of what we published in the hardcopy. We then started telling a lot more people about it…if you make too much publicity too soon, and it’s not ready, you might get criticized” (Developer # 3). Only one atlas was implemented non-incrementally; however, in this case the developer recommended that other atlases be incrementally launched as opposed to all at once. “In an ideal world we would have released it incrementally, but we needed to launch this and it had to house all the data inherent in the … Ocean Management plan. So one day it was turned on with all the data present in it” (Developer # 2).

Only one of the atlases studied in this research was divided into different segments based on geographical type (shorelines, estuaries, oceans). Originally designed to decrease the volume of data that appeared on each layer, the next enhancement of the atlas will merge all three segments into a single map interface. The three separate segments increased maintenance costs and data redundancies. The new single interface will allow users to overlay more information and not have to move between different segments. The interviewee in this case commented on the atlas structure as follows: “To try and make it [the atlas] easier to manage, if you look at those three different groups there is a lot of data to manage… So the idea was to make it more manageable and to focus on those particular types of planning decisions. Again it did bring up issues of redundancies in data sets, and the idea is again moving towards a one map. So we are taking the java platform, it is a template that has been created by the GIO office, which is going to be trying to make that a standard map that all the agencies would use. So that when you go to a map you won’t have to re-learn where everything is for different tools and looking at data sets” (Developer # 1).

All four atlases provide a combination of internal (governmental) and external information (NGO, local knowledge, industry, etc.) sources. One developer stated that stakeholder engagement (internally and externally) helped to gain an understanding of what data people wanted to see in the coastal atlas. "Basically we talked to different groups to find out what data was important, and in some cases the GIS group knew which data sets were asked about the most" (Developer # 1) In one case, priorities were given to current information, information on previous print versions of the atlas, or accessible from other national databases; "priority was to get newer research data all together" (Developer # 3).

Overall, consistent criteria were not obvious for how the data layers were chosen by the various atlases. Two (out of three respondents) clearly stated that funding did not influence what layers were placed in their atlases. Developer # 3, for example, emphasized: "No, no, no [for funding demands]. We just decided we would get it populated as soon as we could, and we set ourselves a deadline in middle of 2013." One atlas developer stated layers were added post-research, meaning that if research seemed relevant and useful for information to be available in the tool then it was added. Layers were not added as a way to fill in gaps: "if the project is successful and we feel that the results were valuable and what not we'll say yah let's go ahead and put that data into [the atlas]... Usually, [the atlas] is the repository for either exceptional raw data that we feel is very valuable to a host of people or some derived data product" (Developer # 2).

3.2.2 Data maintenance

All of the developers stated that data maintenance and updating is a primary challenge. The data contained in the atlases are typically static and, therefore, need to be updated frequently if the tools are to remain relevant. Updating the atlases is time consuming, and it can be challenging to find the time to complete updates. As Developer # 2 noted: "We have a lot of data that are out-of-date, I know it. I'd like to fix them. I just simply haven't had the time to do it."

A difference in opinion regarding who is responsible for ensuring the data showed up in the interviews. One developer believed that the creator of the data set is responsible for updating and alerting the atlas administrator about such updates. This developer claimed that: "the onus in that case is not us to change the data but just to get the correct new version from the contributing source and put in in [the atlas], where on the other side with the mooring data I am the one that made the data and need to re-crunch it and re-build it and put it back" (Developer # 2). Another developer believed that the administrator is responsible for ensuring the data in the atlas is current and the third developer believed that a combination is required, meaning that technicians input/delete information in the atlas, but the administrator oversees the management of the data.

All of the atlas administrators are government employees. Two of the three respondents said that the atlas administrator works in a coastal government department at the federal level. Another developer was unsure about who exactly the administrator is but knew the administrator was a government employee.

Two of the developers (out of four or 50 percent) stated that currently there are no formal data sharing agreements between internal/external data providers. In one case, data that was purchased was acquired with a licensing agreement, as Developer # 3 pointed out: "Some datasets, for instance, we buy in from commercial sources and we sign license agreements for those, which sometimes restrict how we can use the data." One atlas did have some basic data sharing agreements in place in which users had to state their intended use with the data and whether or not there would be any restrictions. Developer # 4 described this argument as follows: "It would be a data sharing agreement basically saying 'these are the datasets that were obtained from…' basically listing the dates they were collected or the currency of them… and if there was any updates, that would be included in the agreement. It's just a fairly standard data sharing form of the two parties, this is the intended use of the data, and if there were restrictions, that would be laid out as well."

In response to a question about the next steps in the development of the atlases, sixty-seven percent of respondents (two out of three) stated that they

would like to complete some basic enhancements such as updating the technological features and adding more layers/data to the atlas. In one case, the developer specifically wanted to add more regional data and noted that technical updates depended on user feedback, meaning user feedback influences the development of the atlas. "We're also looking to get, content wise, more regional data … and find a way of linking it with our [marine plan name] when we publish it so that users can hop around between spatial information and the policy that we have for the sectors" (Developer # 3).

One developer was unsure of specific goals other than to alter the atlas so that it will complement the implementation phase of their marine plan as opposed to the planning phase in which they are currently. "I think as we wrap up the planning phase, which [we] are nearing completion on in the next few months, and these plans get hopefully endorsed by respective governments and signed off, and we emerge into an implementation phase, [named atlas] will be, as my understanding, a key part of the implementation phase" (Developer # 4).

User feedback was collected in a variety of ways including: email, forums, and a "contact us" section of the atlas. All of the developers (three out of three interviewed) commented that they did not receive a large volume of user feedback and the primary feedback received related to technological challenges with using the atlases. As no external contribution update feature is planned, it seems that the developers want to maintain quality control of their respective atlases.

One atlas developer stated that a request regarding adding additional data sources had been received. "I would say yes, I couldn't speak to specifics, but certainly we've had feedback on additional data sources" (Developer # 4).

3.2.3 Defining audiences and promotion of the atlases

On the subject of audience, there was consistency among all atlas developers. They all expected their atlases to have a wide user base, consisting of both internal (government) and external (NGOs, local communities, general public, academia) users. All of the developers also thought that internal users would have

higher-level university degrees and some technical competency and conversely they expected external users to have minimal or no technical competency. For example, Developer # 2 stated: "In terms of technical ability some basic competency in running a web map. I think at this point we all have, you'd have to be really a non-computer user to not be able to use like Google Maps or something. That is sort of the level we were shooting for." For user educational backgrounds Developer # 4 said: "Internally everyone would have a technical degree at the very minimum, all the way up to doctorates and world leading experts on certain topics. Externally, it could be Joe the Farmer that has his coastal plot of land… so quite a wide range."

Similar approaches were used to promote the different atlases but training methods varied. Developer # 2 stated that promotion included a state-wide press release, website promotion, and email. "We had a press release, the state puts out a feed of a couple or three things a day and it was one of them. And our office's email listserv we had it in there, things of that sort and we had it on our web page." The same developer stated that training was offered on request and providing a comprehensive help menu in the atlas is beneficial. "It was more on a request then a we'll come out and train anyone for anything kind of deal. We made a really good help menu that is where you want to start on this kind of thing" (Developer # 2). Developer # 3 stated that initially the atlas was not promoted, but when enough data was available in the tool, they promoted it through presentations, newsletters, email and organizational notifications. "Initially, if I'm truthful, we didn't. We have something called [named] Forum, which is our marine stakeholders, once we've got a reasonable content in there, we started telling them about it. I gave a presentation a couple of years ago at the [named] workshop in … There's somebody in the [named country] who's got a very large mailing list and we put stuff out to them, to alert people" (Developer # 3). Developer # 4 stated that emails and newsletters were distributed to promote the atlas and with regard to training user guides are available in the atlas and internal stakeholder training was provided.

Some of the developers interviewed were unaware of their user base and some of the atlases have not yet implemented web analytics tools. Developers who

were aware of their user base stated that a diverse range of individuals used the atlases. Developer # 2 noted that some users of the atlas were unexpected. “I’ve had people from, I think I’ve mentioned before, like the middle of the country… a lot of the time they are students who have been, like there was some school group that was using [the atlas] to do some type of lesson … There are architects that use it; there is a very diverse users base” (Developer # 2).

The atlases studied in this research implemented varying levels of data control. The large majority of the information displayed in the four different atlases is publically available with no restrictions. However, all of the developers who responded to the question about control and whether any data layers were not available to the public (3 in total) stated that their respective atlases did include some restrictions related to zoom and scale, since zooming into different datasets can reduce the resolution of the data. One of the four atlases provides a private chat function so that different marine planners can discuss their ideas regarding planning subjects. “Different sectors had blogs set up on the sites, or forums so they could have a discussion in more or less private, if they wanted to discuss certain layers. Maybe they wanted to review them and maybe they noticed some inconsistencies of how they thought things actually were” (Developer # 4). Two developers (out of three) stated that their respective atlases included private or restricted layers, such as, sensitive species areas, First Nations data layers, private landownership layers, and privacy or security issues layers. “Private land ownership information, [named] referral areas, [named] boundaries, various other dataset that have privacy issues or security issues. Fisheries data that is more fine grain, and some of the coarser data that is available publically. They pull at a coarser level so that people can’t find fishing or hunting spots, kind of thing” (Developer # 4).

3.2.4 Assessment / lessons learned

All of the developers that responded to the questions about challenges in using the atlases stated that there were no known challenges associated with their respective atlases, which implies that each is user-friendly and functions well.

None of the developers are aware of any type of legal or liability issues arising from use of their respective atlases. All four digital coastal atlases present a disclaimer prior to displaying the map area. Developer # 4 stated that: "we have disclaimers built in that would absolve us of any liability, so that was considered… I would say there has been no issues, and that those disclaimers adequately protect us from any misuse of the information." Developer # 2 thought that providing good metadata is important to inform users about how the data should be used. "Its [the disclaimer] for first line of defense, but the other part of it, and it is a lot more important in a lot of ways, is that every single piece of data comes along with metadata and that tells you how or how you shouldn't use the data appropriately. And that is right there and if you ignore that we say we have provided you with all the information we can about the origin of the data, the scale of the data, the accuracy the data, linearity, etc., You know from here forward if you start making really stupid decisions then sort of the onus is on you" (Developer # 2).

None of the developers were aware of any political issues associated with the information generated from their respective atlases. A disagreement regarding the credibility of one of the data sets occurred with one atlas and in this case creating a mechanism for determining data credibility was recommended. Developer # 3 explained: "We've only had the one dataset so far that somebody wanted, and we wouldn't put it up…and if you're trying to work in collaboration with people, you can't necessarily make decisions that offend others. You might have to have a good debate whether it's right or not, and you really need a mechanism for deciding what goes up, if there's any elements of controversy about it. At the moment, we have a steering group and we can discuss it, but we only have the one dataset so far that we've had a problem with.

Surprisingly many of the atlas developers interviewed (two out of three or 67 percent) were unsure whether any type of web analytics were applied on their respective atlases. Two of the four atlases were created relatively recently, so information generated from an analytics tool may not be useful this early after development. A unique feature of one of the tools is a registration feature, which requires atlas users to register to gain access to more features, such as downloading data layers and updates and currently 351 users are registered. Developer # 3 explained: "Well, I've got an app-in portal, I can see how many people are registered. We do that, we give them extra functionality if they register. It's free to do so. We've now started doing some monthly updates to registered users to let them know what's new, what additional layers have been added. We do have access to a certain amount of web analytics, but I must admit, I haven't done a lot of looking at them, on the basis that it's still early days, and I don't want to misinterpret what I'm seeing."

Similarly to the question about analytics, two of the three developers were unsure about whether their atlas had informed new policy or regulation. The third developer (Developer # 2) believed that the atlas is not used to inform large-scale policy, but it could be used to inform smaller, more regional scale policy. Developer # 2 also believed that the primary purpose of the atlas was to house data. "We are doing ocean management through the GIS environment and then taking the final data sets and putting them into [the atlas] for the world to look at and see and deal with themselves. Perhaps on more local levels, specific town or something like that, they might be able to use the data in some way that says something meaningful to them that says hey let's take this area of shell-fishing and … cordon it off for something else… the atlas is simply being that place at the end of the day where the data get housed."

Two of the three developers believed that their atlases could be used to manage and promote a wide range of data sets. For example, Developer # 3 stated: "Oh yes. It [the atlas] just allows us to have access to such a wide range of datasets that you can bring in the picture for when you're developing marine planning." Developer # 4 voiced a similar view: "It certainly helps you to visualize a broad

range of datasets very easily. The data's not really managed in the atlas," and pointed out that an outside consulting company manages the data that is viewable in this particular atlas.

The developers were asked to comment of the greatest benefit (if any) of implementing their atlases. Various responses were received. Two of the three developers stated that the greatest benefit was the ability to house a large amount of data in a single openly accessible location and one developer stated that open accessibility to the information increases transparency of government data.

> "I think the fact that we've been told a lot of times that the tool is simple easy to use, effective, and the data on it are high quality, useful well documented things in one location" is the greatest benefit (Developer # 2).

> "Let's use one expression. Openness and transparency" (Developer # 3).

Developer # 4 thought their atlas was "a really effective tool for communicating our spatial design and helping to refine that work, understand people's concerns and challenges, and identify other areas to consider or make adjustments to improve the overall outcomes."

At the end of each interview the developers were asked to share any key tips, recommendations, or comments pertaining to atlas development and implementation. Their responses varied considerably. Developer # 1 emphasized the importance of good project management and thought that mobile apps are likely the way of the future. "I am saddened that we don't have money to turn our atlas into a mobile device. That is where everything is going it should be a mobile device" (Developer # 1). All three developers stated that rigorous testing of a digital coastal atlas is incredibly important and development of a large tool like a digital coastal atlas should be incrementally implemented. The developers also

stated that the following points should be conceptualized or known prior to even approaching a GIS contractor:

- Audience
- Desired technical requirements
- Conceptual working model
- Shared vision among stakeholders, and
- Good data custodian, who helps to keep the tool relevant.

Developer # 2 offered the following advice: "If you can have things working conceptually in your head and on paper ahead of time you can march in with those thoughts in head… [and] you'll be a far leg up and also find a very good heavy duty group of testers that can do everything they can think of the break it for you, and provide detailed response back… Know your audience, know what their technical needs are, know what your goals are… Go on a million different sites, like you've done, to find out which ones work and meet the goals of your organization and then just steal the best pieces from those and discard the ones you don't like. Keep doing that until you have built the perfect tool and then hire someone to make it for you."

4. Discussion

At a general level, every user and developer interviewed in this research project found their respective coastal web atlas (CWA) helpful for a variety of different reasons. One user stressed that it would not be possible to complete occupational responsibilities if the digital coastal atlas did not exist. This user explained that: "[completing occupation responsibilities] would actually be pretty much impossible because you have to access too many different organizations within the [name country] that hold the data. The marine spatial plan that I am doing it would actually be very difficult to point people towards those data layers in order that they could use them to make decisions, something like this would have to had existed in order to be able to do my work" (User # 10). All of the user

interviewees were aware and used their respective atlases showing that coastal atlases are useful in government, non-government, and consulting sectors. Furthermore, every user and developer stated that they would recommend their respective atlas to a variety of other users, which confirms that the atlases are helpful and the interviewees think others would find them helpful as well.

This research aimed to determine whether coastal atlases are proving to be useful for data and information management, as well as coastal policy and decision-making. With regard to the matter of data and information management, all of the atlas users stated that their respective coastal web atlases allowed them to access a diverse range of information and twenty-two percent of those respondents stated that the atlas not only allowed them to access a wide range of information it also enlightened them about information that they did not know previously existed or was accessible. As stated in the introductory section of this paper, the goal of information management is to collect and manage information from a variety of sources and distribute that information to one or more stakeholders. The purpose of many digital coastal atlases is to make a wide variety of information accessible to wide user bases in easy to understand and visual formats (O'Dea et al., 2011). Based on the interviews conducted in this study, it seems clear that CWAs are an ideal tool for managing large quantities of geographic data and information. The number of data layers can be sizeable as two of the four CWAs illustrated. The British Columbia CWA contains over 250 data layers and the Massachusetts CWA contains almost 700. With reference to the second part of the research question about whether CWAs are useful in coastal policy and decision-making, the literature clearly states that CWAs can be used to inform a wide variety of marine related policy and decisions with regard to climate change, population pressures, coastal hazards, resource management, and hazard assessment (O'Dea et al., 2011; Wright et al., 2011). The interview findings mirrored the literature as many users (50 percent) stated that the use of the CWA made them more confident about their decisions, as they were able to access a large volume of credible data in a centralized location. Thirty-eight percent of users believed that because the data in the CWAs are publically available and thus transparent they were able to

communicate their decision-making processes to the public more easily. It is clear that CWAs are an important aid in decision-making; however, many of the interviewed users were unsure about whether the atlases had actually influenced policy development. Surprisingly, thirty-five percent of users were unsure about whether their CWA led to new policies being developed. An equal number of users (35 percent) believed that the CWA they had used had led to the creation of new policy but were unable to think of specific examples. Maybe because two of the four CWAs studied (Scotland and British Columbia) have only been launched recently (approximately 2013 for Scotland and 2014 for British Columbia) not enough time has passed for policies to be created from the information generated by these tools. Policy development is inherently associated with formal outcomes or procedures; consequently, it is possible that users were unclear about what constituted a policy and thus were hesitant to comment. Two of the four tools (Scotland and British Columbia) were created to complement large-scale national policy plans, thus users of these atlases may have believed that it was unlikely that any other policy would be created from the information generated by these atlases.

The Nova Scotia Department of Fisheries and Aquaculture is interested in developing a digital coastal atlas as a way to manage and centralize the province's coastal and marine data. Managers with the NSDFA have stated that they would primarily develop a coastal atlas for internal governmental use rather than opening the tool for the external users, such as the public, at least initially. Although CWAs would definitely be useful internally within government departments and agencies, the users interviewed in this study were quick to recommend their respective atlases for use by people or organizations external to governments, such as local communities, NGOs, and other groups. Throughout the interviews, the participants stated that the atlases they were familiar with were particularly important for public engagement and transparency due to CWAs open access to data policy. The corresponding literature also suggests that publically accessible data, like in CWAs, increases transparency of government activities. Allowing stakeholders to view the information that policy and decision-makers use in planning can increase understanding and acceptance of decisions. Furthermore, public acceptance of

decisions can increase the perception of the legitimacy of policies, which is a desired goal of many policy and decision makers (de Fine Licht, 2013; Tyler, 2006). Nova Scotia has many different natural resource development opportunities, for example, aquaculture. However, natural resource development can be a contentious issue (Sarker et al., 2013; Nova Scotia Department of Fisheries and Aquaculture, 2010). Developing a province wide coastal atlas could help internal governmental departments visualize the best locations, with the least conflict among uses, for development. Opening the atlas to the public would decrease implementation challenges because external stakeholders could be aware of the information that policy and decision-makers used, thereby increasing stakeholder understanding of decisions.

The NSDFA is hesitant about opening a potential CWA for the province to the public because of liability or political issues, but such issues may arise because of a lack of transparency and openness. If data is used incorrectly in a CWA, inaccurate conclusions may be drawn leading to possible liability or political implications. In this study, the developers were asked about whether they were aware of any legal or liability concerns that have arisen from the use of their respective atlases. None of the developers were aware of such an issues arising since the atlases were launched. Anticipating that liability might be an issue, one atlas prepared for such occurrence. The developer stated: "we have disclaimers built in that would absolve us of any liability, so that was considered… I would say there has been no issues, and that those disclaimers adequately protect us from any misuse of the information" (Developer # 4).

Direct stakeholder involvement at the developer stages of the atlases appears to have been limited. One developer presented seemingly conflicting views about the roles stakeholders could take in developing a coastal atlas. When asked whether stakeholder input was considered while the atlas was being built, the developer stated: "I think that if we had opened this up for everyone's input and said what do you want to see it do, how do you want to see it work, we would have lost the ability to maintain a real tight control over how we thought it would work best" (Developer # 2). This statement suggests that minimal, if any stakeholder

input was considered. Later in the interview the same developer stressed that is it important to "know your audience, know what their technical needs are," which indicates that understanding users' needs can inform the development of a coastal atlas. In the case of this atlas, though, little stakeholder input was included during development phase. The questions remains: how can users' needs be evaluated without stakeholder input? In a manner similar to the limited initial stakeholder involvement, the three developers stated that they conducted minimal analysis of the use of the atlases via web analytics. Such analysis would allow the developers to determine, how many people used each tool, what data layers are viewed, what information is downloaded etc. Web analytics would be helpful in understanding users' ongoing data needs. Interestingly, the developers stated that a key component for ensuring a CWA stays relevant is understanding users' ongoing needs, yet few mechanisms seem to have been implemented to evaluate how users are using the different CWAs.

As stated at the beginning of the discussion, all of the atlas users in this research use a wide variety of information presented on their respective tools, which suggests that users found the information contained in CWA they used to be salient, credible, and legitimate. The literature on evidence-based policy making notes that barriers to the use of information in policy and decision-making include: a lack of time to sort through a large volume of data, the possibility that the data is not current, unavailability of the data, the inability of users to interpret the data, and the inappropriateness of the information (Jacobson et al., 2013; Steiner-Davis et al., 2014). One of the criteria in this study for determining if information is useful was whether it enables policy makers to achieve desired outcomes. Users were asked if use of a coastal atlas enhanced their ability to make decisions and almost all the users stated that their respective atlases allowed them to not only achieve their desired outcomes but actually enhanced their ability to make decisions. Their views on this point indicate that the information in the four CWAs aided the users in their work. Fifty percent stated that using a coastal atlas increased their confidence in decision-making because they had access to a large volume of easily accessible and digestible information in a centralized location. A third of users

believed that the open access nature of the data increased transparency in decision making and over half stated that the CWA enhanced their ability to make decisions more efficiently because it saved them time. Relating the users' responses to policy-making barriers, shows that CWAs help to overcome barriers many decision-makers face while trying to make evidence-based decisions. Users were also asked if they believed that the information on the atlas they used was both credible and current. Ninety-four percent of users believed that the information on their tool was current and 88 percent thought the information was credible, furthering the view that CWAs contain a wide variety as well as useful information.

One of the developers discussed the idea of incremental promotion of the atlases. During early development, when their atlas had only a few data layers, no effort was made to promote its use. The developer stressed that backlash would have occurred about why certain information was not available. However, as the number of layers increased, promotional efforts were also increased. Public criticism about the kinds or volume of data in the atlases was not directly addressed in the interviews; however, it is important to note that clearly defining the goals and purpose of a CWA could help to manage the expectations of the public. A large degree of uncertainty surrounding marine environments still exists; therefore, it should not be assumed that a digital coastal atlas will be able to answer every question.

The division of the Maryland Coastal Atlas into three separate tools was one of the primary reasons that atlas was chosen for this research. Interestingly, in interviewing users and a developer from this atlas it was learned that the atlas will no longer be separated into three different sections. The next enhancement of this atlas will merge all the data into a single tool. The developer stated that originally the atlas was divided because it matched the users' needs and it was believed that the data would be easier to manage and easier for users to be able to find the data they sought in relation to the specific decisions they needed to make. However, as time progressed, users began to notice data redundancies between the tools and they wanted to layer data available in one tool with data from another. Therefore, if

a Nova Scotia coastal atlas is developed, the experience of the Maryland Coastal Atlas shows that separate sections is not advised.

5. Conclusion

In Nova Scotia, no single data management tool currently brings together all government data scattered through numerous departments and agencies. As a result, a serious management problem exists; decision makers within the government and the wider stakeholder community cannot effectively, and maybe more importantly efficiently, make decisions. The results from this study confirm that Nova Scotia would definitely benefit by proceeding with the conceptualization of the digital coastal atlas. A coastal atlas would meet the objective for data and information management and as all of the individuals interviewed for this research emphasized a coastal atlas is a useful tool for efficient decision-making. A Nova Scotia digital coastal atlas could prompt steps to address the current data management problem within the province. In addition, the benefits of a coastal atlas for the province, derived from this research, include the centralization of data, data transparency, increased stakeholder communication, more efficient decision-making, and education of stakeholders by increasing their understanding of activities that occur in coastal zones. Although there are many benefits to launching a coastal web atlas, potential issues that should be considered include: the cost of implementing and maintaining a digital coastal atlas (these tools are expensive to create), stakeholder involvement in the conceptualization and implementation process (particularly containing expectations of stakeholders), and the length of time required to create such a large digital tool (it would not be unusual to take months to years to launch an atlas).

The evidence assembled in this study is clear that a digital coastal atlas could help to resolve the data management challenge found in Nova Scotia. Nova Scotia can call on the experience of over 40 CWAs globally, not just the four studied in this research (Rideout, 2014). Nonetheless, the four atlases provide ample

evidence for Nova Scotia to proceed with development of as digital coastal atlas. In 2009, the province initiated an extensive process to introduce a strategy for managing its extensive coastal areas (Government of Nova Scotia, 2013). Development and launch of a publically accessible coastal web atlas would provide a substantial decision support tool to complement that earlier work and aid numerous stakeholders in developing plans for the management of coastal areas.

6. Recommendations, Limitations, and Future Research

6.1 Recommendations

The Nova Scotia Department of Fisheries and Aquaculture is in the early stages of conceptualizing and discussing the benefits of building a coastal web atlas for the province. The results of this research show that a coastal atlas would be especially beneficial for numerous reasons as noted above (e.g. the assembly of widely distributed data sets, efficient decision-making around marine planning, transparency of the data and decision making, and public education). As this study shows, these benefits result from public access to coastal web atlases. The development and implementation of a digital coastal atlas is a large project. The following recommendations should be taken into consideration as Nova Scotia proceeds:

• When starting to conceptualize a major project like a coastal web atlas the NSDFA should articulate concrete goals and priorities, namely, why the tool will be created, what will be gained from implementing a digital coastal atlas, what is the timeframe for completion and initial launch of the atlas, how will priorities be set with regard to the information that will be included in the tool, etc.

• As stressed by the developers interviewed in this study, a clear understanding of the audience or users is crucial. The users of a coastal web atlas will ultimately

determine if it is relevant. Therefore, it is important to determine their needs prior to implementing the tool. One way to determine users' needs is to solicit their input about the features or data they would like to see in the tool.

• Coastal web atlas development should be incremental and iterative and following each stage of development intensive testing should be completed by the anticipated users. Testing helps developers to understand what refinements (technical and data related) should be completed to ensure that the atlas remains user friendly.

• Developers and users repeatedly emphasized the necessity of high quality metadata. When data is loaded into a digital coastal atlas, it is recommended that corresponding high quality metadata be included at the same time. High quality or full metadata will allow users of the atlas to determine the source of the data and ultimately be confident in its credibility.

• Funding is an important aspect of any management project, especially one that is as long term as a digital coastal atlas is. Funding is required throughout the development and implementation of a coastal web atlas and it is important to stress that maintenance of a coastal web atlas also requires financial resources. A couple of the coastal atlases developers interviewed in this research implied that at the moment they are unable to update and maintain their respective tools to the standards they prefer because of limited funding. Therefore, it is recommended that the NSDFA complete a comprehensive cost analysis, which includes long-term funding for maintenance and updates not just development and implementation of a coastal atlas.

• Lastly, it is recommended that the NSDFA choose a highly qualified atlas administrator/data custodian, as the person responsible for ensuring that the tool continues to be updated/user-friendly. This individual can be tasked with addressing user concerns and comments, which is important to ensure that the

atlas meets the objectives it was created for and responds to innovations as additional data is included and the underlying technology evolves.

6.2 Limitations

Over 40 different digital coastal atlases have been launched worldwide (Rideout, 2014). In order to understand, on a larger scale, how atlases are used it would have been beneficial to analyze the use of information in decision-making in a larger variety of atlases. However, due to the timeframe of this project, the scope was set at four different atlases in three countries (Canada, United States, and United Kingdom). The intent of this study was not to be comprehensive, but to provide an informative preliminary review of how coastal atlases are used in decision-making and whether they can be used in data management.

How the sample of interviewees was selected could be considered a limitation. The majority of participants were identified by a single contact involved with each atlas. This research was conducted in Halifax, Nova Scotia; therefore, it was difficult to personally seek out potential participants and, as a result, convenience sampling was used. However, it is believed that the contacts are typical representatives of the atlas users. Retrieving web analytics data proved to be difficult. All the atlases in this research are government-based with restricted access to data on users and use. This information is proprietary and only accessible to employees of the respective governments. The information collected through a review of the literature gives an overview of general use, and the interviews provide a more in-depth analysis of exactly how coastal atlas data is used, and the developers outlined the rational for the atlases and offered recommendations. One of the developers was unable to be interviewed during the study period due to a personal issue. This limited the number of developers who were interviewed for the research. One of the users for the Maryland atlas was able to answer some of the developer questions; however, many of those questions remain unanswered for that atlas. An additional limitation relates to the relatively novel nature of this research. There is little literature on the subject of how coastal web atlas

information is used by decision and policy makers. Much of the literature on the subject of coastal atlases concerns technical advancements and features of various atlases worldwide.

6.3 Future Research

This research discussed how atlases in four different jurisdictions, outside of Nova Scotia, were created and used by policy and decision makers. If Nova Scotia proceeds with development of a coastal atlas, the first step is to conceptualize the purpose of the coastal atlas, including the intended audience, and the features it should contain. To decide what type of tool should be implemented, the needs of the users must be determined. Therefore, future research could include detailed interviews with various stakeholders about expected uses of an atlas. Although Nova Scotia's original motivation was, at least initially, to create an internal data management tool for the government, the findings from this research indicate that coastal web atlases can be a useful to the public and local decision makers as well. Thus, if interviews are conducted, the participants should include both individuals inside and outside the government increasing the probability that the interface of the tool will meet all current and possibly future users' needs. One of the main findings of this research was that coastal web atlases are effective in data management because all the information is housed in a single location making it easily accessible by a wide range of users. However, the scope of this research did not extend to understanding the technical requirements of how the data is stored in the four different coastal atlases, for example, the types of files or data formats used in the various tools. Future research, therefore, should include a detailed analysis of the technical requirements of various coastal web atlases in order to evaluate the best format(s) for Nova Scotia's needs. Future research should also explore the difference in information copyright between Canada and the United States and how copyright could impact an atlas's ability to display information and in what format. In the United States there is no crown copyright for federal information creating fewer restriction on how the data can be used and by whom

(Executive Office of the President, 2013). In Canada crown copyright of federal information does exist. However, the recent open data initiatives (since 2011) may have implications for how crown copyright is interpreted. There may be less concern or fewer restrictions on how the data can be used and by whom (Government of Canada, 2014; Government of Canada, 2014b).

7. References

Bazeley, P. (2007). Analyzing qualitative data: More than "identifying themes". *Qualitative research convention.* Draft for the Malaysian Journal of Qualitative Research 2009, 2.

Bottcher, R. W. (2003). Information needs related to extension service and community outreach. *Environment International, 29,* 337-340.

Communications Branch. (2007). A new ecosystem science framework in support of integrated management. *Fisheries and Oceans Canada, Ottawa, 1-13.* Retrieved from http://www.dfo-mpo.gc.ca/science/publications/ecosystem/pdf/ecosystem-eng.pdf

De Fine Licht, J. (2013). Transparency actually: How transparency affects public perceptions of political decision-making. *European Political Science Review, 6*(2), 309-330.

ESRI Canada. (2014). *About us.* Retrieved from: http://www.esri.ca/en/content/about-us

Executive Office of the President. (2013). *Memorandum for the head of executive departments and agencies.* Retrieved from http://www.whitehouse.gov/sites/default/files/omb/memoranda/2013/m-13-13.pdf

Foley, M. M., Halpern, B. S., Micheli, F., Armsby, M. H., Cadwell, M. R… Steneck, R. S. (2010). Guiding ecological principles for marine spatial planning. *Marine Policy, 34*(5), 955-966.

G8. (2013). *Open data charter.* Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/207772/Open_Data_Charter.pdf

Government of Canada. (2014). *Canada's action plan on open government.* Retrieved from http://open.canada.ca/en/canadas-action-plan-open-government

Government of Canada. (2014b). *Open government.* Retrieved from http://open.canada.ca/en

Government of Nova Scotia. (2013). *Coastal management in Nova Scotia.* Retrieved from http//www.novascotia.ca/coast/

Government of Nova Scotia.(2009). The 2009 state of Nova Scotia's coast summary report. *Province of Nova Scotia*, 1-21. Retrieved from http://www.novascotia.ca/coast/documents/state-of-the-coast/WEB_SummaryReport.pdf

Green, J., Willis, K., Hughes, E., Small, R., Welch, N., Gibbs, L., & Daly, J. (2007). Generating best evidence from qualitative research: the role of data analysis. *Australian and New Zealand Journal of Public Health, 31*(6), 545-550.

Jacobson, C., Lisle, A., Carter, R. W., & Hocking, M. T. (2013). Improving technical information use: What can be learnt from a manager's perspective? *Environmental Management, 52,* 221-233.

Katsanevakis, S., Stelzenmüller, V., South, A., Kirk, T., Sørensen, T., Jones, P. J. S… ter Hofstede, R. (2011). Ecosystem-based marine spatial management: Review of concepts, policies, tools, and critical issues. *Ocean & Coastal Management*, *54,* 807-820.

Kay, R., Adler, J. (2005) *Coastal planning and management: Second edition*. New York: Taylor & Francis Group.

Kopke, K., Dwyer, N., Belpaeme, K., Berman, M., Taylor, K., Hart, D., & Wright, D. (2011). Improving participation users in coastal web atlases. *Littoral*, *1-8.* doi: 10.1051/litt/201112001.

Maelfait, H., & Belpaeme, K. (2010). The Belgian coastal atlas: Moving from the classic static atlas to an interactive data-driven atlas. *Journal of Coast Conservation, 14,* 13-19.

Marine Planning Partnership for the North Pacific Coast. (2014a). *Marine planning partnership for the north pacific coast: Home.* Retrieved from http://mappocean.org/

Marine Planning Partnership for the North Pacific Coast. (2014b). *Science and planningtTools/marine planning portal.* Retrieved from http://mappocean.org/science-and-planning-tools/marine-planning-portal/

MaPP Marine Planning Portal. (n.d). Retrieved from http://www.seasketch.org/#projecthomepage/50e58ab28aba4075183f8fc0

Maryland Department of Natural Resource. (n.d). *Chesapeake and Coastal Service.* Retrieved from: http://dnr.maryland.gov/ccs/index.asp

Maryland Department of Natural Resources (n.d.b). *Maryland's coastal atlas.* Retrieved from http://dnr.maryland.gov/ccs/coastalatlas/

Maryland Department of Natural Resources. (n.d.c). *Coastal atlas: Oceans*. *Maryland Department of Natural Resources.* Retrieved from http://dnr.maryland.gov/map_template/coastalmaps/coastal_atlas_ocean.html

Massachusetts Office of Coastal Zone Management. (2014a). *Massachusetts Ocean Resource Information System.* Retrieved from http://www.mass.gov/eea/agencies/czm/program-areas/mapping-and-data-management/moris/

Massachusetts Office of Coastal Zone Management. (2014b). *CZ-Tip - There's a map for that on Massachusetts Ocean Resource Information System*. Retrieved from http://www.mass.gov/eea/agencies/czm/program-areas/communications/cz-tips/cz-tip-moris.html

Massachusetts Office of Coastal Zone Management. (2012c). *MORIS/Oliver user guide.* Retrieved from http://maps.massgis.state.ma.us/map_ol/moris_users_documentation.pdf

McNie, E. (2007). Reconciling the supply of scientific information with user demands: an analysis of the problem and review of the literature. *Environmental Science & Policy*, *10,* 17-38

Miriam, L. E., Davis, S., Tenopir, C., Allard, S., & Frame, M. T. (2014). Facilitating access to biodiversity information: A survey of users' needs and practices. *Environmental Management, 53*, 690-701.

Mitchell, R. B., Clark, W. C., & Cash, D. W. (2006). *Information and influences.* In Mitchell, R. B., Clark, W. C., Cash, D. W. & N. M. Dickson. (Eds.). *Global environmental assessments: Information and influence.* (pp. 307-338). Cambridge, MA: MIT Press.

MORIS: CZM's Online Mapping Tool. (n.d.) Retrieved from http://maps.massgis.state.ma.us/map_ol/moris.php

Munro, R. (2013, October 4). How much science is there? *Science.* Retrieved from http://www.sciencemag.org.ezproxy.library.dal.ca/site/special/scicomm/infographic.jpg

National Marine Plan Interactive. (2013). Retrieved from http://marinescotland.atkinsgeospatial.com/nmpi/

Nova Scotia Department of Fisheries and Aquaculture. (2010). *The public confidence inaAquaculture: A community engagement protocol for the development of aquaculture in Nova Scotia.* Retrieved from www.novascotia.ca/fish/aquaculture/aqua-final-rpt.pdf

Nutley, S. M., Walter I., & Davies, H. T. O. (2007). *Using evidence*: *How research can inform public services*. Chicago, IL: The Policy Press.

O'Dea, E. K., Dwyer, E., Cummins, V., & Wright, D. J. (2011). Potentials and limitation of coastal web atlases. *Journal of Coastal Conservation, 15,* 607-627.

O'Dea, E., Haddad, T. C., Dunne, D., & Walsh, K. (2011b). *Coastal Informatics: Web atlas design and implementation* (pp. 12-32). Hershey, PA: IGI global.

Penn State University. (2014). *What is data management.* Retrieved from http://www.libraries.psu.edu/psul/pubcur/what_is_dm.html#what-is-data-management.

Pomeroy, R., & Douvere, F. (2008). The engagement of stakeholders on the marine spatial planning process. *Marine Policy, 32,* 816-822.

Rideout, E. (2014, May). EIUI coastal atlas project description. Unpublished report.

Rosenberg, A. A., & Sandifer, P. A. (2009). *Ecosystem-based management for the oceans* (pp. 13-30). Washington, DC: Island Press.

Ryan, G. W., & Bernard, H. R. (2003). Techniques to identify themes. *Field Methods, 15*(1), 85-109.

Sanderson, I. (2002). Evaluation, policy learning and evidence-based policy making. *Public Administration, 80*(1), 1-22.

Sarker, P. K., Bureau, D. P., Hua, K., Drew, M. D., Forster, I., Were, K., ... & Vandenberg, G. W. (2013). Sustainability issues related to feeding salmonids: A Canadian perspective. *Reviews in Aquaculture*. doi: 10.1111/raq.12013

Steiner-Davis, M. L. E., Tenopir, C., Allard, S., & Frame, M. T. (2014). Facilitating access to biodiversity information: A survey of users' needs and practices. *Environmental Management, 53*, 690-701.

The Scottish Government. (2014a). *National planning*. Retrieved from http://www.scotland.gov.uk/Topics/marine/seamanagement/national

The Scottish Government. (2014b). *Interactive marine planning*. Retrieved from http://www.scotland.gov.uk/Topics/marine/seamanagement/nmpihome

Treasury Board of Canada Secretariat. (2009). *Policy framework for information and technology* (Appendix A: Definitions). Retrieved from http://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=12452&section=text

Tyler, T. R. (2006). The psychology of legitimacy: A relational perspective on legitimacy and legitimation. *Annual Review of Psychology, 57,* 375-400.

Wright, D. J., Cummins, V., & Dwyer, E. (2011). *Coastal Informatics: Web atlas design and implementation* (pp. 1-11). Hershey, PA: IGI global

8. Appendix

8.1: E-mail recruitment message

Dear [Mr / Ms] _____,

I am writing to you to invite you to participate in a research project that is being conducted at Dalhousie University, Halifax, NS. My name is Shelby McLean. I am a Master of Marine Management student at Dalhousie University.

One of the requirements for the successful completion of my Masters degree is a graduate research paper. My research is a study of the use of data and information provided by coastal atlases in coastal policy and decision-making. Results from this research may aid the Nova Scotia government, our partnering organization, in evaluating whether or not it should proceed with implementing a province wide coastal atlas.

This research uses multiple methods, which include: detailed interviews, web analytics, and a literature review. Interviews will be conducted with individuals who have experience in developing or using coastal atlases or other mapping tools, or with individuals who may use mapping tools in the future.

The project is being co-supervised by Dr. Bertrum MacDonald (bertrum.macdonald@dal.ca / 902.494.2472) at the School of Information Management in the Faculty of Management at Dalhousie University. This project is a joint initiative by the interdisciplinary Environmental Information: Use and Influence research program, which Dr. MacDonald leads, and the Nova Scotia Department of Fisheries and Aquaculture.

You are invited to complete an approximate 45 minute long interview regarding your views on benefits and uses of coastal atlases.

Please let me know if you are willing to be interviewed. I will set up an interview time, which can be conducted by telephone or in person, and I will provide you with a consent form.

If you have any questions about the research project please feel free to contact me via email (shelbypmclean@dal.ca).

Thank you for considering this request,
Shelby McLean

8.2 Interview Questions

PART A: Questions for Atlas Producers/Developers

Thank you [name…] for participating in this research. Today I will be asking you questions about the rationale for developing this atlas [atlas name…], how the atlas's data is maintained, the audience/users of this atlas, how the atlas's use is assessed and the lessons learned throughout the development of this atlas. So to start, I'll ask you some questions about the rationale (ideas and development) for creating this digital atlas…

1.Rationale: Ideas & Development

1.1 What was the intended goal (or rationale) of this atlas [name of atlas…]?
Possible follow-up:
- To what extent has the goal been achieved?

1.2 What types of questions/decisions were you anticipating the atlas to answer?
Possible follow-up:
- Were these questions answered, if not what types of questions does this tool aid/address?

1.3 Who identified the need for an atlas?

1.4 Who is funding the atlas?

1.5 Was stakeholder input included in the development of the atlas?
Possible follow-up(s):
- If yes, what stakeholders were involved in this process (*prompt:* governmental, non-governmental, industry, etc.)
- How was this input collected?

1.6 Did developers use a template or guide for the creation of this atlas?
Possible follow-up(s):
- Please explain.
- What criteria did you use as a template for the creation of this atlas?

1.7 Was the atlas launched incrementally (in stages) or all at once?

1.8 Is your atlas tool segmented into different atlases containing different information?
Possible follow-up(s):
- If yes, what are the benefits of creating multiple atlases/map applications/tools/products with different information?
- What are the challenges? Does each individual section of the atlas tool target different users?

1.9 What data is included in the atlas?
Possible follow-up(s):
- What are your criteria for deciding what coastal data is included in the atlas?
- Where does the data come from? Data sources?

1.10 How were the data layers chosen?

Possible follow-up(s):

- Was there a rank for priorities?
- What was this ranking based on? (*Prompt:* funding, user demands, etc.)

2.Data maintenance

2.1 How is the atlas's information updated?

Possible follow-up(s):

- Who is responsible to for ensuring each data set is kept up to date and accurate (quality control)?
- Is there a set update schedule or is it updated as the information comes in? (*Prompt:* incrementally or all at once)

2.2 Who is the administrator of the Atlas?

- Can you explain the level of government they work in?

2.3 If governmental information is entered into the atlas, is there any type of data sharing agreements between governmental departments (cross-jurisdictional)?

Possible follow-up:

- What form is this data sharing agreement in? (*Prompt:* Memorandum of Agreement, agreement letter, annual data sharing agreement)

2.4 As a developer what are your next steps to enhance this atlas?

Possible follow-up(s):

- Is use driving development? (*Prompt:* bottom-up or top-down or both)?
- Is funding driving development?

2.5 Is there a mechanism that allows users to input feedback about the atlas?

Possible follow-up:

- If yes, are these comments taken into account when updating the atlas?
- If yes, could you please explain how there comment are taken into account?

2.6 Are there requests for certain information to be added?

Possible follow-up(s):

- What information are users requesting to be added?
- Are requests being tracked?

3. Defining audience/ promotion

3.1 Who were the expected users of this atlas?

Possible follow-up(s):

- If there was an expected user, how did you decide what the target audience was?
- What educational (or technical) background do most users of this coastal atlas have?

3.2 How was the atlas promoted? (*Prompt:* workshops, training session etc.)

Possible follow-up(s):

- Was any training provided for the intended users of the atlas?
- If yes, what kind of training support is provided? (*Prompt:* tutorials)

3.3 Who is using the atlas and what are they using it for?

Possible follow-up:

- Are there any unexpected or secondary users of the atlas?

3.4 Do you control who has access to the data?

- Please Explain

3.5 Are there any data layers that are not available to the public?

Possible follow-up:

- If yes, what layers and why?

4. Assessment / lessons learned

4.1 Do users face any challenges when using the atlas?

4.2 Are there any types of legal or liability issues arising from the use of this atlas?

4.3 Are there any political challenges associated with the information generated in the coastal atlas? I.e. Does the data reveal anything unexpected that politicians may not want to address? [Remind interviewee that responses will be anonymized].

4.4 Does your atlas use analytics tools to evaluate who is accessing the atlas and what information they are looking at?

Possible follow-up(s):

- If yes, is this information accessible?
- If yes, are there any peaks in use? (*Prompt*: before a major storm)
- What layers are used the most?
- Can you hypothesize why these layers are used more often?

4.5 Can you describe an instance when the atlas informed new policy or regulation development?

4.6 Does the atlas help you to manage a diverse range of data sets?

Possible follow-up:

- Please explain.

4.7 What has been the greatest benefit (if any) of implementing this atlas?

Possible follow-up:

- Can you discuss a couple of lessons learned throughout the creation process of this atlas? *(Prompt:* what advice would you give future atlas developers)?

Thank you [name…] very much for participating in this research and taking the time to talk to me about this coastal atlas.

PART B: Questions for Atlas Users

Thank you [name…] for participating in this research. Today I will be asking you some question on your background, general coastal atlas use, coastal atlas use in connect with decision-making, challenges you may have encountered using this tool, and whether or not you would recommend it to other people. So to start, I'm going to ask you a couple of questions about your background and occupation…

1.Background on User:

1.1 What is your current occupation?

Possible follow-up(s):

- What are your major responsibilities in your occupation (related to coastal/ocean planning)?
- What decisions are you required to make in your occupation

1.2 Do you use, or have you ever used, GIS mapping based tools?

Possible follow-up(s):

- If yes, what types of tools have you used?
- If yes, what have you used them for?
- How often (times per month) do you use digital tools – e.g. GIS maps?

1.3 When did you become aware of the existence of this coastal atlas [name of atlas…]?

Possible follow-up(s):

- How were you made aware of this coastal atlas?

1.4 Did you provide any input to the development of the atlas?

Possible follow-up:

- Please explain

2.General Use:

2.1 Have you ever used this coastal atlas?

Possible follow-up:

- If yes, what layers of data have you used?

2.2 Apart from the atlas, where would you access the types of information you need to answer questions regarding the decisions you make in your position?

2.3 What features (or layers) in the atlas are the most useful to you?

Possible follow-up:

- Please explain.

2.4 Do you know of other people inside or outside your organization who have used this atlas?

Possible follow-up:

- If yes, do you know what they are using it for?

2.5 [*If there is a mobile app, determined in advance of the interview, ask the following question]* Has the mobile app tool been useful to you?

Possible follow-up(s):

- If no, would this type of tool be useful to you?

3.Decision-making Use:

3.1 What types of questions or decisions do you try to answer/make when using this coastal atlas?

Possible follow-up(s):

- Did the atlas help you to answer those questions?
- How did it help you? What types of information were accessible using this type of tool in comparison to other tools (*Prompt:* primary literature)

3.2 Has this coastal atlas increased your ability to find a diverse range of information?

Possible follow-up:

- If yes, in what ways?

3.3 Has your ability to answer questions changed after the implementation of this atlas?

Possible follow-up:

- If yes, what types of questions are you able to answer now versus before the creation of this atlas?

3.4 Overall, does this atlas enhance your ability to make decisions?

Possible follow-up(s):

- If yes, how? (*Prompt:* save money, save time, etc.)
- If yes, does it increase your confidence in your ability to make decisions?

3.5 Has the creation of this atlas led to new policies being developed?

Possible follow-up(s):

- If yes, please explain.
- Have you used the information contained in the atlas to inform political or policy change?
- If yes, please explain.
- If no, do you know of anyone who has used the information to inform political or policy change?

4.Feedback/challenges:

4.1 Did you experience challenges while trying to use this tool?

Possible follow-up(s):

- If yes, was there any technical support or a feedback mechanism to aid you with the use of this atlas?
- If no, would a feedback or a technical support section be beneficial?
- Was the data easily useable for decisions you needed to make?

4.2 On a scale from 1-5 where would you place this atlas in terms of technical requirements to use it? (1 being easy to use, 5 being challenging to use)?

Possible follow-up:

- Please explain.

4.3 In your opinion, is the information contained in the atlas up to date (current)?

Possible follow-up:

- If no, explain.

4.4 Have you noticed any information absent from the atlas or have you noticed that a certain type of information is more prevalent than others?

4.5 In your opinion does the source of the information affect its credibility?

Possible follow-up:

- Please explain.

5. Recommendations:

5.1 Would you recommend this atlas to other people?

Possible follow-up:

- Please explain.

5.2 Overall, what is the greatest benefit (if any) of a digital coastal atlas?

Thank you [name…] very much for participating in this research and taking the time to talk to me today about this coastal atlas.

8.3 Ethics Approval Form

FACULTY OF MANAGEMENT
DALHOUSIE UNIVERSITY

Graduate Student Ethics Approval for a Course-based Project

August 26, 2014

Shelby McLean,
I am pleased to inform you that I have reviewed your project "**A study of the use of data and information provided by coastal atlases in coastal policy and decision-making**" for the course MARA5002: Marine Affairs Graduate Project, under the supervision of Bertrum MacDonald, and have found the proposed research involving human participants to be in accordance with the *Faculty of Management Ethics Review Policy and Procedures for Course-based Projects* and the *Tri-Council Policy Statement on Ethical Conduct for Research Involving Humans (TCPS2).* This project has received ethics approval.
This approval will be in effect until and not exceeding December 16, 2014 (fourteen days from the final date of classes for the 2014 Dalhousie Fall Semester). It is your responsibility to immediately report any adverse events involving participants. Please note that any significant changes to the research methodology, consent form or recruitment materials must be resubmitted to the Ethics Review Assistant for review and approval prior to their use.
Congratulations on your successful Faculty of Management Graduate Student Ethics Approval for your Course-based, Non-thesis Project. I wish you all the best as you begin this next phase of your research. Should you have any questions regarding ethical issues at any point during your project, please do not hesitate to contact me.

Sincerely,
Ashley Doyle

Ethics Review Assistant,
Faculty of Management
Dalhousie University
PO Box 15000 Halifax,
NS B3H 4R2
a.doyle@dal.ca