Towards a Marine Spatial Plan for the Westfjords of Iceland

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Declaration

I hereby confirm that I am the sole author of this thesis and it is a product of my own academic research.

_______________________________
Student‘s name
Abstract

Marine Spatial Planning (MSP) is widely recognized as being a key step to achieving ecosystem-based ocean and coastal management. It is a process that borrows tools from terrestrial planning, but that must also be adapted to address the unique challenges and qualities of the marine environment. It involves gathering spatial information in order to better visualize and understand the marine environment and to better inform management decisions that plan for the future. Recent interest sparked MSP initiatives around the world, most notably in Europe. Iceland, a country that has always depended on the sea for survival and which today still relies heavily on living marine resources, lacks an integrated management framework. To investigate which methods of MSP would be best suited for the Westfjords, this paper reviewed the current literature, compared MSP around the world in case studies, and trialled some of these methods in a small pilot area in Isafjarðardjúp (a large fjords system in the Westfjords). The results suggest that current conflicts on the water usually involve the fishing and aquaculture sector and that increased conflict in the future is expected as new technologies emerge (such as the wet renewables sector). It was established during the project that job creation, sustainable development and increasing the population are key values and objectives in the region. Information was gathered from interviews with local experts and GIS was then used to create maps to capture their knowledge on spatial use. Methods were then recommended to continue the MSP process in the Westfjords. In conclusion, MSP provides potential benefits and opportunities for reduced conflict and sustainable development through a better-informed and more efficient management regime in the Westfjords.
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<th>Full Form</th>
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<td>AMWF</td>
<td>Association of Municipalities of the Westfjords</td>
</tr>
<tr>
<td>BPNS</td>
<td>Belgian Part of the North Sea</td>
</tr>
<tr>
<td>CBD</td>
<td>Convention on Biological Diversity</td>
</tr>
<tr>
<td>CS</td>
<td>Continental Sea</td>
</tr>
<tr>
<td>DEFRA</td>
<td>Department for the Environment, Food and Rural Affairs</td>
</tr>
<tr>
<td>DSS</td>
<td>Decision Support System</td>
</tr>
<tr>
<td>EB</td>
<td>Ecosystem-based</td>
</tr>
<tr>
<td>EBM</td>
<td>Ecosystem-Based Management</td>
</tr>
<tr>
<td>EEZ</td>
<td>Exclusive Economic Zone</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
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<tr>
<td>GBR</td>
<td>Great Barrier Reef</td>
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<tr>
<td>GBRMP</td>
<td>Great Barrier Reef Marine Park</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographical Information System</td>
</tr>
<tr>
<td>ICZM</td>
<td>Integrated Coastal Zone Management</td>
</tr>
<tr>
<td>IOC</td>
<td>Intergovernmental Oceanographic Commission</td>
</tr>
<tr>
<td>ITQ</td>
<td>Individual Transferrable Quota</td>
</tr>
<tr>
<td>MPA</td>
<td>Marine Protected Area</td>
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<tr>
<td>MS Plan</td>
<td>Marine Spatial Plan</td>
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<tr>
<td>MSP</td>
<td>Marine Spatial Planning</td>
</tr>
<tr>
<td>NGOs</td>
<td>Non-Governmental Organizations</td>
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<tr>
<td>OSPAR</td>
<td>Convention for the Protection of the Marine Environment of the North East Atlantic</td>
</tr>
<tr>
<td>RAP</td>
<td>the Representative Areas Program</td>
</tr>
<tr>
<td>SEA</td>
<td>Strategic Environmental Assessment</td>
</tr>
<tr>
<td>SIC</td>
<td>Shetland Island Council</td>
</tr>
<tr>
<td>SMSP</td>
<td>Shetland Marine Spatial Plan</td>
</tr>
<tr>
<td>SPSD II</td>
<td>Scientific Support Plan for Sustainable Development Policy</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>SSMEI</td>
<td>Scottish Sustainable Marine Environment Initiative</td>
</tr>
<tr>
<td>TBT</td>
<td>Tributyltin (chemical used in anti-fouling paint)</td>
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<tr>
<td>TS</td>
<td>Territorial Sea</td>
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<tr>
<td>UK</td>
<td>United Kingdom</td>
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<tr>
<td>UNCED</td>
<td>United Nations Conference on the Environment and Development</td>
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<td>UNESCO</td>
<td>United Nations Education, Scientific and Cultural Organization</td>
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<tr>
<td>WSSD</td>
<td>World Summit on Sustainable Development</td>
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1 Introduction

1.1 The Need for Ecosystem-based, Integrated Coastal and Ocean Management

Oceans and coasts create unique, valuable and sometimes fragile ecosystems. They provide food, minerals, raw materials, renewable energy and immeasurable ecosystem services like climate regulation. They furnish us with spaces for recreation and relaxation, transportation of goods and serve as communication corridors. The oceans, vast bodies of water, once thought to be inexhaustible and untouchable are now showing signs of change due to human impacts like pollution, overfishing and increased levels of carbon in our atmosphere (Cicin-Sain & Knecht, 1998). As populations increase around the world, so does a trend of coastal urbanization. Today, roughly half of the world’s population lives within 200 kilometers of a coastline (Creel, 2003). Within the next two decades our urban centers will grow by another 2.1 billion people, most of them on the coasts, dramatically increasing the human-induced stressors to the coastal ecosystems. Environmental stressors associated with urban growth do not scale linearly with population size, meaning that the per capita contribution to ecosystem stressors increase with population size (Baird, 2009). Because of these stressors, global and regional assessments continue to point to a loss of biodiversity in the oceans and coastal zone due to human impacts (Millenium Ecosystem Assessment, 2005; Worm et al., 2009).

Concern about human impacts on the coasts and oceans has led to a growing interest and scrutiny of how human activities and resources are managed. Traditionally, management of activities on the coasts and oceans has been done through a sector-by-sector approach, but a new school of thought calls for holistic, integrated management
practices called Integrated Coastal Zone Management (ICZM)\(^1\)\(^2\) (Cicin-Sain & Knecht, 1998). There are many definitions for ICZM, but a commonly cited and widely used definition comes from the Commission of European Communities (2000):

ICZM is a dynamic, multidisciplinary and iterative process to promote sustainable management of coastal zones. It covers the full cycle of information collection, planning (in its broadest sense), decision-making, management and monitoring of implementation. ICZM uses the informed participation and cooperation of all stakeholders to assess the societal goals in a given coastal area, and to take actions towards meeting these objectives. ICZM seeks, over the long-term, to balance environmental, economic, social, cultural and recreational objectives, all within the limits set by natural dynamics (pg. 25).

The ICZM concept, though constantly evolving, was first born out of the increasing public outcry over an emerging environmental crisis which led, in part, to the United Nations Conference on the Human Environment held in Stockholm in 1972, and twenty years later, the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro (the Earth Summit). The most important early international directives for ICZM were laid out in Chapter 17 of Agenda 21 from the Earth Summit.

More recently, another important concept has been added to the discussion about how to improve management within the marine environment: Ecosystem-Based Management (EBM). EBM takes the full ecosystem and its complex interactions into consideration, regardless of arbitrary geographical or political boundaries. EBM is defined as:

Comprehensive, integrated management of human activities based on best available scientific knowledge about the ecosystem and its dynamics, to identify and take action on influences that are critical to the health of the marine ecosystem, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity (OSPAR Commission, 2011, para. 2).

\(^1\) Integrated management of the ocean and coastal zone has many names, such as Integrated Coastal and Ocean Management, Integrated Coastal Management, but for the purposes of this paper, it will be called Integrated Coastal Zone Management (ICZM).
Because ecosystems and human uses are place-based, an important step needed to advance ICZM and EBM is to gather spatial information which can be analyzed to better understand the marine environment, in order to make better management decisions – this concept is called Marine Spatial Planning (MSP).

1.2 What is Marine Spatial Planning?

Oceans are a common property resource, and historically, the seas have been managed from a laissez-faire approach. Hugo Grotius’ idea of Mare Liberum, ‘freedom of the seas,’ was intended to apply to freedom of navigation during 17th century maritime conflicts, but became interpreted as the right to access and a freedom to fish and use the marine space with little regulation and oversight (Russ & Zeller, 2003).

Regulation of the ocean and coastal zone is allocated and enforced on a sector-by-sector basis, an example being the EU Common Fisheries Policy or the EU Maritime Transport Policy. Without a framework that facilitates integrated, comprehensive planning, conflicts between users and between users and the environment arise due to overlapping human uses and due to a lack of coordination between authorities that make management decisions (Douvere, 2008). There is also a risk of decreasing biodiversity, hindering ecosystem services and losing an important food source.

Spatial planning has long been an essential tool for managing natural resources on land. In comparison, spatial planning has only recently been applied to the ocean. The United Nations Economic Commission for Europe (UNECE, 2008) states that spatial planning:

…addresses the tensions and contradictions among sectoral policies… conflicts between economic development, environmental and social cohesion policies. The key role of spatial planning is to promote a more rational arrangement of activities and to reconcile competing policy goals (pg. 1).

MSP is a crucial step for achieving EBM in marine spaces (Crowder & Norse, 2008; Douvere, 2008; Foley et al., 2010). Planning in the ocean was first utilized to help create and manage Marine Protected Areas (MPAs) and the earliest example of MSP is in
the Great Barrier Reef Marine Park (Ehler & Douvere, 2009). Since that time MSP, as a process, has been evolving and today it is applied in a broader sense, to help manage the increasing multiple uses within the marine environment (Douvere, 2008). The United Nations Education, Scientific and Cultural Organization’s (UNESCO) Intergovernmental Oceanographic Commission (IOC) defines MSP as:

…a public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that usually have been specified through a political process.

Characteristics of Marine Spatial Planning include ecosystem-based, area-based, integrated, adaptive, strategic and participatory (UNESCO a, 2009, Para. 2).

MSP is a management tool, something that should be in use, constantly evolving and changing to reflect current social and environmental conditions (Day, 2008). It is a process, not a means to an end, and therefore must be iterative and adaptive. As new information is acquired or changes occur in the environment, MSP must incorporate that information, meaning that it must periodically be updated and reviewed (Day, 2008).

MSP should not replace single-sector planning. It should work in tandem with pre-existing management regimes, aiding in a more holistic process that will reduce conflicts among sectors and consider the larger picture – the ecosystem and cumulative affects (Douvere, 2008). With new technologies, visions of the ocean are expanding and there are new ways to map and understand ocean spaces that were previously impossible. As increasing human populations and expanding uses in the oceans threaten our ability to sustainably manage and protect the marine environment, MSP is the framework, a public process to allocate space, necessary to direct and shape management decisions (Douvere & Ehler b, 2009).

1.3 The Need for Marine Spatial Planning in Iceland

Around the world the need for MSP is increasing with the increasing population and the growth of sectors such as wet renewable energies, aquaculture and with the establishment of Marine Protected Areas (MPAs). While Iceland is not yet developed when it comes to alternative energies in the ocean, such as offshore wind farms, they are growing quickly in
the areas of tourism (World Travel and Tourism Council, 2011) and aquaculture (Icelandic Ministry of Fisheries and Agriculture, N/A, a). These new developments, combined with their reliance on fish as an export and Iceland’s general lack of integrated management in the coastal zone (Cauhépé, 2006), creates a good argument for the need for MSP in Iceland.

1.4 Outputs of Marine Spatial Planning

Marine Spatial Planning is a tool that helps decision makers make consistent, well-informed decisions that consider the future. It may lead to a new or improved permitting system, regulations or initiate other management measures (Ehler & Douvere, 2009) such as fisheries stock management, targeting gaps in knowledge about the marine environment or oil-spill pollution contingency planning to protect assets. Similar to terrestrial planning, the principal output of MSP is a comprehensive Marine Spatial Plan (hereafter referred to as MS Plan). The MS Plan is a written document that should be consistent with existing policies. It should take environmental, social, and economic values into account and requires statutory standing to reach its full potential. The MS Plan should consider the future and have lasting relevancy, but it must periodically be updated and drafted anew.

1.5 Thesis Objectives and Outcomes

The objective of this thesis was to answer the research question: What tools and methods can be used to begin the Marine Spatial Planning process in the Westfjords region of Iceland? The methods used were determined by the culmination of research: the specific needs for ICZM in the Iceland and the regional context were investigated, local conflicts were identified within a pilot area, and expert opinion, both local and international, was sought to determine and test best practice. Thesis outcomes include:

- a review of literature about Marine Spatial Planning;
- a comparative analysis of MSP efforts from around the world,
• a pilot study towards MSP in Isafjarðardjúp in the Westfjords of Iceland, which includes maps made with Geographical Information System (GIS) software; and
• specific recommendations for progressing MSP in the Westfjords of Iceland.

Due to the scope of this project, the pilot study will not result in an actual MS Plan, but rather a step towards a MS plan with recommendations and mapped elements of marine human and non-human use in Isafjarðardjúp. The most important outcome is the lessons learned from the methods applied and recommendations for future MSP efforts in the pilot study area and the Westfjords.

1.6 Thesis Organization

This thesis consists of two main parts: a theory-based study to determine the best method of MSP for the Westfjords and the applied pilot study in Isafjarðardjúp.

i. Theoretical – Understanding MSP Methods and Practice

In addition to a review of the literature, a comparative analysis of MSP practices and methods from four case studies will provide a real-world context for the project. The four case studies include planning in the in the Norwegian Sea, the Great Barrier Reef in Australia, the Belgian Part of the North Sea, and the Shetland Islands of the United Kingdom. A brief review of policy and geo technologies will also help increase understanding of how MSP developed and is practiced today.

ii. Applied - Pilot Project in Ísafjarðardjúp

The applied part of this project trialed MSP methods in a pilot area of the Westfjords of Iceland. Initial research was conducted to review existing policies relevant to the pilot location and to understand the marine ecosystem of the area. Maps were created using local knowledge and transferred into GIS to show important features of the area. Recommendations were suggested to advance this work with the intention that one day MSP would be taken more seriously and be given financial support.
2 Theoretical Overview

2.1 Literature Review

2.1.1 Introduction
Recent assessments around the world show that our oceans are threatened, that marine ecosystems services are compromised and that current, single-sector management in the marine environment is failing (Millenium Ecosystem Assessment, 2005; Crowder & Norse, 2008). It is widely recognized that we need more integrated, place-based management that takes the entire ecosystem into account, including humans (Cicin-Sain & Knecht, 1998, Crowder & Norse, 2008). Management of ocean spaces is particularly difficult due to a number of reasons (taken and adapted from Day, 2008, pg. 825):

- High degree of interconnectedness (e.g. due to the physical properties of water, activities and parts, such as pollution or plankton, are not confined to one location and move from place to place under the influences of tides and currents);
- The three dimensional aspect of oceans and water bodies (i.e. the seabed, the water column and the surface);
- The temporal dimension (e.g. breeding seasons or seasonal algal blooms);
- Logistical difficulties and expence of sampling in the marine environment;
- A general lack of knowledge and information about marine ecosystems; and
- Ownership issues (e.g. since ocean spaces often fall under state or federal jurisdictions, it is often unclear who has the rights to submerged lands for oil exploration, shellfish farming, fish trawling, windfarms, etc. and how leasing and permitting should work).

Marine Spatial Planning (MSP) is a key step in achieving integrated, ecosystem-based management (Douvere et. al., 2007; Douvere, 2008; Ehler, 2008; Plasman, 2008; Gilliland & Laffoley, 2008; Gopnik, 2008; Douvere & Ehler, 2009; Foley et al., 2010).
Crowder and Norse (2008) state that:

Refining and integrating our concept of place in the sea is critical to implementing ecosystem-based management, and mapping biophysical conditions as well as human uses is a critical first step in that process (pg. 772).

MSP is a process that should inform spatial distribution of activities in the ocean by thought-out management practices in order to sustain existing and emerging uses: it should help reduce conflicts and uphold and sustain ecosystem health and services (Foley et al., 2010).

2.1.2 What Marine Spatial Planning Should Achieve

A summary of subheadings listed below provides a framework for this section, which gives an overview of what Marine Spatial Planning should achieve:

i. Facilitate reduced spatial and temporal conflicts;
ii. Provide a connection and communication between competent authorities and environmental management;
iii. Provide a connection between people and the resources they use;
iv. Provide investment certainty for developers; and
v. Facilitate conservation of sensitive areas and ecosystem services

i. Facilitate reduced spatial and temporal conflicts

Considering alternatives and compensation

The MSP process should be used to allocate space in a rational manner (Douvere & Ehler, 2009; Gopnik, 2009). It should involve collecting and mapping spatial information, which can then be analyzed to inform management decisions that reduce spatial and temporal conflicts. A key to reducing conflicts through MSP is the consideration of alternatives (Gilliland & Laffoley, 2008). This will involve determining values and objectives and making difficult decisions with trade-offs and consequences (Douvere, Maes, Vanhulle & Shrijvers, 2007). In the Belgian MSP initiative, a zone was designated for the development of offshore wind power. This designation meant that a number of fishermen would lose
rights to fish in that region. As an alternative, fishermen were given the option to begin mussel farming in that zone (Douvere et. al., 2007).

**Policy to clarify regulations**

Statutory MS Plans that guide policy and have clear system for management and spatial allocation are important because they provide an even playing field with clear objectives and regulations that everyone must follow (Gilliland & Loffley, 2008). Once enforceable principles are identified and outlined in a statutory MS Plan, decision makers will have guidance in making difficult decisions and support for defending those decisions (Ehler, & Douvere, 2009). Again, looking at the example from Belgium, there was a statutory requirement for Belgium to produce six percent of its total energy consumption from renewable sources, this defined objective made it defensible for decision-makers to establish a zone for offshore wind development that had previously been fishing grounds (Douvere et. al., 2007).

**Stakeholder involvement**

Involving stakeholders from the outset ensures that the values and objectives of the community are understood and recognized. There may be less conflict and outcry if stakeholders feel that they are being heard, even if decisions do not go their way (Ehler & Douvere, 2009). Stakeholder involvement from the outset will also give stakeholders and users a sense of ownership, harbor trust, and encourage them to comply with policy regulations on a voluntary basis (Pomeroy & Douvere, 2008). Another advantage of stakeholder involvement is that new alternatives and solutions can be discovered through collective brainstorming that otherwise may not have been considered (Ehler & Douvere, 2009). Furthermore, involving stakeholders can help individuals gain a better understanding of the larger management problems, human influences on the management area and of policies (Ehler & Douvere, 2009).

Part of involving stakeholders will be education and disseminating information. Pomeroy and Douvere (2008) call this concept “social preparation,” which should increase awareness, knowledge, skills and institutional capacity through environmental education and social communication. Increasing understanding of important issues and policy will help avoid conflicts altogether (Pomeroy & Douvere, 2008).
Zoning and analyzing space

Zoning is one of the common outcomes from a Marine Spatial Plan. Zoning is a tool borrowed from land-use planning and it divides space and designates specific uses or regulations to that space (Gopnik, 2008). It can reduce conflicts by separating activities, only making activities allowable at certain times or keep sensitive, ecologically valuable areas free from use (Day, 2002). In Australia’s Great Barrier Reef Marine Park, a “multi-use” zoning approach allows high levels of protection or restriction in certain areas and allows reasonable uses in others (Day, 2002). Additionally, spatial analysis can help identify compatible uses and spaces to create synergies between users.

Forward-thinking

An inherent part of MSP is considering the future. By considering and preparing for changes (measuring pressures, cumulative impacts, social and environmental change) MSP should be a tool to help users avoid future conflicts or at least make decisions that consider other sectors, the environment and potential consequences (Gilliland & Laffoley, 2008).

ii. Provide a connection and communication between competent authorities and environmental management

Integrated management

The major problem with environmental management today is that it is done by individual sectors, lacking an holistic overview and understanding of ecosystem interactions (Cicin-Sain & Knecht, 1998; Foley et al., 2010). MSP should not replace existing management and planning within sectors: it should guide sectoral management by nesting it within a more comprehensive Ecosystem-Based Management (EBM) scheme that involves planning (Ehler, 2008; Ehler & Douvenere, 2009). MSP should help integrate management by involving authorities at various levels of government and who manage different sectors, as well as scientists who understand and study the marine environment (Plasman, 2008).

Nested scales

There is no set rule about who should be involved or how the MSP initiative is developed (Douvere & Ehler b, 2009). Determining the scale or region that is to be managed will
influence which competent authorities are involved. For example, a large-scale initiative in Norway, to develop a Management Plan for the North Sea involved a ministerial-level working group and was created and led by the Ministry of the Environment. The working group included eight other government ministries as well as other government agencies and research institutes (Ottersen, Olsen, van der Meer, Dommasnes, & Loeng, 2011). A smaller initiative in the Shetland Islands involved local Chief Executive- or Regional Manager-level members on the Steering Group (some of whom were scientists, planners, policy makers or advocates for social justice).

Not only should competent authorities work together horizontally, there should be nested, vertical integration as well. Douvere & Ehler (2008) state:

The interconnectedness of adjacent ocean spaces, the cross-boundary impact of ocean uses, and the broader scale needed to be ecologically meaningful require that marine spatial plans developed at the national level are embedded in a broader, international context and integrate, or at least address, the dynamics of the system as a whole (pg. 87).

This means that cooperation between competent authorities from neighboring countries is necessary. This is not only in keeping with EBM principles, it is also required by international and regional frameworks such as the EU Marine Strategy Directive, the OSPAR Convention (the North Atlantic) and the Barcelona Convention (Mediterranean).

Although historically there has been a lack of international perspective in MSP efforts (Douvere & Ehler a, 2009), there are a few recent initiatives that involve international cooperation, such as the tri-lateral Wadden Sea plan involving Denmark, the Netherlands and Germany and the Plan Coast project for the Baltic, Black and Adriatic Sea, led by a German ministry and involving sixteen regional authorities from Bosnia-Herzegovina, Bulgaria, Croatia, Germany, Italy, Montenegro, Poland, Romania, Slovenia and the Ukraine (Schultz-Zehden, Gee, & 'Scibior, 2008).

Improved communication

If all sectors are involved in the MSP process it can provide an holistic awareness of sensitive issues and provide insight into what stimulates or shapes policy (Douvere, 2008; Crowder & Norse, 2008; Douvere & Ehler, 2009). For example, as learned through
developing the MS Plan in Shetland, not all competent authorities understood their environmental obligations, so it was important to interpret the regulations into policy for those authorities to practice (L. Gray, personal communication, Feb 12, 2011). There is interdependency between the ecosystem resources and its users, therefore Ecosystem Based Management (EBM) depends on users understanding the human influences on the management area (Pomeroy & Douvere, 2008). The MSP process should identify sensitive issues and increase awareness with tools like a policy guide or a zoning map. For the Norwegian Management Plan of the North Sea, a map of particularly valuable areas was created. Now if an offshore oil company is looking for potential drilling sites, they are aware of vulnerable habitats, spawning grounds, areas with high densities of seabirds and mammals (Ottersen et al., 2011).

iii. Provide a connection between people and the resources they use

Stakeholder involvement

When a stakeholder is allowed to participate, contribute and voice their opinion, it provides them with a sense of ownership and inclusion (Pomeroy & Douvere, 2008; Ehler & Douvere, 2009). This sense of inclusion is essential to the success of any MSP initiative and connects people to the resources they use (Oxley, 2006; Pomeroy & Douvere, 2008). Stakeholder involvement promotes better understanding of the marine environment and deepens their understanding of challenges in the management area. When stakeholders agree upon management measures for implementation, they will most likely encourage compliance as well (Gilliland & Laffoley, 2008; Ehler & Douvere, 2009).

In developing the Shetland Islands MS Plan, community members were involved from the outset and later consulted for input when the MS Plan was drafted and re-drafted. Their input helped define the aims and objectives of the plan, provided spatial information for the mapping and analysis, and helped shape the policies within it. This involvement secured “buy-in” from the community and key to the success of its implementation (L. Gray, personal communication, Feb 12, 2011).

The human element

Because MSP largely relies on datasets, mapping and spatial analysis that is dependent on geo-technologies, Martin & Hall-Arber (2008) argue that effort must be assigned to
incorporating the social landscape into MSP. They developed a participatory method to map the presence of fishing communities at-sea that involved fisherman demarcating maps and providing rich narratives for added meaning. This is a method they hope will be applied to other sectors (Martin & Hall-Arber, 2008).

The Shetland Marine Spatial Plan’s “Marine Atlas” utilized local knowledge to fill in the gaps of missing information and datasets. Interviews were conducted and users drew on maps to provide spatial information that was otherwise absent (SSMEI b, 2010). Including local knowledge is another way to involve stakeholders and is extremely useful in places where there is a lack of formal data. It is also a necessary tool to involve indigenous populations who may otherwise feel alienated from the MSP process (Ban, Hansen, Jones, & Vincent, 2009; Ehler & Douvere, 2009).

iv. Provide investment certainty for developers

Creating robust and clear policy

One of the overarching aims of MSP is to guide the placement of activity, such as new developments, through policy. There is a lack of unified policy that guides marine management around the world, although this is starting to change with initiatives like the EU Marine Strategy Framework (Plasman, 2008; Ehler & Douvere 2009). Unlike land-use planning that has an established hierarchy of involved authorities that is embedded in a legal framework, MSP must sort through a number of different laws, regulations and authorities (Plasman, 2008). The same goes for developers. The MS Plan should provide a relatively concise statement of policy from the responsible management authority (Ehler & Douvere, 2009).

MS Plans in the Shetland Islands and in the Netherlands included a policy to guide the use of coastal and marine space. Policy guides users, such as developers, through regulations that apply to a particular location. This, used in combination with maps, provides a centralized place for information that attracts developers. It attracts developers by doing the work for them – developers have information provided for them that would have taken a considerable amount of time and effort to gather and interpret. Developers and investors will be more likely to invest in a place where they know the rules will remain
the same for the duration of their activity (Ehler & Douvere, 2009). In this sense, creating consistent concise policies with spatial information can streamline the permitting process.

Timeframes

MS Plans should be designed to span a specific length of time. It is important to consistently re-draft Plans in order to ensure that management and policy are adaptive (Day, 2008), and a typical timeframe for a plan might be ten to twenty years (Gilliland & Laffoley, 2008).

Mapping and spatial analysis

Similar to terrestrial planning, MSP mapping and zoning can promote development and add to investment certainty by directing uses to specific spaces (Gopnik, 2008). Spatial analysis can identify compatible uses and help develop synergies (Ehler & Douvere, 2009), such as space designated for a wind farm that also allows shellfish farming. Maps can increase awareness of vulnerable habitats or natural risks such as coastal erosion or coastal flooding (i.e. areas where a developer is likely to avoid, collectively known as “constraint mapping”).

Conversely, analysis can produce opportunity maps, which show where the best potential sites are for development and where it is permitted based on current policies and regulatory frameworks (Interdepartmental Directors’ Consultative Committee North Sea, 2005; Douvere & Ehler, 2009) or maps that show different future scenarios based on a set of decided parameters, i.e. zoning (Douvere et. al., 2007).

v. Facilitate conservation of sensitive areas and ecosystem services

Based on the ecosystem

A key goal of ecosystem-based MSP is to maintain the delivery of ecosystem services that humans want and need, therefore it must be based on ecological principles that articulate the scientifically recognized attributes of healthy, functioning ecosystems (Crowder & Norse, 2008; Halpern, McLeod, Rosenberg, & Crowder, 2008; Foley et al., 2010). Without understanding biological heterogeneity, food webs, apex predators, key oceanographic processes, and the heterogeneity of human uses, management efforts in the coastal zone will not succeed (Foley et al., 2010). The marine environment and its ecological
interactions are complex, so managers in the coastal zone must exercise the precautionary principle in order to prevent environmental degradation. Once the marine environment is degraded or altered, recovery cannot be assumed, so “prevention is a far more robust management strategy rather than seeking a cure for degraded systems” (Crowder, 2008, pg. 772).

Ecosystems operate at different scales and so should MSP: a hierarchical, nested approach is widely accepted as being the necessary way to plan along the coasts and in the ocean (Crowder & Norse, 2008; Halpern, McLeod, Rosenberg, & Crowder, 2008). The scale at which planning is developed will ultimately vary with each country. In the UK there is planning at the national, regional, and local levels (Gilliland & Laffoley, 2008). In Australia, MSP has long been implemented at regional and local levels in the Great Barrier Reef, but more recently a countrywide effort was taken to create “Bio Regions” (Day, 2002).

In Guiding Ecological Principles for Marine Spatial Planning, a group of twenty ecologists and marine biologists established four ecological principles to guide MSP: (i) maintaining or restoring native species diversity; (ii) habitat diversity and heterogeneity; (iii) key species; and (iv) connectivity (Halpern, McLeod, Rosenberg, & Crowder, 2008; Foley, et al., 2010). They also highlight the need to account for uncertainty in the planning process and using the precautionary principle.

**Strategic Environmental Assessment**

MSP should involve a Strategic Environmental Assessment (SEA), which will ensure that the environment is being monitored and any impacts are mitigated. SEA requires documenting the current environment to establish baselines as well as continuous monitoring to determine the effects of policy (through the MS Plan) on the marine environment after its implementation.

**Linking scientists**

Ecosystem-Based Management (EBM) must be based on science and therefore requires planners and the competent authorities to be linked with scientists. One of the first steps in any MSP process should be creating a biological valuation of the
region (Douvere et. al., 2007). In the Belgian Part of the North Sea, biological valuation maps were created to show intrinsic biological value of different sub-areas within the region. Maps like these help people visualize the marine environment in an holistic way and become an indispensable tool for informing policy and management decisions.

2.2 Marine Spatial Planning Policy Review

2.2.1 International Policy
There are no international policies or legal instruments that specifically advocate for MSP, but a number of them relate to how marine spaces are used and support ICZM and EBM. Many of the international policies and conventions listed below include spatial components and use language such as “Special Areas” or “Particularly Sensitive Sea Areas,” making them particularly relevant for MSP (Douvere & Ehler b, 2009). The two main legal frameworks that apply to MSP are the United Nations Convention on the Law Of the Sea (UNCLOS) and the Convention on Biological Diversity (CBD).

UNCLOS provides the overarching legal framework for ocean spaces in regards to resource exploitation, the allocation of activities and the duty to protect the marine environment. It covers nearly all uses of the sea, including: navigation, shipping, pollution, resource exploration and exploitation, and fishing. It creates seven areas in which coastal states can exercise jurisdiction: internal waters, archipelagic waters, Territorial Seas (TS), contiguous zones, Continental Shelves (CS), Exclusive Economic Zones (EEZ), and fishery zones. The diagram below (Figure 1.), by the Parliament of Australia, provides a diagram of the jurisdictions laid out in UNCLOS.

The United Nations Conference on the Environment and Development (UNCED) conference addressed environmental degradation in relation to economic and social development. The outcome was the adoption of Agenda 21, a global plan of action to protect the environment. Chapter seventeen of Agenda 21 covers “Protection of the oceans, all kinds of seas, including enclosed & semi-enclosed seas, & coastal areas & the protection, rational use & development of their living resources.” (UNCED, 1992).

iii. World Summit on Sustainable Development -2002

The World Summit on Sustainable Development (WSSD) promotes the Ecosystem-Based (EB) approach to management, especially in regard to sustainable fisheries management, ICZM to maintain biodiversity and the creation of a Marine Protected Areas (MPA) network.

The Convention on Biological Diversity (CBD) formally supports the concept of EBM. Parties to the convention are committed to reducing the loss of biodiversity in the ocean supports MSP by calling for a network of protected areas to be established by 2012.

2.2.2 Regional Policy

Listed below are regional Nordic and European policies that support MSP that apply to Iceland. Although Iceland is not an EU member state, it is part of the European Economic Area (EEA) and is currently negotiating EU membership (Traynor, 2010), which means that it is often influenced by (and sometimes influences) EU legislation (Nordic Council of Ministries, 2009).

i. The Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR) - 1992

The OSPAR convention deals with preventing pollution in the waters of the North East Atlantic. It supports assessing water quality and managing human activities through a number of programs and measures, including MSP. Signatories to the OSPAR convention are committed to establishing a network of MPAs. Since 2004, OSPAR has coordinated work on MSP (Nordic Council of Ministries, 2009).

ii. European Union Frameworks

• *The EU Communication on An Integrated Maritime Policy for the European Union (the Maritime Blue Book)-2007*
  
  Within the Maritime Blue Book, Marine Spatial Planning was highlighted as one of three important tools for integrated policy-making for the marine environment of the EU.

• *The EU Marine Strategy Framework Directive -2008*
  
  This directive requires member states to develop and implement strategies for the marine environment and apply EBM principles. It calls for programs and measures that are spatial in nature, contributing to a network of MPAs.
• **Natura 2000 Network**
  
The Natura 2000 Network is a network of protected areas supported on a legal basis by the EU Habitats Directive and the EU Birds Directive.

• **EU Common Fisheries Policy**

• **The EU communication “Green Paper on Maritime Strategy”**

• **The EU Water Framework Directive**

### 2.2.3 Policy in Iceland

Like most countries, there is no policy in Iceland that directly supports MSP, however the *National Planning and Building Act* makes no reference to the marine or coastal environment despite most of its population living there. The overarching domestic policy governing ocean activities in Iceland is:

• **The Ocean, Iceland’s Policy (2004)**

  The Ocean, Iceland’s Policy is based on three pillars: UNCLOS, sustainable development, and the idea that decisions for conservation and utilization of marine resources is best made by those who are invested and directly affected by those decisions. It outlines the competent national authorities that control ocean management and covers the international environmental principles that Iceland adheres to and the means by which those principles are upheld. This document calls for EBM, ICZM and sustainable development, all of which can support or be supported by MSP (Icelandic Ministry for the Environment, Ministry of Fisheries & Ministry of Foreign Affairs, 2004).

### 2.3 Comparative Analysis

The comparative analysis looks at MSP case studies from around the world to assess the experience of other nations and regions that are implementing MSP, highlighting successes, failures and lessons learned. After a general survey of MSP around the world, four case studies were chosen in these locations:

1. The Shetland Islands
2. The Great Barrier Reef Marine Park
3. The Belgian Part of the North Sea
4. The Norwegian Sea

2.3.1 Choosing the Marine Spatial Planning Case Studies

Iceland is part of the European Economic Area (EEA) and tends to adhere to EU policies, so looking at MSP initiatives within Europe provided a starting point for narrowing down the case studies from around the world. Additional considerations were: how long MSP initiatives had been implemented; how similar the marine environment in the case study is to Iceland’s marine environment; and how much information was available about the case study.

• **The Shetland Islands** – Marine Spatial Planning initiatives in the Shetland Islands began in 2006 and a great amount of progress has been made since that time. The Scottish Government created four pilot studies, each with a different geographic location and governing structure. The Shetland pilot focused on community involvement, which seemed like an appropriate model to apply in the small communities of the Westfjords. Lastly, in the Westfjords there was already local interest in the Shetland MSP experiment and Dr. Lorraine Gray, who led the project, was invited to speak about their experience at a Coastal Zone Management and Spatial Marine Planning Symposium held in Ísafjörður in September, 2009.

• **The Great Barrier Reef Marine Park (GBRMP)** – As one of the oldest examples of Marine Spatial Planning in the world, The Great Barrier Reef Marine Park provides important lessons discovered through years of experience – something that most other MSP initiatives lack. Additionally, MSP and the zoning plan in the Great Barrier Reef Marine Park has been viewed as a success, providing more incentive to examine why and how they achieved that success.

• **The Belgian Part of the North Sea (BPNS)** – The North Sea is one of the busiest marine environments in the world, making regional cooperation and planning an important part of sustainably managing their marine resources and avoiding conflicts. Iceland has considerably less activity in their oceans, but if a successful MSP method can be found in a busy marine corridor such as the North Sea, it seems reasonable to assume that their model could be of value to others.
• *The Norwegian Sea* – Iceland is a Nordic country and since their policies and legislation often mirror that of their Nordic counterparts, the author felt it was appropriate to find a Nordic case study. Additionally, Norway’s social and marine environment has many similarities to Iceland: both countries have northern locations on the globe, small populations in proportion to their size, relatively pristine environments and a history and heritage of depending on the sea.

### 2.3.2 Marine Spatial Planning in the Shetland Islands

#### i. Background

The Shetland Islands are an archipelago 200 miles off the Scottish coast situated in the middle of the North Sea. The Scottish coast and the surrounding seas play an important role in the culture, economy, and landscape, and today, over 70% of Scotland's population lives within ten kilometers of the coastline (Joint Marine Programme in Scotland, 2004). The Scottish fishing industry alone provides over 14,000 jobs and 66% of the value of landed fish for the United Kingdom (GHK consulting and Scott Wilson, 2004). In the Shetland Islands, the sea directly provides around 3,100 jobs (about one third of the working population), which yield £302 million in revenue (SSMEI a, 2010). With over eighty different acts of legislation that govern marine and coastal activities in Scotland, interest in finding better ways to manage the marine environment has been ongoing. Furthermore, the desire for a centralized place to store and access information sparked interest in exploring a Marine Spatial Planning (MSP) framework (Feilen, 2006). The Shetland pilot was funded by various government bodies (total funding was £144,000 over four years) and was led by one Project Officer with the support from a Steering Group and other entities (L. Gray, personal communication, Feb 12, 2010). The Shetland Marine Spatial Plan (SMSP) is an example of how a regional-level plan could be set out. It took just over two years from starting the process of writing the SMSP to implementation on a voluntary basis. However, the SMSP has gone through two further public consultations and a third draft comment period ended in June 2010. This case study will examine the MSP process in Shetland over the past five years, with a focus on its development through important stages, applications and lessons learned.
ii. Important Stages

National Support

The concept of the SSMEI initiative was strongly influenced by a UK Government document published in 2002 called *Safeguarding Our Seas*, which established guidelines for managing the marine and coastal environment (DEFRA, 2004). As most legislation in Scotland related to the marine environment is devolved to the Scottish Parliament, the Scottish Government used the SSMEI pilots to inform and develop new laws. Finalization of the Marine [Scotland] Act in 2010 provides a legislative basis for completion and implementing Marine Spatial Plans. The new legislation recognizes the need for an overall National Marine Plan to aid in developing, protecting and managing Scotland's marine resources. The Act also calls for the establishment of Scottish Marine Regions and Regional plans, and once the Secondary Legislation has been drafted, the SMSP will become statutory ordinance (L. Gray, personal communication, Aug. 18, 2010).

With a few exceptions, the political will was quite easy to win over in Shetland (L. Gray, personal communication, Aug. 18, 2010). Shetland has had local control of its developments in its territorial waters (to 12 nautical miles) for over 30 years through the Zetland County Council Act, 1974. This is a unique situation in Scotland; no other local council has the ability to grant licensing for aquaculture, oil and gas infrastructure and renewable energy. The need to resolve conflict in a more efficient way was evident, for example, fishermen would object to a planning application for a fish farm, delaying procedures and adding costs to development (L. Gray, personal communication, August 18, 2010). This is typical example of what can be better managed with a MSP system in place, so public and government backing was fairly straightforward.

Developing the Marine Spatial Planning Initiative in Scotland

One of the considerations at the beginning of the pilot project was to work in tandem with existing governing bodies as well as other environmental management initiatives already underway. The local authority Shetland Islands Council (SIC), already had a Coastal Zone Manager as well as Environmental Management Plans for aquaculture in certain locations. The fishing and fish farming sector also fell under pre-existing management systems. The Coastal Zone Manager, as well as SIC were contacted by the Scottish Government to
discuss the idea of developing a framework for MSP. Community involvement was a focus for the Shetland MSP and further discussions were held with a marine management steering group, local businesses, the planning authority and other key stakeholders (L. Gray, personal communication, Feb 12, 2010). These discussions addressed the different uses and resources within the Shetland marine environment and how they were currently being managed; what was working and what could use an improved management system (Scottish Executive, 2005). These consultations created a starting point to understand the complex interactions taking place in the waters surrounding the Shetland Islands. It also highlighted gaps in the current management systems and what was needed in a new regime that would help the region sustainably develop. The Shetland pilot was led by one Project Officer who was based at the NAFC Marine Centre, which is a scientific institute whose strategy is to support the local marine-dependent industries. A Local Steering Group made up of eighteen members took only an advisory role, as it was essential for one person to take the lead on decisions (L. Gray, personal communication, Aug. 18, 2010). The early involvement of stakeholders, as well as working with existing management authorities to define the MSP process provides the foundation for the framework and underlying philosophy of the Shetland experience (SSMEI a, 2010).

**Determining the Aims and Objectives**

The aim of the Marine Spatial Plan for the Shetland Islands is to “Ensure that use of the coastal and marine environment of Shetland is sustainable” (SSMEI a, 2010 pg. 16). The objectives to achieve this aim is to “ Ensure a high quality, fully functioning marine and coastal ecosystem for the benefit and prosperity of local communities; protect and enhance areas where there are locally, nationally, and inter-nationally important marine species and habitats whilst taking account of natural changes; identify areas with differing priorities for sustainable use (such as fishing, aquaculture, recreation & tourism, oil, nature conservation etc.); and ensure that stakeholders can take advantage of development opportunities in a sustainable way” (SSMEI a, 2010, pg. 16).

**Determining Boundaries**

The Shetland MSP covers the territorial waters around the archipelago out 12 nautical miles (See Figure 2.) on the seaward side of the Mean High Water of spring tide, but also includes relevant habitats and ecological processes as well as archaeological features
within 150 m of the coastline. Boundaries of the landward side generally extend as far as ecological processes affect the land. This includes major salt marshes and sand dune areas, which are vital habitats for a variety of species (SSMEI a, 2010).
Figure 2. Jurisdictional Zones for Shetland Marine Spatial Plan [map] from SSMEI b (2010).
Community and Stakeholder Involvement

Community and stakeholder involvement was less an important stage of the Shetland MSP and more of an underlying philosophy, but the specific ways the pilot project involved stakeholders is worth mentioning. In addition to the Local Steering Group, the Scottish Government chaired a National Steering Group for all four SSMEI pilot areas. This group oversaw the progress of the different areas and took an interest in some of the issues raised. Both Steering Groups met on a quarterly basis and provided the opportunity for the Project Officers to discuss any issues at the national stakeholder level. Roughly one hundred national stakeholders also contributed to the study via email updates, including environmental Non Governmental Organizations (NGOs) and public bodies. A Biodiversity Working Group and a Policy Development Working Group were established to ensure sensitive habitats and species were protected and to formulate policy on what areas or sectors should take priority over another. A Working Group on Spatial Analysis agreed upon methods of zoning and ranking planning constraints. Interviews were carried out with fishermen and recreational users to fill gaps in data – these people drew on maps areas important to them. Formal public consultations played a large role in the pilot project: to date, there have been three public consultations, each lasting twelve weeks and included open days and visits to all eighteen community councils (NAFC Marine Centre, N/A).

Compiling Data

The centralization of information entailed compiling data and maps, and determining where maps were lacking that would add value to the planning regime. A six-month period of data scoping helped determine existing baselines, dataset collation and established priorities for data. As data was collated from different organizations for different purposes, a long period (one year) was required to streamline the information using Geographical Information Systems (GIS). A third party copyright agreement was given by the data providers, which enabled a CD with relevant data to be distributed. Obtaining this copyright agreement was an important milestone, as the pilot wanted to enforce the "collect once, use often" philosophy in data stewardship (L. Gray, personal communication, Aug. 18, 2010). When important information was missing, interviews were conducted to fill gaps, such as interviews with fisherman to determine key fishing sites (See Figure 3.) and
recreational users to determine areas important to them (SSMEI b, 2010). A seabed habitat map was created using existing data on sediments, depths, temperatures, and previous surveys which was later ground-truthed with historical and new seabed surveys.

Figure 3. Important Finfish grounds based on interviews with fisherman [map] from SSMEI b. (2010).
iii. Outcomes and Applications

The Shetland Marine Spatial Plan (SMSP), which included a Policy Framework and a Marine Atlas, was the main output of the MSP process in Shetland. The SMSP was written by a broad spectrum of the marine sector and therefore provides a unified source for users and managers of the marine environment to consult when making decisions. It delivers guidance for the spatial placement and analysis of current and future uses within the marine environment through a marine atlas and policy framework.

The Policy Framework details why certain activities conflict with each other and what features should be avoided by certain sectors and at certain times of the year. It creates a hierarchy of policies for regulators (like the Scottish Environmental Protection Agency), government advisors on conservation, planners (who administer the planning consents regimes), managers (such as those who administer fishing licenses) and developers to consider. This provides them with consistent advice to help them understand the needs of other sectors, which was very piecemeal in the past, as well as helping them determine, spatially and temporally, where development should or should not occur. Additionally, it draws attention to existing legislation that is relevant to their activity, helping them abide by current legislation and have an understanding of their responsibilities and local values.

The atlas details where different activities and features occur, and breaks the constraints into a hierarchy of:

- **Statutory constraints** - where there is a fundamental incompatibility between the activities.
- **Activities** – where there is potential competition for resources or space between activities. An agreement to co-exist would be dependent on evidence of consultation with affected sectors to support compatibility and determine allowable consequences and mitigation.
- **Advisory constraints** - where activities can co-exist but potential exists for unmanaged conflict. These are mainly the species and habitats out with the designated conservation areas that will trigger Environmental Impact Regulations and mean the developer has to do a survey, which will add costs and delays to the development. (SSMEI a, 2010).
One of the main benefits that the Plan brings to Shetland is increased investment certainty. A developer is encouraged to use the policy framework and marine atlas before a planning application is submitted to the local authority. If evidence is shown that the Plan has been referenced, then the authorities will look favorably on their application (L. Gray, personal communication, Aug. 18, 2010). With passage of the 2010 Marine [Scotland] Act a framework for implementation and enforcement is established, including a permit process to ensure alignment with the Plan. Formal adoption of the SMSP will be through the Local Development Plan (the terrestrial plan).

However, developers, regulators and planners are using the Plan already, and benefits are being realized already. In 2010, a major wave energy company, Vattenfall, came to Shetland with a proposal for a substantial area of the sea to be used for its device. They used the SMSP in their site selection process and their subsequent consultation. In their workings with the SSMEI project, they said that having the Plan (and the new knowledge it brings) was one of the main reasons for choosing Shetland (L. Gray, personal communication, Aug. 18, 2010).

Furthermore, the SMSP has facilitated the protection of important species and habitats from potentially damaging fishing practices (scallop dredging) by recommending areas for closure. The incentive for the fishermen is to get environmental accreditation on the marketing of their produce (they will subsequently get a higher price and demand).

Additionally, the SMSP includes Oil Spill Contingency Planning for improved environmental protection. It has facilitated the protection of important species and habitats from oil spills by creating sensitivity maps for archiving by the oil companies’ pollution response team (L. Gray, personal communication, Aug. 18, 2010).

iv. Discussion

The UK is one of the first countries to endorse a statutory Marine Spatial Planning process through legislation. The Shetland Islands piloted MSP to inform this new legislation, and this trial resulted in a guide for planners, regulators and developers that provides consistent advice and adds value to the current planning regimes. The SSMEI project also improved the knowledge base and information efficiencies, which is essential if environmental protection is to be realized.
Community involvement was fundamental to the success and acceptance of the SMSP. All interested participants were considered to have legitimate standing. The planning process (involving stakeholders and making them stewards of the environment and resources they use) and the SMSP therefore facilitates reduced conflict.

One thing that is not addressed in the SMSP is the concept of trade-offs and developing alternative scenarios. Coastal managers are left to decide when it comes to trade-offs and prioritizing, which could be problematic to enforce if there is a weak leadership or if this has not been agreed by consensus. The SMSP was intended for new users (developers) and to help existing users who are changing use patterns by identifying potential conflicts and work to avoid them. There are no new conflict resolution mechanisms identified in the SMSP, so existing conflict resolution processes in the management of permits and licensing would be used.

Although the SMSP does not focus on trade-offs and future scenarios, it does most importantly recognize that uncertainty exists and must be taken into account and that research will continue to identify sources of uncertainty, which will be incorporated into revisions of the SMSP. Within the SMSP there is a strategy for updating the decision support tools based on monitoring and evaluation. Monitoring and evaluation are addressed in two ways; first, it is recognized that significant marine monitoring is underway and second, gaps in the monitoring and specific monitoring needs for the SMSP are considered in the Delivery Plan (an appendix of the SMSP).

It appears that the prime mechanism for achieving the SMSP objectives is seen in the spatial mapping of uses (as is the case with most MSP efforts around the world) – but these can quickly become outdated or inaccurate since the environment is always changing.

Another strength of the SMSP is that formal metrics of success of the plan (i.e. indicators and reference targets) have been adopted. Performance indicators have been identified, however, detailed reference targets have not been set for what constitutes success. Qualitative standards are expressed under four objectives, i.e., integrating sectors, increasing knowledge, assessing sensitivities and restoring the environment and applied to themes, actions to be taken, and partners with target dates for completion.
One specific reference is made to adaptive management with respect to actions for environmental restoration. The Plan itself calls for revisions based on new information in two to three years, which implies an adaptive approach. Although adaptive management is not formally structured, it is certain to incorporate feedback from monitoring.

2.3.3 Marine Spatial Planning in the Great Barrier Reef Marine Park

i. Background

The Great Barrier Reef Marine Park (GBRMP) stretches 2,300 kilometers along Australia’s northeast coastline and extends one hundred to three hundred kilometers offshore, covering a total of 344,400 square kilometers (GBRMP Authority, 2003). The GBRMP includes the world’s largest coral reef system with inter-reefal lagoons, seagrasses and mangroves. It has a system of interconnected marine habitats with over 2,900 coral reefs and a high degree of biodiversity. It supports over 1,500 species of fish, one third of the world’s soft coral species, six of the seven species of sea turtle and over thirty marine mammals (GBRMP Authority, 2003).

In addition to its environmental importance, the Great Barrier Reef (GBR) is also economically and socially important. Australian Aboriginals and Torres Strait Islanders have depended on the GBR for tens of thousands of years (GBRMP Authority, 2003). In 2003, the tourism industry alone earned over four billion Australian dollars in Gross Value Product (Productivity Commission, 2003). It was added to the list of World Heritage Areas in 1981 and is one of the largest World Heritage Areas in the world (GBRMP Authority, 2003).

Concern about pollution and environmental degradation of the reef led to the establishment of the GBRMP in 1975. The Great Barrier Reef Marine Park Act of 1975 (GBRMP Act) also established a new government agency, the Great Barrier Reef Marine Park Authority (hereafter Park Authority), tasked with planning and managing the GBRMP. Spatial planning and zoning are seen as the keystones in managing the GBRMP and it is one of the oldest examples of Marine Spatial Planning (MSP) in the world (United Nations Education, Science and Culture Organization, 2010). This case study will review the steps taken to develop and implement MSP in the GBRMP and lessons learned along the way.
ii. Important Stages

National Support

The initial establishment of the GBRMP resulted from concern about coastal development and increasing activity, such as oil drilling, limestone mining, tourism, fishing and shipping in the GBR, and how those activities were affecting the overall health of the reef system and biodiversity (UNESCO a, 2010). Since the GBRMP Act, additional national policies, plans and acts were created to support MSP and integrated management in the GBRMP, such as:

- The Intergovernmental Agreement on the Environment (1992)
- Australia and New Zealand Environment Conservation Council’s Strategic Plan of Action for Establishing the National Representative System of Marine Protected Areas (1999)
- Australia’s National Ocean’s Policy (1998) – this document directly supports MSP as a tool for integrated and ecosystem-based ocean planning and management.
- The Environment Protection and Biodiversity Conservation Act (1999)

Developing MSP in the Great Barrier Reef Marine Park

Australia and the state government work together to manage and fund management in the GBRMP. The Park Authority, created to manage and plan the GBRMP, is a federal agency but has state representatives (GBRMP Authority, 2003). They created a spatial planning system of multiple use zones, which is the foundation for management in the GBRMP. Multi-use zones range from the “preservation zone,” which is undisturbed by human activity, to “general use zones,” which allow reasonable activities to take place. From 1981 to 1987 the first zoning plans were implemented and since that time the zoning plans
have changed considerably in response to measures of effectiveness and changes in the marine environment (UNESCO a, 2010).

Initially, only 4.5% of the GBRMP was designated as “no-take areas” but monitoring showed that the ecosystem goals were not being met and a re-zoning process took place from 1998 to 2003. To begin the re-zoning process, a Representative Areas Program (RAP) was created to increase protection of biodiversity while still maximizing activities and upholding local values (GBRMP Authority, 2003). Under RAP, steering committees of experts formed to look at the biology and physical aspects as well as social, economic and cultural values within each area. After the re-zoning process, roughly one third of the GBRMP became designated as “no-take” areas. A team of natural science experts established seventy “Bioregions” for the GBRMP World Heritage Area using the best available scientific information as well as input from fishermen and other experts. Stakeholder involvement played a key role in developing the zoning Plan and was a formal part of the process (GBRMP Authority, 2003).

A governmental review of the GBRMP Act in 2006 recommended an “Outlook Report” to be released every five years. This report, the first of which was released in 2009, documents the environmental conditions of the GBRMP, effectiveness of management and pressures on the ecosystem (GBRMP Authority, 2009).

Determining the Purpose, Aims and Objectives

The purpose of MSP and the resulting “Zoning Plan” was to serve as the planning instrument for conservation and management of the GBRMP. It aimed to conserve the GBRMP for future generations, regulate uses within the park, regulate resource exploitation, reserve some areas for public enjoyment, and to preserve some areas so they remain in a natural state, “undisturbed by man” with an exception for research (GBRMP Authority, 2003).

Determining Boundaries

The boundaries for the GBRMP were determined by the physical environment and ecology that make the GBR an important habitat. Since 1975 when the park was established, it has expanded and continues to do so: between 2000 and 2001, 28 coastal areas were added to the pre-existing five management areas. The then 33 sections were amalgamated and four
management areas were established (GBRMP Authority, 2003). The original plan had zone boundaries based on physical features (such as a “reef edge”). Users and enforcement officers had difficulty determining zone boundaries that way, so the new zoning plan adopted a clearly defined coordinate-based system and uses explicit landmarks when possible for anyone without a global positioning system (GBRMP Authority, 2003).

**Stakeholder Involvement**

The GBRMP Act includes two statutory phases of community participation when zoning plans are made. Each phase of community participation is widely publicized and inclusion of stakeholders is cited widely as one of the reasons for successful management in the GBRMP (Day, 2008). When the new zoning plan was developed in 2003, over 31,500 public submissions were received (GBRMP Authority, 2003). A variety of literature was published to ensure public understanding of the zoning plan, including maps, user guides and CDs. Under RAP, the communications program had two hundred formal meetings, face-to-face engagement with 6,000 people, 1,500 community service announcements, one hundred newspaper articles as well as an interactive website, radio, TV and newspaper advertisements (Great Barrier Reef Marine Park Authority, 2003). The 2003 *Report on the Great Barrier Reef Marine Park Zoning Plan* detailed all of the public submissions, organized by sector, what issues were raised and how those issues were addressed.

**iii. Outcomes and Implementation and Lessons Learned**

The major outcome of the GBRMP Zoning Plan (2003) is a statutory, standardized zoning system (See Figure 4.) for the entire park, consisting of eight different zones that are color-coded (See Figure 5.):
Figure 4. Townsville/Whitsunday Management Area zoning map from GBRMPA (2003).

- General Use Zone (GUZ)
- Habitat Protection Zone (HPZ)
- Conservation Park Zone (CPZ)
- Buffer Zone (BZ)
- Scientific Research Zone (SRZ)
- Marine National Park Zone (MNPZ)
- Preservation Zone (PZ)
- Commonwealth Islands Zone (CIZ)
Figure 5. Summary of Activities Used in Zones from the GBRMP Authority (2003).

The Zoning Plan determined the purpose of each zone and whether they can be entered with or without written permits from the Park Authority. Each zone has clearly defined objectives and an activities guide establishes what activities are allowed within each zone (GBRMP Authority, 2003). There is also a long-term, twenty-five year management plan made in conjunction with the zoning plan that is reviewed every five years in the “Outlook Report.” The review is based upon the best available scientific and cultural data, which is then plugged into decision support software for analysis (GBRMP Authority, 2007).
For over thirty years, the Zoning Plan has been implemented and management practices have been adapted and changed numerous times. Monitoring and evaluation of both the environment and management practices is seen as the foundation for a continuous process of adaptive management (Day, 2008). The RAP program provides greater scientific monitoring and understanding of important habitat systems for biodiversity (Day, 2008). During the re-zoning process there was a large response from the conservation sector with concerns about biodiversity and habitat loss, which ultimately led to a major increase in the amount of “Preservation Zones” within the park (GBRMP Authority, 2003).

It is widely recognized that the zoning system will not be successful without compliance and enforcement. To foster compliance, the GBRMP Authority simplified the boundaries, aligning them with landmarks and providing clear coordinates, and increased efforts to educate users about the park zones (GBRMP Authority, 2003). Increased funding for enforcement began after the re-zoning process in 2003, providing more commitment to cooperation among enforcement agencies, more prosecution of offenders, better use of intelligence and an increase in patrolling and enforcement range. Improvements in technology continue to help enforcement efforts (GBRMP Authority, 2003).

To reach the intended outcomes and aims for the GBRMP, scientific knowledge, effective leadership and a high level of public participation and socio-political support have played crucial roles (Day, 2008). Declining fish stocks have recovered, coral ecosystems have stabilized and tourism, mining, fisheries and other sectors continue to be powerful economic forces. Yet there are still threats to the GBRMP, mainly climate change, catchment runoff and coastal development (GBRMP Authority, 2009).

iv. Discussion

Australia has been implementing and improving their management and zoning system for over thirty-five years, which makes examining their experience an important resource for any country or region looking to begin MSP. According to the literature available, management efforts have been successful in recent years. The zoning system appears to keep the GBR healthy, maintaining biodiversity while still allowing for economic growth and upholding cultural values. It should be recognized that the high level of political will and funding available for management, zoning and research is unique in the GBRMP because of its international significance. The coastal areas in Queensland are also not as
densely populated as some areas of the world, where establishing a zoning system would be more difficult and complicated.

It may be worth asking if more precaution should be taken to protect the coral reef system. It is widely recognized that global warming and ocean acidification are serious threats to coral reefs around the world (Intergovernmental Panel on Climate Change, 2007). How can spatial planning incorporate and account for global threats with long-term, long-lasting consequences? Does establishing a preservation zone do enough to protect a vulnerable habitat when multi-use zones can be close by?

With a developed zoning system like the one in the GBRMP, outreach and education become extremely important for compliance. If users do not have access to information about regulations and zonation, compliance will be hopeless. Creating clearer guidelines and zone boundaries (and then disseminating that information through education and literature) is an example of the kind of adaptive management that has made MSP in the GBRMP a success. Continuous public outreach and stakeholder involvement is another thing they do particularly well in the GBRMP.

Perhaps the most important lesson to take from the GBRMP is their approach to adaptive management: they monitor and evaluate the environment as well as the effectiveness of their management and seem willing to admit when there are failures and to change their approach when necessary.

2.3.4 Marine Spatial Planning in the Belgium Part of the North Sea

i. Background

The North Sea is located in the northeastern part of the Atlantic Ocean, between the United Kingdom, Norway, Sweden, Germany, Denmark, the Netherlands, France and Belgium. It is a relatively shallow, small sea, but it is surrounded by densely populated countries, contains busy shipping routes, and is heavily used for fishing, tourism, infrastructure and more (GAUFRE, 2005).

The Belgian part of the North Sea (BPNS) extends only sixty-six kilometers (km) at the widest part and eighty-seven km out from the coast, comprising just 0.5 percent of the total mass of the North Sea (See Figure 6.) (GAUFRE, 2005).
Concern over the increasing uses and environmental pressures in the BPNS led to the establishment of a new federal minister responsible for the management of the BPNS in 2002 (Douvere et al., 2007). The Natura 2000 network and the Ministerial Declaration of the Fifth North Sea Conference (the Bergen Declaration) triggered interest in Marine Spatial Planning (MSP) as a tool for ICZM regionally. At the same time in Belgium, controversy over new developments on the sea, such as offshore wind farms as a renewable source of energy and establishing protected areas, jumpstarted a study of MSP in the BPNS. The study “Towards a Spatial Structure Plan for Sustainable Management of the Sea,” also known as GAUFRE, began in 2003 and spans Belgium’s Territorial Sea (TS), Exclusive Economic Zone (EEZ), Fisheries zone and continental shelf, covering 3,600 square kilometers (GAUFRE, 2005). The study ran from 2003-2005 with a large team of 10 people. This case study will examine the history and efforts to create and implement a framework towards a MS Plan in Belgium and lessons learned along the way.
ii. Important Stages

Regional and National Support

Before ICZM or MSP initiatives began, management of the BPNS was limited, driven mainly by legal jurisdictions and resource exploitation. There are permits and licenses for almost all activity within the BPNS, but new activities and users in the finite space of the BPNS has led to conflicts. These existing conflicts and projected, future conflicts created interest in finding an integrated approach to coastal and marine management and an interest in MSP (GAUFRE, 2005).

The Regional Advisory Council for the North Sea also established a Working Group for Marine Spatial Planning to help tackle problems in fisheries management. Countries surrounding Belgium, such as the Netherlands, Germany and the United Kingdom began their own MSP initiatives, establishing them as world leaders and creating a regional momentum to begin spatial planning in the North Sea.

At a national level, Belgium’s Federal Plan for Sustainable Development supports MSP efforts. Although there is no legal basis, Belgium’s Master Plan for the Sustainable Use of the Belgian Part of the North Sea (BPNS) is one of the first in-depth planning systems being implemented that covers the TS and the EEZ (Douvere et. al., 2007).

Developing a Structure for the Project

A team of ten experts was assembled to work together for two years on the initial project, which included researchers and scientists from Ghent University and an environmental consulting firm. Team members represented the legal sciences, socio-economic sciences, experts in the marine biology and marine geology field as well as planners (Maes et al., 2005). The methodology for the project was borrowed from spatial planning methods used in land-use planning in the Flemish region, but with the foresight that certain adaptations would have to be made because of the unique nature and jurisdictions of ocean spaces (GAUFRE, 2005). It was also noted that the framework for MSP in Belgium would have to also consider international, regional and pre-existing national legislation (Maes et al., 2005). The difference between “End Use” planning and “Structural” planning was
highlighted early in the project and structural plan was deemed more appropriate for MSP since it is:

…a global and strategic vision on the desires spatial development of a particular area, a framework for sustainable spatial content represented by structural maps rather than detailed final planning maps (Maes et al., 2005, pg. 8).

The document “Towards a Spatial Structure Plan for the Sustainable Management of the North Sea,” outlines a four step program in order to create a concrete spatial plan for the BPNS: 1) determine the key values of the North Sea; 2) development of various scenarios of the BPNS; 3) drawing the structure plan for the BPNS; and 4) the transnational approach. The pilot project, lasting two years with a staff of ten people, only reached steps one and two.

**Determining the Purpose, Aims and Objectives**

The end result of the project was not intended to be a final master plan, but rather a working process towards a plan that is multi-functioning, interdisciplinary and involving public participation (Belgian Science Policy, 2010). Determining the methodology for MSP was highlighted as a main objective of the project. It was an aim to outline different scenarios of future use and future possibilities BPNS and to begin a dialog about how decisions are made and how the public participates in regard to MSP (GAUFRE, 2005; Maes et al., 2005). The Belgian Science Policy (2010) lists these three outcomes for the project:

1. The making of an accessible and scientific knowledge module.
2. The making of maps on which effects of user functions are shown.
3. A first proposal towards an optimal spatial allocation.

**Stakeholder Involvement**

The GAUFRE project results were discussed and presented to stakeholders in a workshop in February of 2005. Additionally, a website was produced and brochures were distributed to involve stakeholders, which helped the public understand the value of MSP and created support for the initiative in Belgium (Plasman, 2008).
Data Collection

The GAUFRE project built upon and updated research and work done by existing institutions and by the federal minister appointed to manage the BPNS. Belgian Science Policy funded a number of projects under the Second Scientific Support Plan for the Sustainable Development Policy (SPSD II), such as TROPHOS and MAREBASSE, in which scientific baseline information is gathered about the North Sea. These programs provided a great starting point with information and data about the BPNS (Maes et al., 2008). After data was collected, it was translated into GIS maps for visualization and to interpret the data in various ways (GAUFRE, 2005). Figure 7 shows the projection of all uses within the BPNS superimposed onto one map. Through the GIS system, a database of layered environmental information allowed analysis of interactions within the marine environment (Douvere et. al., 2007). This analysis helped to determine zones for better management and created better understanding of how different parts of the BPNS interact and integrate within the ecosystem (GAUFRE, 2005).
iii. Application and outcomes

The GAUFRE project ran as a study of MSP in the BPNS and has been incrementally implemented since 2003. The initial study determined a method towards MSP and created scenarios and a future vision for the North Sea (Douvere et al., 2007). The project can be used to produce plans and maps for policy makers and stakeholders to analyze and envision uses and interactions within the BPNS (Maes et al., 2005). The project created the document, Flood of Space: Towards a Spatial Structure Plan for Sustainable Management of the North Sea (Flood of Space), which is composed of three main sections:

- **Analysis** - The analysis section describes the BPNS by compiling data and information from a number of sources. It looks at physical aspects, natural values, pollution and disturbance, fixed infrastructure, human activities and uses and attempts to then synthesize all of that information into structure maps for analysis
of space but also conflict interactions (GAUFRE, 2005). Below is a map (Figure 7.) combining all users within the BPNS from Flood of Space.

- **Interaction** - The Interaction section studies things in relationship to each other. A workshop was held in January of 2004 to identify important interactions between users and how spatial planning could be used as a tool for management decisions. The interactions focused on in Flood of Space are suitability, interactions between users and the environment and interactions among users. This section looks beyond spatial interactions at things such as developments and environmental trends like climate change.

- **Integration** - This is the section of the project that borrows from a land-use planning framework. The information gathered in the Analysis and Interaction sections were compiled into GIS layers and interaction matrices to create a flexible, integrated approach to MSP by creating future scenarios. Scenarios for possible spatial structure plans were created with “sustainability” as a guiding concept. These scenarios are meant to help policy makers make better decisions and to help them visualize future uses and interactions.

A six-step process is provided for developing alternative scenarios (UNESCO b, 2010):

1. Defining current trends, demands for space and conditions
2. Defining key values of the marine area
3. Defining strategic objectives and goals for the marine area
4. Identifying general spatial and temporal constraints
5. Developing alternative spatial use scenarios, each reflecting a priority of set goals, objectives and values
6. Defining the significance and implications of each spatial scenario for the different functions and activities within the marine area

As far as implementation goes, a Master Plan was created in 2003 and is being implemented incrementally, but it lacks legal backing. From the Master Plan, there is now an updated and diversified zoning system for sand and gravel extraction with new management zones that involve rotating heavily exploited areas, temporal closures that coincide with fish spawning seasons and an exploration zone where future extraction and use is investigated (United Nations Education Science and Culture Organization, 2010). Additionally, the Master Plan helped establish a zone for developing offshore wind farms.
Aquaculture is also allowed within that zone as a compatible use (Douvere et. al., 2007).

iv. Discussion

The MSP planning initiative in Belgium is praised as being one of the first in the world to apply land-use principles to the sea (Douvere et. al., 2007), and yet, the Master Plan lacks statutory standing. Given that there were ten people working for two years, the project should have been further along than the second of the four stages they developed for creating and implementing a MS Plan. Implementation is arguably the hardest step in the MSP process and Belgium was late to begin this step. The only documented examples of implementation are for sand and gravel extraction and zoning for offshore wind farms. This is a step in the right direction, especially in a complex, heavily used sea. There has already been a considerable amount of resources and time put into the MSP process in Belgium, so observing how Belgium moves forward with the implementation stage may reveal valuable insights down the road.

The GAUFRE project’s focus on “structural maps” that represent a “conceptual framework for sustainable spatial content rather than detailed final planning maps” (Douvere et. al., 2007, pg. 187), is an interesting idea but has yet to produce convincing, concrete results in the real world. At the same time, these “structural maps” focus on future scenarios and look at inter-connectedness of spaces within the marine environment to help determine alternatives and priorities, which is undeniably an essential part of “planning.”

Considering how small the BPNS is and how interrelated it is to other parts of the North Sea, it seems that a coordinated international effort with neighboring countries should have been in place. Coordinated efforts may have saved time and money which could have been put towards implementing the plan. Furthermore, a coordinated effort would have been more holistic (considering other sectors and stakeholders with influence in the region) and more in line with EBM principles. At the very least, establishing a consistent framework and method (because different countries may have different visions and objectives) would have provided a basis by which to compare results and monitor progress.
2.3.5 Marine Spatial Planning in the Norwegian Sea

i. Background

The Norwegian Sea is located northwest of Norway between the North Sea and the Greenland Sea. Most of the Norwegian Sea is not part of the continental shelf, making it a deep sea, averaging 1,700 meters in depth (World Atlas, N/A). The Norwegian Current is a branch of the Gulf Stream, bringing strong, warm currents northeast towards the Barents Sea and leaving the Norwegian Sea ice-free throughout the year (World Atlas, N/A).

Norway has a long history of depending on the sea and today nearly one percent of the population is employed in the fisheries sector alone (fishing, aquaculture and fish processing) (Norwegian Ministry of Foreign Affairs, N/A). The Norwegian Sea is considered one of the richest fishing grounds in the world and also contains deposits of oil and natural gas. Although the Norwegian Sea is considered to be healthy, concern over the cumulative effects of environmental impacts, coupled with projected future impacts, like ocean acidification and overfishing, have created interest in building a better management system to safeguard the sea (Ottersen et al., 2011).

In 2001 the Norwegian white paper Protecting the Riches of the Sea laid the foundation for integrated, Ecosystem-Based Management (EBM) of the Norwegian coastal and marine areas. Between 2002 and 2006 the first Integrated Management Plan was completed in Norway for the Barents Sea-Lofoten area and resulted in the white paper titled Integrated Management of the Marine Environment of the Barents Sea and the Sea Areas off the Lofoten Islands. After that report, in early 2007, the Norwegian government initiated a program for integrated and EBM, which includes elements of Marine Spatial Planning (MSP), in the Norwegian Sea (Nesse, Veie-Rosvoll, & Østby, 2010). This case study will review the steps taken in Norway to develop and implement that plan.

ii. Important Stages

National Support

The international push for Ecosystem-Based Management and more specifically, the Convention on Biological Diversity (CBD), led to a number of Norwegian initiatives focused on improving the ocean and coastal management. Norway aims to create Integrated Management Plans for all sea areas under Norwegian jurisdiction by 2015 and

**Starting the Process**

The development of the Management Plan for the Norwegian Sea was modeled after the process and development of the Barents Sea-Lofoten Plan, which was in turn influenced by the Eastern Scotian Shelf Integrated Management Project in Canada (Ottersen et al., 2011). An interministerial steering committee, with representatives from eight government ministries and chaired by Ministry of the Environment, led the initiative. The steering group was challenged to work across traditional management divides while also addressing the separate, sometimes conflicting, objectives of the different sectors (Ottersen et al., 2011). The Norwegian Sea Management Plan began in 2007 and a report on the initiative was released in 2009 titled *Integrated Management of the Marine Environment of the Norwegian Sea* (Report No. 37), and the plan is currently in the implementation stage.

**Purpose, Aims and Objectives**

The Norwegian Report No. 37 states:

… the purpose of the present management plan is to provide a framework for value creation through the sustainable use of natural resources and ecosystem services in the Norwegian Sea and at the same time maintain the structure, functioning, productivity and diversity of the ecosystems of the area (Norwegian Ministry of the Environment, 2009, pg. 12).

The plan aims to assess the current human impacts on the Norwegian Sea as well as future projected impacts, in order to create a framework for managing human activities in the Norwegian Sea. Another purpose of the plan is to facilitate agreeable coexistence between different industries and make sure that there is a common understanding of management goals (Norwegian Ministry of the Environment, 2009). A key objective is the establishment
of areas of particular value that have unique environmental importance and/or vulnerability to anthropogenic pressures (Ottersen et al., 2011).

**Determining Boundaries**

When the project began, clear demarcations of the boundaries for the plan were not established and the borders changed several times (Ottersen et al., 2011). It was difficult to decide how close to the coastline the inner boundary should lie. Ultimately the boundary included the Norwegian Exclusive Economic Zone (EEZ) and covers around 1.17 million square kilometers of the Norwegian Sea (See Figure 8.) (Norwegian Ministry of the Environment, 2009). Excluded from the boundaries were the waters off the coast of Lofoten and Vesteralen Islands since they were included in the Integrated Management Plan for the Barents Sea-Lofoten area. Ecology was also taken into consideration and an area inside the baseline in the Vestfjorden was included because it is a main spawning area for cod and an important overwintering area for herring (Ottersen et al., 2011).
Figure 8. Boundaries for the Integrated Management Plan of the Norwegian Sea [map] from Ottersen et al. (2009).
Stakeholder Involvement

In order to include all stakeholders and interested parties, developing the Integrated Management Plan was kept as transparent as possible (Norwegian Ministry of the Environment, 2009). Consultations were held at various stages throughout the development of the plan. Written feedback from stakeholders was encouraged in two steps of development process for the plan that involved impact assessments (see Figure 8) (Norwegian Ministry of the Environment, 2009). In addition, a conference on the management plan was held in Ålesund in 2008, which was attended by more than 200 people. Stakeholders were also encouraged to submit written responses after the conference (Norwegian Ministry of the Environment, 2009).

iii. The Plan: Development, Outcomes and Implementation

The project followed a three step process (See Figure 9.). In Step one, an expert group was formed, comprised of representatives from research institutes and government directorates, and they created five reports. The reports gathered information about the Norwegian Sea and focused on: particularly valuable areas, fisheries activities, petroleum related activities, maritime transport, commercial activities and social conditions in counties bordering the Norwegian Sea (Ottersen et al., 2011).

The second step was to conduct four extensive Environmental Impact Assessments (EIAs) based on the reports completed in step one. The EIAs focused on three areas thought to be the most likely to effect the marine environment: fisheries, petroleum related activities, and maritime transport. External pressures, such as climate changes, ocean acidification, pollution, emissions from coastal activities, and the introduction of alien species were also assessed. In the EIAs, relationships between individual sector activity and pressures were examined as well as current impacts and how the activity or sector would impact the environment in projected, future scenarios (for the year 2025 and 2080) (Ottersen et al., 2011).

Step three examined cumulative impacts across sectors. The EIAs from step two were assessed in three areas: cumulative effects across sectors, conflicts of interest between sectors and the need for further knowledge. In each of those categories, cumulative effects were assessed based on current activity levels (2006) and projected future activity levels.
for the years 2025 and 2080. Reports on vulnerability in particularly valuable areas and key environmental indicators and thresholds were also taken into account for this step. A five-point scale was developed to signify the level of impact (Ottersen et al., 2011).

Areas of particular value were established based on two main criteria: whether the area is important for biodiversity or important for biological productivity. Secondary criteria were also considered for additional values, such as economic, social or cultural (Ottersen et al., 2011). With reference to Figure 10., it can be seen that eleven areas were identified as being particularly valuable and ranged from fish spawning grounds to coral reef systems to seabird cliffs. The vulnerability of the eleven selected areas was examined, largely focusing on anthropogenic pressures and how they uniquely affect each area. The areas were then ranked to determine which places are most vulnerable and why. The

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**Figure 9. Three Step Process for developing the Integrated Management Plan for the Norwegian Sea.**  
**S1:** written feedback from stakeholders on plan for EIA,  
**S2:** written feedback from stakeholders on EIAs,  
**S3** stakeholder hearing conference on Assessment of cumulative effects from Ottersen et al., 2009.
management plan calls for special priority and attention to vulnerable areas with strict regulations and management (Ottersen et al., 2011).

Figure 10. Particularly Valuable and Vulnerable Areas of the Norwegian Sea [map] from Ottersen et al. (2009).
Implementation of the Integrated Management Plan for the Norwegian Sea has been underway since 2009 and is seen as top-down, driven by government agencies. The mandated cooperation amongst government ministries ensures that management remains integrated, but it is recognized that involving stakeholders and users from different sectors will undoubtedly make consensus about management decisions difficult. The risk is having loose, general management restrictions in order to appease all parties (Ottersen et al., 2011). The plan calls for continued data collection and analysis for establishing environmental indicators and thresholds. In particular, it calls for more study of pollution in the open parts of the Norwegian Sea (Ottersen et al., 2011).

iv. Discussion

The Norwegian Government ministries developed the Integrated Management Plan for the Norwegian Sea. The Minister of the Environment worked with eight other government ministers, which is commendable, however, wider stakeholder involvement and collaboration with universities at all stages, not just after EIAs, would have been beneficial.

A strength of the Integrated Management Plan for the Norwegian Sea is that it borrowed from existing examples of Integrated Management Plans, such as the Barents Sea plan and also elements from the Eastern Scotian Shelf Integrated Management Project in Canada. It is obvious that the pre-existing frameworks allowed for quick development of the Norwegian Sea plan. Another strength is that there are a number of recent acts, which legally support and mandate the creation of Integrated Management Plans.

The plan discussed for the Norwegian Sea is called an “Integrated Management Plan” and rarely is it called a “Marine Spatial Plan,” but it incorporates mapped elements and spatial analysis throughout the project. One of the main outcomes of the plan is the establishment of eleven particularly valuable areas, which are represented spatially, but the plan also relies heavily on impact assessment and analysis looking at interactions within the environment, cumulative impacts and future projections. In a way, this seems more holistic than some Marine Spatial Plans that are presented alone as a tool for achieving Ecosystem-Based Management.
Although the plan has been in the implementation stage since 2009, there is little documented information available about their experience in action. In addressing the implementation, Report No. 37 states that:

… the particularly valuable areas should be managed with special care. This means that knowledge development and environmental impact assessment for these areas should be given high priority, and further that a particularly cautious approach must be taken to activities in such areas and strict regulation enforced (Ottersen et al., 2011, pg 396).

This sentiment is easier said than done and one could argue that some system of legalized zoning or a more-developed licensing system needs to be associated with the established particularly valuable areas.

2.4 Technology for Marine Spatial Planning

Advancing geographical technologies make the ocean and marine spaces more visible and allow for more spatial understanding and planning. The most important geographical technology is Geographical Information Systems (GIS). GIS is a useful tool for creating maps at different scales and projections based on spatial data sets or information. It can also be used for data analysis and integration because it can identify common information between information layers and can even be used with modeling to predict changes in the marine environment (Rodríguez, Montoya, Sánchez, & Carreño, 2009).

There has also been considerable growth in recent years in the development of Decision Support Software (DSS) programs, which are interactive computer-based information systems that can support solutions to management problems (Power, 2007). Some examples of DSS programs include: Marxan with Zones, a tool for developing multiple zone schemes; MarineMap, a tool for designing Marine Protected Areas; and SimClim, a program for climate change impact and adaption assessment. Describing the numerous decision support system programs that exist is beyond the scope of this paper, but an excellent source with more information can be found at://www.ebmtools.org/
A technological tool that assists with data collection and organization, and which could be invaluable to the MSP process, is called a “wiki.” The most well known wiki is the online encyclopedia “Wikipedia.” A “wiki: is a web-based software program that allows users to create and edit a series of interlinked web pages in an organized way yielding an easy-to-use platform for collaborative works (Ebersback, Glaser, & Heigl, 2005). An example of a wiki used for gathering information about coastal and marine information can be found here: http://www.coastalwiki.org/coastalwiki/Main_Page.

It is also important to recognize the limits of tools such as GIS. You cannot store local knowledge (which can be important to understanding local values and context) in the form of anecdotal stories and narratives in layers of a map (Martin & Hall-Erber, 2008).
3 Research Methods

3.1 Introduction

Having spent one year in Ísafjörður the author was familiar with the pilot study location and formed a rapport with many of the users, which helped “break the ice” and gain cooperation. Having background knowledge of the area (gained through study at the University Centre of the Westfjords, which included fieldwork in the pilot area), was invaluable to the work of the project.

An important contact for the work was Gunnar Páll Eydal, an environmental planner at Teiknistofan Eik (a local planning firm), who provided a great deal of context and understanding of existing issues relating to the marine environment and planning in Iceland. Gunnar Páll Eydal was one of the authors of the Ísafjarðarbær Municipal Plan and was helpful in translating some of its contents.

The Association of Municipalities of the Westfjords (AMWF), in partnership with Teiknistofan Eik and the University Centre of the Westfjords, released the “Resource Utilization Plan for the Coastal Zones of the Westfjords” (Resource Utilization Plan) in 2009. The Resource Utilization Plan is short proposal that outlines a three to four year pilot study looking at the potential to begin ICZM and MSP in the Westfjords in anticipation of adoption of the EU Water Framework Directive, EU 2000/60/E (G. P. Eydall, personal communication, March 7, 2010). As part of the pilot study, they began exploring MSP frameworks and this current project was created to inform and begin this work.

In starting their initiative for the Resource Utilization Plan, people in the Westfjords were interviewed in order to assess what uses occurred in the region. Maps were created
with a coded system for demarcating activities (see Figure 11.). These maps provided an excellent starting point for this project.

Figure 11. Uses in the ocean around the Westfjords [map] adapted from Teiknistofan Eik, MSP initiative (2010).

To develop the structure of the project, the author partnered with Teiknistofan Eik and had discussions with members of the Association of Municipalities of the Westfjords (AMWF). It was important to the author that the project would have real-world applications, be consistent with existing local efforts to support Integrated Coastal Zone Management and that the project would benefit the inhabitants of the Westfjords of Iceland.

Outlined below are the methods used to develop the project and to answer the research question: What is the best-suited method of Marine Spatial Planning for the Westfjords region of Iceland?

3.2 Determining the Pilot Study Location

Careful consideration was taken to determine the best pilot location: the large fjord system of Ísafjarðardjúp (for the seaward boundary) in the Westfjords of Iceland. Ísafjarðardjúp is the largest fjord in the Westfjords with many smaller fjords emptying into it (See Figure 12.). The series of fjords to the north, Jökulfirðir, is not included in pilot study. This site
was chosen based on the ecosystem, the users and uses within Ísafjarðardjúp and the scope of the project.

3.3 Determining Stakeholders and Interviewing Techniques

Initial research was done to establish stakeholders within the region. This was an ongoing process that continued for much of the project’s duration. Once a stakeholder was identified, an email was sent explaining the project and asking for their involvement. If there was no response, a second email was sent followed sometimes by an attempted phone call, but more often, by a physical visit (to the harbor, to city hall, to Fiskistofa and Kampi Ehf). Pre-existing user maps produced by Teiknistofan Eik, a local planning firm, provided an invaluable starting point for establishing stakeholders within the region. Although the maps did not have any contact information, it provided a fairly comprehensive list of activities occurring within Ísafjarðardjúp.

3.4 Determining the Local Context and Conflicts within Ísafjarðardjúp

Semi-formal interviews were conducted with local stakeholders to gain an understanding of the values and potential user conflicts and to increase knowledge about the natural marine environment of the pilot area. Standard questions were asked about the nature of the interviewees relationship to Ísafjarðardjúp, if they have conflicts with any other users or see any potential future conflicts, but the interviews were designed to be informal, allowing the discourse to develop and grow according to the unique information that each user or stakeholder could provide. Spatial data provided by interviewees was recorded on maps and then translated into digital form using GIS software.
3.5 Mapping

Mapping was done using collated data from existing sources and collected data from interviews. This information was turned into maps using the GIS software ArcGIS®. See the list of maps 1-5 provided at the beginning of this document.

3.6 Data Scoping

Where possible, the author collated historical data to add to the baseline and transferred this to maps using GIS. This involved searching for information by contacting government ministry agents, scientists, planners, archaeologists, etc. and using traditional research methods, like reviewing academic articles, for any available spatial information. The author was not able to find any pre-existing mapped elements within the pilot area except some infrastructure maps around Ísafjörður, completed by the local planning agency. A few sources were able to provide GPS coordinates for specific locations, such as seal haul-out spots and aquaculture cages.

3.6.1 Filling in the Gaps

Where there was no official data to be found about a use or habitat, interviews were conducted to fill in the gaps. The author provided standard maps of the pilot study location on size A3 paper to interviewees who drew on the maps to delineate boundaries (such as cod trawling locations or important habitat areas for seabirds) and lines of activity (such as kayak routes).
4 Results - Pilot Study of Marine Spatial Planning in Isafjarðardjúp

4.1 Background and Context

4.1.1 The Need for Marine Spatial Planning in Iceland and the Westfjords

Arguably there is a need for MSP in every part of the world, but MSP could be of particular value in Iceland and the Westfjords because of the following:

- their long history and heritage related to the ocean
- the importance of fishing to their economy and culture
- fast growth in aquaculture
- fast growth in the tourism sector
- threats to the marine environment
- a total lack of Integrated Coastal Zone Management (currently sector by sector)
- a total lack of planning in the ocean
- the potential for sustainable development and growth of economy

4.1.2 History, Heritage and Fishing in Iceland

Historically, Iceland has always relied on the ocean. Iceland is not well suited for agriculture due to its geographic location, climate and the soil conditions, so fisheries have kept the nation alive. Some of the richest fishing grounds in the Atlantic are found around Iceland, providing the country with a valuable commodity for export and leading them to become one of the wealthiest nations in the world during the 20th and 21st century (Icelandic Ministry of Fisheries and Agriculture, N/A, b). Relying on the ocean and fishing are not only an important part of Iceland’s economy, but constitutes the underlying fabric of their heritage and history. Despite having a small population of just 318,452 people
(Statistics Iceland, 2011), in 2003 they were the twelfth largest fishing nation in the world, catching around two percent of global catch (Iceland Trade Directory a, N/A). The fishing industry is especially important when looking at communities outside of Reykjavík (Icelandic Ministry of Fisheries and Agriculture, N/A, c). Fishing and fish processing is often the most important source of jobs and economy for coastal communities. Fishing may play a larger role in Iceland’s economy in the coming years due to the global financial crisis because the industry, based on exports, is benefitting from the favorable exchange rate (Icelandic Ministry of Fisheries and Agriculture, N/A, c).

i. Fishing in the Westfjords

Throughout the centuries, the fishing industry has sustained the communities of the Westfjords. Even though the fishing grounds around the Westfjords are some of the best in the Atlantic, the fishing sector has declined in recent years, which many blame on the Individual Transferrable Quota (ITQ) system (Matthiasson, 2000). Still, the region continues to have one of the largest fisheries in Iceland. Certain towns in the Westfjords are almost completely dependent on fish factories that employ a majority of their residents; such is the case in the towns of Flateyri and Suðureyri.

4.1.3 Aquaculture in Iceland

In the past, aquaculture was not seen as very successful in Iceland and often resulted in damage to equipment, high mortality and escaped farmed fish, but recent years have seen greater success. In 2009, five thousand tons of farmed fish were produced consisting of ten species of fish, mostly Arctic char, Atlantic cod, Atlantic salmon and turbot (Icelandic Ministry of Fisheries and Agriculture a, N.A.). Since 2000, the main industry growth has been for the production of salmon, cod and char – the latter of which Iceland is now the world’s largest producer (Icelandic Ministry of Fisheries and Agriculture a, N/A). Iceland has not had as much success as neighboring countries when it comes to aquaculture, but many people have great optimism for the future of fish farming in Iceland due to continued research, improving and adapting fish cage designs and because of favorable changes in the environment due to climate change (Icelandic Ministry of Fisheries and Agriculture a, N.A.).
i. Aquaculture in the Westfjords

Aquaculture in the Westfjords mainly consists of Atlantic cod and blue mussel. There are at least three companies that have fish cages: Hradfrystihusid-Gunnvor, Álfsfell and Glaður ehf. Hraðfrystihúsið - Gunnvör (HG) is looking to expand their operation in the future, a potential site being at the mouth of Seyðisfjörður within Isafjarðardjúp (See Map 2.) (K. Joakimsson, personal communication, Aug. 3, 2010). Blue mussel farming is done in the pilot study area in a few locations by Vesturskel ehf.

4.1.4 Tourism in Iceland

Tourism is one of the fastest growing sectors in Iceland. The number of tourists visiting Iceland has increased at an annual average of six percent for the last decade (Icelandic Trade Directory b, N/A). Tourist activities on or relating to the ocean include sea angling, river and lake fishing, boat charters, wildlife viewing, yachting, rafting and kayaking. In 2003 the number of cruise ship passengers berthed in Reykjavik was 31,000 and in 2009, that number increased to just under 61,000 (Icelandic Tourist Board, 2010). Tourism in Iceland is projected to continue increasing, with up to a million visitors anticipated in 2020 (Icelandic Tourist Board, 2010).

i. Tourism in the Westfjords

The Westfjord, compared to the rest of Iceland, does not have as much infrastructure in place for tourism. A popular route that many tourists take when visiting Iceland is circling the country on Route 1, the Ring Road, which does not enter the Westfjords (See Figure 12.).
In the Westfjords the roads are not as well maintained and stretches remain composed of dirt or gravel. There are shortages of electricity (IceNews, 2010), long stretches between gas stations, and it is sparsely populated by only 7,137 people (Statistics Iceland, 2011), meaning that there are few airports, hostels, hotels, ports and marinas that typically support tourism.

Despite the lack of infrastructure, tourism in the Westfjords is quickly growing. Lonely Planet, a popular travel guide, recently listed the Westfjords as one of the top ten places to visit in the world (Lonely Planet, 2010). The Westfjords have Hornstrandir Nature Preserve, two of the largest sea bird cliffs in the Atlantic –Látrabjarg and Hornbjarg, Drangajökull glacier, Dynjandi waterfall, and a number of hot springs (Westfjords Tourism Office, N/A). In building their tourism infrastructure, they aim to create “sustainable tourism” and to be an “eco-tourist” location, valuing environmental protection while providing professional tourist services (Atvest, 2009). Sustainably developing the region is one of the core values in the Westfjords. The tourism sector is
growing and relies partially on a pristine environment to attract visitors (A. Óskarsson, personal communication, Sept. 9, 2010).

There is a large potential for growth in the tourism sector through sea angling. A few towns in the Westfjords offer this service, but there is room for growth (e.g. nothing is offered in Ísafjörður, the largest town in the Westfjords) (E. Oddsson, personal communication, Aug. 17, 2010).

4.1.5 Threats to the Marine Environment

The main environmental threats to Iceland’s oceans include untreated sewage and wastewater creating pollution (Persistent Organic Pollutants (POPs) and radioactive substances), ecosystem damage from trawling or dredging, and overfishing and climate change (Icelandic Ministry of Fisheries and Agriculture, N/A; Marine Research Institute, N/A). Compared to other countries eutrophication and pollution are generally not problems found in Iceland’s waters, but almost all land-based pollution ends up in the ocean and so pollution levels must constantly be monitored (Icelandic Ministry for the Environment, Ministry of Fisheries & Ministry of Foreign Affairs, 2004).

Pollution transported from far away can be found in the Arctic environment and tends to persist there for a long time (Arctic Monitoring and Assessment Programme, 2009). The chemical fungicide, Tribuyltin (TBT) has been detected locally in Iceland in dogwhelk populations, especially close to harbors where exposure is greatest (it is used as a paint additive on boats) (Icelandic Ministry for the Environment, Ministry of Fisheries & Ministry of Foreign Affairs, 2004). The strength of radioactive substances in Iceland’s waters varies, but the highest levels are found around the Westfjords in the East Greenland Current, which is known to bring radioactive substances from Sellafield nuclear waste reprocessing plant in England (Icelandic Ministry for the Environment, Ministry of Fisheries & Ministry of Foreign Affairs, 2004).

While there are relatively less threats to the marine environment in Iceland than in other parts of the world, it is important to acknowledge the fragile nature of northern ecosystems. Hydrocarbons (oil) is known to persist longer in cold waters than in the warmer oceans near the tropics (Dunbar, 1973), and yet there is no continuous monitoring for hydrocarbons in Iceland (Icelandic Ministry for the Environment, Ministry of Fisheries
& Ministry of Foreign Affairs, 2004). Being an island nation that depends on vessel traffic for trade and communication, monitoring the marine environment for litter and pollution should be done in a consistent manner.

Iceland continuously monitors POPs and radioactive substances nationally and also participates as a member of the Arctic Council in the Arctic Monitoring and Assessment Programme. Locally, there is a lack of monitoring of point sources for industrial wastewater and hydrocarbons (Icelandic Ministry for the Environment, Ministry of Fisheries & Ministry of Foreign Affairs, 2004).

The large-scale global threats from climate change, e.g. ocean acidification and increasing water temperatures, must also be taken into account when studying and planning within the marine environment in Iceland. A study by an assessment panel on climate change shows that Iceland’s waters could warm 0.3°C per decade in the coming decades (Icelandic Ministry of the Environment, 2002). These large-scale shifts have the potential to disrupt food webs, cause sea-level rise, increase the amount of invasive species and speed up extinctions (Intergovernmental Panel on Climate Change, 2007).

Due to drainage and the cultivation of marshes, there are few undisturbed wetlands left in Iceland. Only 18% of undisturbed wetlands remain in the western part of Iceland (Icelandic Ministry of the Environment, 2002).

i. Environmental threats in the Westfjords

There are a number of threats to the marine environment in the Westfjords. Due to the importance of the fishing industry, which has been strong for centuries, bottom trawling may have negative effects on seafloor structures, benthic life, fish species and more (Ocean Studies Board, 2002). In addition, areas of the ocean around the Westfjords are dredged for materials for the cement industry. Trawling and dredging can disrupt the food web, alter rates of decomposition of organic matter and recycling of nutrients through resuspension of bottom sediments (Ocean Studies Board, 2002).

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2 More environmental threats found in the pilot study location are listed below in section 4.4.1 Issues/Conflicts.
In the Westfjords, untreated sewage and wastewater is discarded into the ocean. Studies have shown that this is not having detrimental affects on the environment, but continuous monitoring should be in place\(^3\) (R. Trylla, personal communication, Aug. 11, 2010).

### 4.1.6 Sector-by-sector Management in Iceland’s Ocean\(^4\)
As is the case in most areas of the world, Iceland’s ocean management regime involves a number of different government ministries that manage single sectors:

- **The Ministry of Fisheries** implements policy in regards to living marine resources, including marine aquaculture. Their responsibilities also include protecting marine biodiversity and habitats.
- **The Ministry of the Environment** is responsible for protecting marine biodiversity and ocean habitats as well as preventing pollution in the marine environment. They are also give licenses for aquaculture.
- **The Ministry of Foreign Affairs** works together with the Ministry of Fisheries and the Ministry of the Environment regarding cooperation in international ocean initiatives and issues.
- **The Ministry of Agriculture** is responsible for managing aquaculture for freshwater species.
- **The Ministry of Industry** and Commerce is responsible for energy from renewable resources.

### 4.1.7 Planning in the Icelandic Marine Environment
In Iceland the Planning and Building Act (1997) excludes what is beyond 115 meters from the low water mark, therefore, municipal control only extends that far. Beyond that point, and out to the 200 nautical mile EEZ limit, it is national jurisdiction. There is no integrated planning in marine environment at the national or municipal level in Iceland. The EU Marine Strategy Framework (and a number of other conventions and directives) has sparked MSP initiatives in most coastal countries in Europe, including almost all other

\(^3\) More information about pollution in the Westfjords can be found in section 4.4 Issues and Conflicts

\(^4\) The information in this section was taken from Cauhépé, 2006, which you can see for a more complete overview of coastal and marine management sectors in Iceland.
Nordic countries. Iceland is a signatory to a number of international agreements that promote planning in the marine environment and come with obligations to implement ICZM, EBM and MSP.

The ministry of Fisheries and Agriculture has applied elements of Marine Spatial Planning (MSP) for the single-sector management of fisheries. There are permanent area closures to most types of fishing in designated places and along portions of the coast, permanent closures for spawning grounds, seasonal closures and temporary closures (Icelandic Ministry of Fisheries and Agriculture e, N/A).

4.1.8 Planning in the ocean in the Westfjords

Without a national planning framework and with municipal control extending only to 115 meters, planning in the waters of the Westfjords has never been done. There is interest in the Westfjords to begin MSP and Gunnar Páll Eydal, from Teiknistofan Eik, cited two concerns over the lack of planning in the ocean (personal communication, July 2, 2010):

1. No plan for the future exists
2. Municipalities have little weight in the decision making process

Iceland’s National Planning and Building Act require that municipalities work together to create regional plans (Icelandic National Planning Agency, 1999). In 2007 the municipalities of the Westfjords met to begin the process of creating a regional plan, but efforts were thwarted by disagreements over the potential for an oil refinery to be built in the region (A. Óskarsson, personal communication, Aug. 9, 2010). In addition, some of the local plans were not complete at that time and they turned their efforts to creating a “coastal plan” (A. Óskarsson, personal communication, Aug. 9, 2010).

4.2 The Ecosystem and its Users

It is important that Ecosystem-Based Management (EBM) principles be taken into account during Marine Spatial Planning. Therefore, when determining the pilot study location for this project, the ecosystem was considered. Isafjarðardjúp has the characteristics common to any fjord; it is long and narrow, formed by a glacier, making a “U” shaped valley that is
then filled in with seawater. Because it is long and narrow (See Figure 13.), Ísafjarðardjúp is surrounded by land on most sides, almost enclosing the marine ecosystem and forming a natural boundary for the pilot study. The currents flow throughout the fjord, entering in the south side of the fjord and flowing out the north. Fish stocks, shrimp, whales, seals, seabirds and human users move throughout the entire marine environment of Ísafjarðardjúp (including the smaller fjords), so taking anything less than the entire fjord for the pilot study would not be consistent with EBM principles.

4.2.1 Scope of the Project

The location and size of Ísafjarðardjúp are appropriate to the scope and limitations of this project. The author, residing in Ísafjörður, had access to stakeholders and therefore endeavored to understand the local issues. In order to complete the project within the timeframe, the seaward boundary extends out far enough to encompass most of the large fjord system without extending too far into the open waters surrounding the region.

The boundary at the mouth of the fjord extends from the point where Ísafjarðarbær touches the municipality to the north (Bolungarvík) and across to the furthest extending point on the peninsula on the opposite side of the mouth of the fjord. Including the entire fjord in the pilot area meant that three municipalities were involved: Súðavíkurhreppur, Strandabyggð and Ísafjarðarbær. These municipalities often work together as part of the Association of Municipalities of the Westfjords (AMWF) and have similar long-term goals for their communities, including sustainable coastal and marine resource management.

The landward boundary of the pilot study location was more difficult to delineate. Based upon EBM principles, it should extend as far inland as necessary. If a river system is being polluted one hundred kilometers inland from the shore, and that pollution effects the marine environment, that river should be included in the planning process. This meant that land-based activities and the municipal plans were taken into account for this pilot study.
Figure 13. Pilot study location, Ísafjarðardjúp, Westfjords region of Iceland from the author.
4.2.2 Sectors and Users in Isafjarðardjúp

A working document of stakeholders and users in Isafjarðardjúp is included in Appendix A. Attempts were made (emails and phone calls) to interview most of those users. Listed below are users that were successfully interviewed:

- Kayakers
- An outdoor/adventure company
- Tour operators
- A Whaler
- A fish company
- A Fisherman
- Fish Farmers
- A Blue mussel farmer
- Government workers
- Environmental consultants
- Planners
- Biologists

4.3 Issues and Conflicts

One of the main concerns within the region is population decline: considerable effort has been put into how to grow the local economy and keep people in the Westfjords. Many people are optimistic about the opportunities found in the ocean – which is part of the reason that the AMWF created the Resource Utilization Plan. Many people attribute the decline in population to the decline in the local fishing industry (Matthiasson, 2000). The ITQ system, which came into force in 1984, has had a pronounced effect on the local fishing industry and many people in the Westfjords have mixed and bitter feelings about it. Some feel that the ITQ system has privatized the fishing industry, making it hard for smaller operations to compete against larger corporations (G. P. Eydall, personal communication, July 16, 2010; G. E. Konradsson, personal communication, Aug. 12, 2010).
Compared to many parts of the world, there are few conflicts between ocean users in the Westfjords. The region is relatively unpopulated and lacks industry such as wet alternative energy and sea floor mining. Nearly all conflicts are related to fishing or aquaculture (as discovered through interviews with local stakeholders). Aquaculture was cited by nearly every stakeholder as a sector that may cause conflicts in the future.

4.3.1 Conflict Between Users

Between fishermen

Conflict within the region often happens between fishermen. The most common conflicts occur between fishermen catching the same species. Conflicts tend to be over gear or catching fish that are too small (H. Karlsson, personal communication, Aug. 17, 2010).

Between community members, the tourism industry and fish farmers

Conflicts between community members and fish farming tends to be for strictly aesthetic reasons (K. Joakimsson, personal communication, Aug. 3, 2010; H. Karlsson, personal communication, Aug. 17, 2010). Although this was voiced as a conflict, there are no known official complaints about the visual impact of the fish cages.

As the aquaculture sector grows and increases the amount of fish cages in the fjords, so will the visual impact. Hraðfrystihúsið - Gunnvör (HG), a local fish company with fish cages and a fish processing plant in the study area intends to place more fish cages within Isafjarðardjúp (See Map 2.), which may create more conflict in the future (K. Joakimsson, personal communication, Aug. 3, 2010).

Currently fish cages are not seen as having a negative impact on the tourism sector. Future growth and increases in the amount of fish cages without proper planning may have a negative impact on the tourism industry if they are placed close to important tourist and recreation sites (See Map 3.) (E. Oddson, personal communication, Aug. 17, 2010).

Between mussel farmers and fisherman

Currently there are no conflicts between blue mussel farming and the fishing sector but this is likely to change in the future. At present, there is only one blue mussel farmer who runs a relatively small operation, producing two hundred tons per year (See Map 2.). If his
operation expands spatial conflicts are likely to arise since his mussel lines are fixed to one location and would prevent fisherman from trawling in those spots (E. Oddsson, personal communication, Aug. 17, 2010).

**Between mussel farmers and fish farmers**

Without any spatial regulations, there will likely be conflicts between blue mussel farmers and fish farmers. If blue mussel farmers put their lines close to the fish cages, which is thought to be beneficial for the blue mussels, it may make fish farming operations difficult (i.e. navigating on a boat around the fish cages) (E. Oddsson, personal communication, Aug. 3, 2010).

**Between aquaculture and the shrimp fishery**

If HG’s long-term plans to place more fish cages in Seyðisfjörður are realized, they will be placed over some of the historically preferred shrimp grounds (See Map 1.). If the shrimp fishery restrictions are ever lifted, conflict could ensue (K. Joakimsson, personal communication, Aug. 3, 2010). Currently some blue mussel lines are fixed over historically preferred shrimping grounds, which again, could be problematic if the shrimp fishery were to open again (E. Oddsson, personal communication, Aug 17, 2010).

**4.3.2 Conflicts Between Users and the Environment**

**Shrimp stock decline**

Big changes in the marine environment of the Westfjords have been observed in recent years (Ástþórsson, Gislason & Jónsson, 2007), and in the Westfjords (and elsewhere in Iceland) this change is easily seen in the shrimp grounds (H. Karlsson, personal communication, Aug. 17, 2010). The Northern Shrimp (*Pandalus borealis*) is the only commercially exploited shrimp stock in Iceland. Three very distinct stocks are exploited: the inshore, offshore and the Dhorn Bank stock (Icelandic Ministry of Fisheries and Agriculture f, N/A). Assessment of the stocks can be quite localized, especially for the inshore stocks. The shrimp fishery began in the Westfjords and had great success for over eighty years until the stocks severely declined and area closures were enforced (H. Karlsson, personal communication, Aug. 17, 2010). Most inshore shrimp stocks have collapsed in recent years and this is the case in Isafjarðardjúp. There are still shrimp
processing plants in the region, but trawling within Ísafjarðardjúp has been banned for over ten years (G. E. Konradsson, personal communication, Aug. 12, 2010). Most research indicates that the decline in shrimp populations was related to predation from cod and that the two species are linked (Icelandic Ministry of Fisheries and Agriculture f, N/A). Research also suggests that when the waters warmed up, there were two year classes of Haddock that never migrated out of the fjords – some of them staying until they were four years-old, eating shrimp year-round (H. Karlsson, personal communication, Aug. 17, 2010).

**Changing Fish Stocks**

The warming of the sea is changing species distribution around Iceland (Ástþórs, Gislason & Jónsson, 2007). Certain species like capelin and mackerel are migrating north with warmer water (where they are increasingly found around the Westfjords) (H. Karlsson, personal communication, Aug 17, 2010). An increase in mackerel could have detrimental or unknown affects on zooplankton and capelin, which is an important food source for a number of commercial fish stocks, including cod (K. Joakimsson, personal communication, Aug. 3, 2010). Another fish that is seen more often with the warming waters is the wolfish. Changes in the ecosystem and in species distribution are likely to alter the food web in ways that are hard to study and predict (H. Karlsson, personal communication, Aug. 17, 2010).

**Aquaculture**

One issue with fish farming is how to treat and deal with waste from the fish cages. Waste from fish cages is known to change the benthic diversity and composition. Research is currently being done at Náttúrustofa Vestfjarða, a natural sciences research center in the Westfjords, to understand the effects that fish farming may have on the surrounding ecosystem. Anticipating negative impacts on the benthic environment, new and alternative ways of fish farming are being developed and new management tools are explored. For example, HG is considering the idea of having rotating fish cage sites as a means to reduce the build-up of waste and alleviate the environmental damage (K. Joakimsson, personal communication, Aug. 3, 2010).
Another issue local to Seyðisfjörður (within Isafjarðardjúp) is drifting ice. This has been shown to damage and cut the fish cage nets, resulting in their eventual removal from that fjord (Elias Oddsson, personal communication, Aug. 17, 2010).

There is concern that fishing for wild cod spawn in the area (See Map 1.) (that is used in aquaculture) may have negatives effects on the fishing grounds and cod stocks (B. Þórisson, personal communication, Aug. 11, 2010). Kristján Joakimsson from HG voiced this as a potential future issue, and went on to explain that their fish cages in Isafjarðardjúp require 150 to 200 tons of captured wild cod for production (personal communication, Aug. 3, 2010).

Pollution

Industrial wastewater and surface water run-off is not treated in the pilot area before it empties into the fjord. There was debate about the best way to disperse the wastewater -- either through one large pipe that emptied far out in the fjord, or from many smaller pipes emptying into various locations. In Ísafjörður there are a number of smaller pipes that empty into the fjord in varying locations.

There is not enough testing being done to monitor the levels of toxins in the environment – the last measurements were done ten years ago, when the results indicated safe pollution levels. Historically, pollution and toxins have not been a problem in the region, but testing should be done more often and on a consistent basis (R. Trylla, personal communication, Aug. 10, 2010).

In Ísafjörður, the largest town in the Westfjords, trash was burnt in a waste-burning incinerator (FUNI) until it was closed in 2010 because of consistently high levels of pollutants. Some citizens were concerned about toxin levels from FUNI, especially on days when there was a lack of wind and a hazy cloud from the incinerator would stay in the fjord for extended periods (R. Trylla, personal communication, March 14, 2011). Little action was taken until testing was completed by the Icelandic Food and Veterinary Authority in early 2011 (Icelandic Food and Veterinary Authority, 2011). In 2007, emissions levels at FUNI were twenty-one times the maximum EC regulation level. High levels of dioxins and PCBs were found in milk, beef and lamb meat from farms near the incinerator (Icelandic Food and Veterinary Authority, 2011).
Recent testing of dioxin levels have not included the marine environment, even though treated wastewater from FUNI emptied into a small catchment and then drained into Skutulsfjörður, one the fjords in Isafjarðardjúp. In the past, amounts of Cadmium and Zinc were found in the water, but in safe amounts. Dioxin measurements are scheduled to take place a few meters out from the point source where the treated wastewater emptied into the fjord (Ralf Trylla, Personal communication, March, 11, 2011).

If any abnormal or unsafe levels of dioxins or heavy metals are found in the marine environment, it will be important to map this information so planners and developers can avoid putting additional environmental pressures on these locations and take safety precautions (e.g. closing the area to local fishermen) into consideration.

4.3.3 Important Sites

Corals, called maerl, were found in Hestfjörður, roughly ten to twenty-five meters out from the shoreline, during a study involving benthic sampling (B. Þórísson, personal communication, Aug. 11, 2010). Maerl beds provide habitat important to biodiversity and can be an economically important resource as a dredged material (Birkett, Maggs & Dring, 1998). Maerl was found in benthic sampling in Isafjarðardjúp, but little is known about the extent of their growth and spatial location since they have not been studied in Iceland (B. Þórísson, personal communication, April 13, 2011). Without protection, corals are threatened by bottom fishing, pipelines, pollution, recreational activities, and changes in the environment due to climate change (Freiwald, Helge Fosså, Grehan, Koslow, & Roberts, 2004).

Æðey Island is listed as an Important Bird Area (IBA) by BirdLife International (See Map 4.). Æðey is one of the largest breeding grounds for the common eider duck, black guillemot and the Atlantic puffin. Æðey does not have national or international protection and predation from mink is cited as a management concern (BirdLife International, 2011). There are also a number of muddy wetland areas along the coast of the pilot area that provide prime feeding grounds for birds in the region (See Map 4.) (B. Þórísson, personal communication, Aug. 11, 2010). It will be important to map these important habitats for planning purposes.
Important recreation sites should be protected due to their value to the community and for tourism (See Map 3.). Within the pilot area there are two main tourism companies that are active on the water: Borea Adventures, which provides kayaking tours as well as yacht tours (often combined with kayaking or skiing) and West Tours a local tour operator and travel bureau that provides boats tours to various locations within Ísafjarðardjúp. There is a large potential for growth in the region for more sailing, wildlife watching and day cruises.

The main conflict for the tourism sector is competing with other places in Iceland to attract tourists to the region. Their biggest competitors are travel companies in Reykjavik who sell tours to other locations in the country (E. Oddsson, personal communication, Aug. 17, 2010). A number of important recreation sites for kayaking are found in the region, particularly around Hestfjörður and Reykjanes in Ísafjörður (the fjord) (See Map 3.). Sites that are used for tourism and recreation can lose value if the visual landscape is negatively impacted. A few such incidences have occurred, some outside of the pilot area but within the Westfjords, where peoples’ actions (such as illegally building a floating dock in front of their summer home or creating illegal roads along the coast) that have had a negative impact on the visual landscape (R. Karlsson, personal communication, July 22, 2010).

Vigur Island, one of the places that WestTours provides a day trip to, is an important site for tourists and for environmental and historical reasons (See Map 3.). Vigur Island is a small island but home to thousands of Atlantic puffins, common eider ducks, black guillemot and arctic terns. On the island is a mid eighteenth century farmhouse inhabited by one family who farm eider down (E. Oddsson, personal communication Aug. 17, 2010). Increased boat activity or the development of aquaculture (fish cages or blue mussel lines) could be detrimental to the tours that operate there (E. Oddsson, personal communication, Aug 17, 2010).

4.3.4 Additional Potential Conflicts

There is a proposed recreational harbor facility for Ísafjörður. The facility would be built in Skutulsfjörður behind the spit of land that Ísafjörður sits upon. The development would involve expanding the harbor and building up the land and infrastructure in order to support construction of the facility (A. Eliasdottir, personal communication, Aug 9, 2010).
Interestingly, a local small boat fisherman and Minke whaler saw no conflict, or reason for conflict, between whaling and the potential future tourism for whale watching (see Map 1.) (G. E. Konradsson, personal communication, Aug. 12, 2010).
4.4 Mapped Uses and Elements of the Marine Environment

The maps below provide a starting point for spatial analysis of the marine environment within the pilot study area. The spatial data for these maps was gathered from a number of sources, often based on local knowledge because authoritative sources did not exist or were unavailable for commercially sensitive reasons. It is an incomplete, working document that should be progressed further with additional maps capturing local knowledge and existing datasets.
Map 1. Fishing Effort in Isafjarðardjúp

Data Source: Gudmundur Eggert Konradsson, Fisherman and Whaler

Shrimp trawling is currently banned in this area, but it was done in the past for many consecutive years and it may open again in the future.
Map 2. Aquaculture

Data Source: Kristján Joakimsson, HG, Elias Oddsson, Vesturskel ehf and Hlynur Reynisson, liffraðningar, Biologist, Teiknesteðan Eik

*GPS coordinates were collected for fish cage and mussel line locations. These coordinates were not successfully placed in this map but they are provided in Appendix B.*

*The blue mussel areas marked on this map outline the areas that contain blue mussel lines but in reality the lines take up much less space.*
Map 3. Tourism and Recreation
Data Source: Bird Sites are from Bird Life International, 2010 and Bóbivar Jónsson, Biologist from Nattúnumfóður Vestfjarðs.
* GPS coordinates were collected for seal haul out locations (both Common and Grey). They were not successfully placed in this map, but they are provided in Appendix C.

Map 4. Species and Habitat
Map 5. Infrastructure
All Uses Superimposed onto one map. The sources of this spatial data is provided in the maps above.

Map 6. All Uses Superimposed onto one map.
4.4.1 Discussion on Mapping

Existing data sets of Global Positioning System (GPS) coordinates were gathered for seal haul out locations and for aquaculture (see Appendix B and Appendix C). Ultimately these coordinates were not mapped due to the technical nature of the source data (which involves knowing the projection of the data collected) and the skills required to transfer this. Although the author was trained in GIS and had consulted a practitioner about the problem, clearly more time and ability was needed.

As new data is collected for MSP, guidelines should be established to ensure consistency and a technical awareness of GIS required and the time to transfer data should not be underestimated.
Conclusions and Recommendations

There is a need for Marine Spatial Planning in Iceland. Historically there has been a lack of integrated management and planning when it comes to Iceland’s marine environment. Management that does occur is done on a sector-by-sector basis by a number of different government ministries with overlapping responsibilities. Although it is a relatively new concept, MSP is happening in other Nordic countries, in Europe and around the world, widely being recognized as a valuable holistic tool in marine management. In addition, Iceland is party to a number of International and regional conventions and directives that directly support MSP initiatives.

Throughout history, the people of Iceland have always depended on the sea. In Iceland the ocean and its resources sustained communities for centuries and today the ocean continues to be a source of food (for Iceland and for export), a place for recreation, a corridor for transport, a means for communication, a source for materials, the basis for innovative developments in technology and biotechnology and space for tourists and residents to appreciate. The ocean is valued in Iceland culture and that value should be reflected in planning and management so as to ensure its riches are sustained for future generations.

Marine Spatial Planning (MSP) provides an opportunity for the Westfjords regions to proactively plan for the future and sustainably develop the region. MSP can help assess what is currently happening in the region and where potential lies for more development. It can attract developers and help streamline processes like site selection and Environmental Impact Assessments (EIA). Developing clear consistent policy as part of the MS Plan ensures that the rules of game remain the same, providing investment security. A lack of MSP “suggests that everything can change, at any time” (Plasman, 2008).

The region is relatively unpopulated, but still there are conflicts at sea and many potential future conflicts with growing sectors like aquaculture and tourism. Marine Spatial Planning should reduce or resolve conflicts in the region in a number of ways. The MSP process itself should involve stakeholders in the region, giving them a sense of ownership
and responsibility. Through MSP, stakeholders should agree on a core set of values and objectives that should help resolve conflicts by examining tradeoffs, alternatives and compensation measures.

There are a number of threats to Iceland’s marine environment – some of them global in nature and harder to curb through management efforts, but other threats, such as sensitive habitat degradation, can be addressed through MSP and ICZM. Creating a centralized place for spatial information allows for spatial analysis that can guide management decisions like creating buffer zones, MPAs or temporal closures.

## 5.1 Recommendations

### 5.1.1 Place-based Regions

MSP should ideally be both a bottom-up and a top-down approach, developed with specific policy at the local/regional level but with high-level guidelines provided at the national level. MSP is inherently place-based, so any initiative in Iceland should be specific to different regions. Iceland is split into regions for administrative and statistical reasons (See Figure 14.), which may provide a starting point for planning initiatives, but MSP should be ecosystem-based, so it must also take ecosystems into account. The environment does not recognize administrative boundaries and yet it can be extremely influenced and affected by them. Similar to efforts in Canada (Large Ocean Management Areas), the UK and Australia (Bioregions), the marine environment around Iceland should separated into regions based on the features, processes and interactions that constitute that ecosystem.
In most cases, determining the ecosystem boundaries is a process undertaken by the federal government who consults researchers. This should not stop local efforts to begin the MSP process (like in the Westfjords), but it must be noted that once ecosystem-based regions are established, it may become clear that two regions should work together in order to properly manage and address issues specific to that area. Or it may become clear that a region has different, distinct types of ecosystems within it and policies and management should take that into consideration.

5.1.2 Establish a Lead Authority and Gauge Support

The first step once the region is established is to establish a lead authority. This should be a Coastal Zone Management Officer for the Westfjords. There is already an interest and partnership between the AMWF, the University Centre of the Westfjords and Teiknistofan Eik, but establishing a lead authority will help streamline the decision making process. It would be ideal if the Coastal Zone Management Officer be stationed in Ísafjörður with an office in Vestrahúss. This location will provide easy access to the above-mentioned institutions as well as the Marine Research Institute.

The Coastal Zone Management Officer leading the MSP initiative must work closely in tandem with the land-use planners – this is imperative since spatially their planning
areas will overlap; there is no defined break in the ecosystem between the mountains, the estuaries, coastal zone and the sea. It will be essential for the officer to gain knowledge about the planning regimes and for the planners to learn about the values of MSP as a tool to achieve sustainable development.

In order for a Plan to reach its full potential, it needs legal backing. This will involve creating new legislation, modifying legislation or adding MSP provisions to legislation under development.

Once policies and plans are in place, enforcement should be done through existing authorities and government ministries with assistance from the Coastal Zone Management Officer. MSP should not replace single-sector management, but the policies and spatial analysis should guide and inform single-sector management under the umbrella of EBM and local values.

5.1.3 Organize Stakeholders and Develop the Process

Identifying stakeholders within the region should not be too difficult considering the small population and intimacy of communities in the Westfjords. Similar to the initiative in the Shetland Islands, anyone self-identifying as a stakeholder, and that is willing to be involved and participate, should be given the opportunity to do so. An extensive stakeholder analysis could have potential benefits, but if funds are limited, resources and time may be better spent in other areas since the stakeholders and their interactions have largely been identified already.

A symposium should be held to introduce the concept of MSP, bring stakeholders to the table and gauge support. Formal announcements should advertise the symposium: fliers, local newspapers, local radio stations and through mailings and email (refer to the contact list in the Appendix). The second part of the symposium should be optional for stakeholders who wish to continue participating, and should be more of a workshop to determine values of the region, develop specific objectives and discuss the long-term sustainability of the initiative.

The next step should be forming a working group or a committee that will meet regularly and lead the project. The working group should consist of no more than twenty
people for the sake of efficiency, but a wider forum of interested stakeholders can remain involved through email updates. Four key institutions should be involved:

1. The University Centre of the Westfjords – as an institution focusing on coastal and marine resource management, this is an obvious partner with experts in the field as visiting professors and students.
2. Teiknistofan Eik, a local planning firm
3. The Association of the Municipalities of the Westfjords
4. The Marine Research Institute (Hafrannsoknastofnunin), the Westfjords branch

The working group should be a key player in executing the MSP process and ultimately creating the MS Plan. In the Westfjords this should involve drafting new policies. The working group should review existing policies (examining what is consistent and what is contradictory) and work to create drafts of a formal MS Plan. This process should be cyclical and at least one draft should be released for public consultation before the final MS Plan goes into effect.

5.1.4 **Continued Stakeholder Involvement**

Stakeholder involvement should start at the beginning of the process, as suggested with the symposium and workshop. If there is a lack of public interest, literature should be distributed and a second attempt should be made. If there is still a lack of interest, additional efforts should be made, such as interviews, personal invitations and follow-up phone calls.

Due to the size and population of the Westfjords, continued stakeholder involvement will be extremely important to ultimate success and approval of the MS Plan. If local companies like Hraðfrystihúsið - Gunnvör (HG) are involved and help determine the value and objectives, the more likely they are to approve of the final plan and help with implementation and compliance. Kristján Joakimsson, the production manager at HG, already expressed interest in being a part of a working group for a MSP initiative in the region (personal communication, Aug 10, 2010). Building on that example, HG has a number of fish cages within the region and their participation in the working group would provide industry insights and could help determine solutions to the problems that so many are forecasting.
As the actual MS Plan is developed, public consultation should be a statutory phase of the process as is the case in many countries practicing MSP. The consultation period should last a minimum of twelve weeks. Suggestions and comments should be analyzed and reviewed by the working group and addressed in a timely matter. Revisions should be made or if no changes are made, explanation should be provided. A listing of public comments and responses from the working group or Coastal Zone Management Officer should be posted on a website for the initiative to provide transparency.

Beyond reviewing drafts of the MS Plan, stakeholders should be provided with information throughout the initiative in various formats: (as mentioned above) there should be a website for the initiative, literature in the form of brochures, fliers should be hung announcing the release of drafts in local grocery stores (Samkaup, Bónus, etc.), local pools and announced through community councils, in local papers and radio stations.

Incorporating local knowledge into the data is another way that stakeholders should be involved. The author gathered local knowledge (spatial information) through interviews in order to fill in the gaps of existing datasets. This process built user interest in Marine Spatial Planning and almost all participants expressed that they would be willing to be a part of a future MSP initiative.

5.1.5 Determine Objectives, Values and Parameters

A key objective in the Westfjords region is job creation and increasing the population. The Westfjords should utilize MSP as a strategy to promote development, but in a sustainable manner. It is intrinsic for MSP to have multiple-objectives, but the Westfjords should weight their objectives, similar to Norway’s efforts in the Norwegian sea where focus was placed on the oil and gas industry, shipping and fishing (Ottersen et al., 2011). From the outset, defining specific objectives will help to determine if the MS Plan is working or if it needs to be adapted. The following should be determined from the outset, before data collection or analysis begins.

- Define current trends, demands for space and conditions
- Define key values of the marine area
- Define strategic objectives and goals
- Identify general spatial and temporal constraints (e.g. an “interactions matrix”)

Without outstanding examples from other MSP initiatives to follow, determining the specific objectives and parameters that are measurable (with data!) for adaptive management and evaluation, will be one of the initial challenges and considerable thought and energy should be put into this step of the process. It may work well in the Westfjords to measure success in reaching the proposed objectives through collaborations with students in the region (see more about this in section 5.1.8 Monitor, Evaluate and Adapt Management).

5.1.6 Collect and Collate Data and Spatial Information

Collecting and collating data is time consuming and should focus on existing datasets that are up to date. Although it is better to gather data that already exists, certain sets of data are more valuable than others. For example, substrate mapping is extremely important for understanding the marine ecosystem and habitats, but consideration has to be given to its actual use. For the pilot project in Ísafjarðardjúp it was difficult to find existing spatial data that covered the entire fjord. For example, there was some data about benthic life collected by Náttúrustofa Vestfjarða, but only from samples in a few locations and spread throughout the fjord. It will be important to transfer this data into a map so that different developments can avoid any important habitats or species. Where scientific study does not exist, filling in the gaps with data from interviews with stakeholders is a relatively cheap way to see the larger picture without exhausting limited resources and time.

Data for MSP typically falls into three categories (Ehler & Douvere, 2009):

1. Biological and ecological distributions
2. Spatial information about human activities
3. Oceanographic data (depth and current direction)

It is recommended that the working group should be split into four smaller focus groups to help collect and collate data of these three types of information listed above, as well as one group that is focused on reviewing policy. Part of the job of the Coastal Zone Management Officer will be to work with researchers to weight certain environmental and ecological elements against each other, such as an area with high biodiversity or with a unique feature.
Data is only beneficial if it is organized and managed properly, therefore developing a wiki as part of the MSP initiative website could be a helpful tool. The wiki could be used as a way to organize information that the working group and Coastal Zone Management Officer gather in a centralized place or it could be opened up to the general public, allowing users to upload data at any time. The wiki could also help provide a level of transparency and accountability because it creates a place where people can see what information is and is not available. For example, in Germany, they use a wiki called the Geo-portal (http://gdiwiki.bsh.de/wiki/index.php/GDI-BSH_Portal_Benutzerhandbuch). The Coastal Zone Management Officer who leads the MSP initiative should also have expertise in GIS in order to produce user maps representing the region.

5.1.7 Analyze and Assess Data and Spatial Information

Beyond just mapping existing uses, habitats and oceanographic features, further spatial analysis should be completed. This may include:

- **Future use / opportunity mapping** – this could be done to identify the best places for offshore wind farms, aquaculture or sea angling.
- **Suitability analysis mapping / constraint mapping / establishing buffer zones**
- **Cumulative effects and pressures**
- **Determining the best place for Marine Protected Areas**
- **Emergency response mapping and plans**

There are a number of different decision support software tools and geotechnologies to assist with spatial data analysis. The website: http://www.ebmtools.org/ provides a wealth of information and includes an Ecosystem-Based Management tools database.

5.1.8 Develop the Marine Spatial Plan

The Westfjords should be proactive and develop a MS Plan, despite the fact that it will have non-statutory standing. As seen in the Shetland case study, plans can be created and later obtain legal backing -- a non-statutory plan was developed (including a policy guide) and it was later adopted through the terrestrial plan and made statutory through the Marine [Scotland] Act, 2010.
When the MS Plan is being developed, determining enforceable principles and objectives becomes critical – this gives decision-makers, the Coastal Zone Management Officer, and enforcement officers the defensible means to make and enforce difficult decisions. In the Westfjords, if developing the tourism industry is identified as one of the key values, it may mean that important recreation sites should be given some level of protection and that regulations should establish buffer zones to determine how close industry (such as aquaculture, wet renewables, or aggregate extraction) can be placed to those sites.

MSP is inherently forward-looking and also needs to be adaptive to reflect a changing society and environment. Thus, timeframes must be established that are both long-term, but also short enough to be reflective and adaptive. In Iceland, the municipal and regional plans must span a period of twelve years. The MS Plan should also span twelve years, but similar to the “Outlook Report” in the GBRMP, a review of the MS Plan (with a report) should occur every 6 years.

The MS Plan should be developed for the region, but also “nested,” within existing national and international regulatory frameworks. This means that consideration of local context must be balanced with larger national interests as well as those of neighboring countries, such as Norway and Greenland. As stated in section 5.1 Place Based Regions, the MS Plan must also be developed in tandem with other regional efforts when the ecosystem boundaries or services are shared. This may mean more Ecosystem-based co-management efforts between Iceland its neighbors to manage migratory fish stocks.

The boundaries for the MSP initiative should be clearly determined. Municipal/regional control in Iceland should extend twelve nautical miles from the low water mark. The Landward boundary should extend inland as far as that environmental feature is affecting or affected by the marine environment; this may include features like rivers, wetlands or inland to nonpoint sources of pollution such as a sheep farm. This is a vague definition of the landward boundary and practice may show that it needs to be defined with greater clarity, but leaving it open-ended will promote cooperation between the marine planners and terrestrial planners.

It was established that sustainable development, growing economies and increasing the population are important values and objectives for the region. More values and
objectives will be added to this list after stakeholders are involved, but based upon those values, one of the most important outcomes of the MS Plan in the Westfjords should include a policy guide that promotes and coordinates future development. It should guide developers, similar to the policy guide from the Shetland MS Plan, through the zoning, regulation and the permitting process.

Ultimately, a zoning system should be established in the Westfjords, but key spatial data sets and analysis are needed before a complete zoning system can be developed. Data, such as 3D substrate maps and benthic community sampling, are not yet available or are incomplete for the region. Once they are obtained, a substantial amount of work is still necessary through analysis and modelling to translate that data into something useful like establishing suitable areas for opportunity or important benthic communities that should be protected by legislation. This does not mean that management measures and planning constraints, such as creating temporary closures or buffer zones should not be exercised. The Westfjords should be proactive and establish a Marine Protected Area (in addition the one in Breiðafjörður in the Southern part of the Westfjords – not within the pilot area) or at least develop a series of protected zones or buffers around unique features, such as the corals in Hestfjörður near Reykjanes or for important archeological sites (the author had little success in gaining access to spatial data or coordinates pertaining to archaeological sites).

5.1.9 Implementation of the Plan
If the MS Plan never gains legal backing, it will lack a robustness for implementation. For this reason, it is important to develop a clear, thoughtful planning document that coincides with national and international frameworks and policies, in order to give it the best chance for approval.

Establishing a Coastal Zoastal Zone Management Officer in the Westfjords as the lead authority is important to the implementation stage for two main reasons: first, they should have the knowledge base and training to serve as a liason between scientists, government officials, politicians, users, etc. and second, their decisions will not be affected by local politics (at least not as much as elected officials) and their vision for the region may be farther reaching than politicians who are cycled through the election process every few years.
Once the MS Plan does have legal backing, implementation and enforcement of can be difficult and costly. For the Westfjords, involving stakeholders and creating policies and regulations that people agree upon (or at least had the chance to voice their opinion on) will be one of the keys to assuring that regulations are followed. In other words, voluntary compliance and self monitoring will (unfortunately) be one of the main enforcement tools. Therefore, money spent for educational programming and for providing literature and guidelines may be a solid investment, at least in the initial implementation.

5.1.10 Monitor, Evaluate and Adapt Management

The importance of monitoring, evaluation and adaptive management cannot be stressed enough. This will have to happen under legislation like the Icelandic Strategic Environmental Assessment (SEA) Act (2006), which require measuring environmental impacts from plans and programs and require monitoring and evaluation with tangible indicators.

The key first step in measuring any management performance is, again, setting clear objectives and outlining management strategies to meet those objectives. Effectiveness is then measured by how well those objectives are met (Day, 2008). Understanding if objectives are being met may be as simple as counting the number of jobs created or as difficult as trying to assess how many fish there are in the sea. In any case, assessment of what already exists – baselines – is needed first.

The general lack of environmental baseline information in the Westfjords will slow down the MSP process, but taking time to properly establish solid baselines is an essential step and will help avoid the problem of “shifting baselines.” Monitoring is extremely important but also very expensive, therefore a simple monitoring system should be implemented at the beginning and then adapted and improved as necessary. Monitoring methods should be adapted to local situations and should involve stakeholders as much as possible, such as getting fishermen to report what they catch where and when for management purposes, without creating a conflict of interest. One important piece of advice from Day (2008) is to monitor inside and outside of the management zone in order to compare results and understand if change is driven by management practices. At the end of the day, monitoring and evaluation is useless if management is not adapted and updated to improve our success.
An inexpensive monitoring option could involve students from the University Centre of the Westfjords who are studying coastal and marine resource management. As part of their ecology class, biodiversity samples could be taken. In the ArcGIS course, students could work with datasets from the region provided by local research institutes. In a methodology course, students could distribute and analyze surveys or conduct interviews asking about the communities’ acceptance and approval of the MS Plan. More partnerships involving students would benefit both parties involved – students can apply what they are taught to the real world by collecting data at targeted locations and providing analysis at little cost. For quality assurance, the data would have to be gathered with guidance from professors and be reviewed by working experts before it is used in the MSP process.

Another benefit of MSP and involving stakeholders is that industry and users may be more willing to share their private datasets. Fishing companies undoubtedly have large datasets based on their catch. This information may be essential in establishing baselines in a data-poor region like the Westfjords. This type of data will always have to be scrutinized in order to assess the validity and value and to avoid conflict of interest.
6 Further Discussion

6.1 Marine Spatial Planning – Benefits for Iceland and the Westfjords

Mark Miller, a professor of Marine Affairs at the University of Washington, highlighted the need to sell MSP in the Westfjords and in Iceland as a way to develop the region economically and in a sustainable manner. If the MSP initiative is framed as an environmental conservation tool it may not be embraced, but if it is framed as a way to create jobs and sustain those jobs, it will probably gain approval among communities (M. Miller, personal communication, July 2, 2011). The Ministry of the Environment lists these economic sectors in Iceland that are related to the ocean and its resources (2004):

- Fishing
- Fish processing
- Aquaculture
- Tourism: whale watching, nature expeditions, sailing, sport fishing
- Biotechnology
- Manufacturing of gear and equipment (for fishing and fish processing)
- Software production and development (for fishing and fish processing)
- Shipbuilding
- Transport
- Service and support industries

These industries (many of which are already operating in the Westfjords) could be developed further in the Westfjords. MSP should provide investment certainty for developers in the region, while simultaneously considering the environment and cumulative impacts.
MSP creates a source of information that saves developers time and money, whether it be in the initial start-up phase, streamlining the Environmental Impact Assessment (EIA) process or avoiding or resolving conflicts. A real world example of this was cited in the Shetland case study when a company decided to do business in the region because it had a good baseline of information ready for use in GIS for site selection and consultation, as well as having established policy that encourages economic growth.

Icelanders, and the people of the Westfjords in particular, have a long, rich history involving the ocean and its resources. Aquaculture and tourism are growing sectors and people in the Westfjords are especially interested in growing and developing their region through sustainable coastal and marine resource utilization. Currently, there is no local planning done in the Icelandic marine environment and the management that does take place happens at the national level and is done individually by sector with a lack of holistic oversight.

The Association of Municipalities of the Westfjords has already shown interest in extending their responsibilities to include management in the ocean, beyond the 115-meter mark. Marine Spatial Planning has the potential to benefit the Westfjords in a number of ways: by supporting sustainable development of new industry, by improving the management of existing uses, by reducing conflict between users and between users and the environment, by protecting vulnerable species and habitats, by informing local policy and by improving communication between stakeholders, managers and scientists to determine values, objectives and to create a holistic vision for the future.

6.1.1 Scaling from the pilot area to the Westfjords

The pilot area was chosen because it was one of the most-used marine areas within the Westfjords and the author felt that it contained many users from a variety of sectors and therefore best represented the region as a whole. This assumption may be inherently flawed since MSP is place-based. Even a region as small as the Westfjords can contain a great variety of users, contexts and ecosystems.
6.2 Lack of Baseline Data

Despite a lack of baseline data in the region, establishing the framework and stakeholder working groups should begin, as should policy research and development. Baseline data is important, especially when it comes to monitoring and evaluating the success of management efforts, but a lack of baseline data must not delay the MSP process. Starting the MSP initiative and creating working groups can play an important role in determining what data is needed for baselines and what should be prioritized.

6.3 The Best Use of Funding?

Resources should be first put towards hiring a Coastal Zone Management Officer, irrespective of an MSP initiative. Arguably, any work that he/she does would benefit the eventual MSP process once it does begin, but it is important to keep in mind that the AMWF has already shown interest in supporting MSP efforts as seen through the Resource Utilization Plan for the Westfjords and their MSP pilot study.

6.4 Jurisdictional Power

It may seem futile to begin a regional MSP process and begin creating a MS Plan when municipal control only extends out 115 meters, but proactively moving ahead with the planning process in the marine environment will create a suitable management scale, which will hopefully be adopted at the national level. It is not appropriate for national level government officials to make decisions about what goes on in the water in the Westfjords unless it has an overriding national interest. The resources management and administration for small-scale development, like a local entrepreneur starting a small mussel farm, would be best placed in the locality. Additionally, the National Planning and Building Act already requires regional plans, which are only now developing around the country. There is an opportunity for the Westfjord’s to be one of the first areas in Iceland to produce a regional plan that includes the marine environment. This established MSP framework, based upon research and findings from pilot studies, could set an example for the rest of the country.
and support the adoption of MSP as part of the statutory, nation-wide planning process. Furthermore, in *The Ocean, Iceland’s Policy (2004)*, it is stated:

…responsibility for the conservation and utilisation of marine ecosystems is best placed in the hands of those states directly affected by the decisions taken and with the greatest interests at stake (pg. 3).
7 Strengths and Weaknesses

7.1 Strengths

The intended outcome was to provide knowledge of what methods of MSP worked well in other places (taking note of regions with similar environments and social context) and applying some of the methods to the Westfjords. With essentially no funding, a limited amount of time and only one person working on the project, the MSP process has started in the Westfjords. This important step can assist with current and future efforts. There is now an archive of spatial information (including an assessment of what is and is not available) as well as a record of contacts, which can be used in the future to continue MSP efforts in the region.

7.2 Weaknesses

7.2.1 The Language Barrier

The Author is a native English speaker and not knowing Icelandic became the largest weakness of this project. Many policy and planning documents, such as the municipal master plans, were not translated to English. Additionally, information regarding the environment in and around Isafjarðardjúp was often only accessible in Icelandic. Not only did this weakness make finding information more difficult, it also made collecting the information that was available take longer than it would have otherwise. In the same vein, communicating and interviewing took longer. Additionally, some of the stakeholders contacted for information or for an interview may have been less likely to respond to an email written in English, as opposed to their native tongue.
7.2.2 The Need For More Interviews

Ideally, there would be more interviews to inform the mapping and validate the spatial information that was mapped. Due to time and mobility constraints, a smaller number of interviews were performed than the author originally intended.

Without a car it was difficult to get to the towns outside of Ísafjörður that were also part of the pilot area. Without more information from the municipalities of Súðavíkurhreppur and Strandabyggð, this pilot study cannot be considered complete.

Further consideration should be given to the coastal homeowner and coastal sheep farmers. Given their jurisdictional power out 115 meters from the low water mark, they are obvious stakeholders that should have been consulted.

Furthermore, additional interviews should have been collected to support and increase the accuracy of any spatial data that was obtained. Especially for sectors that are particularly important in the area, such as fishing and tourism.

7.2.3 Time Constraints

MSP initiatives typically have a staff of people working full-time for a number of years before they get off the ground. While the author attempted to create a realistic timeline and schedule for obtaining interviews, it took longer than anticipated to pin people down (especially during the summer month when many people were on vacation). The three months allotted for collecting interviews proved to be insufficient.

7.2.4 Lack of focus on Policy

This project lacks focus on policy as an outcome of MSP. Establishing policy, which guides the decision-making process with consistency and clarity is arguably one of the most important outcomes of MSP, as seen in the case study in the Shetland Islands and the GBRMP. The lack of focus on policy for this project is largely due to the language barrier (which made it hard to fully examine pre-existing policy and policy frameworks in Iceland) and time constraints – the amount of work required to develop policy necessitates forming a working group, a feedback loop mechanism for writing the policies and policy research.

http://www.westfjords.is/media/files/Wellness%20in%20the%20Westfjords%2017032009.pdf


http://www.marinesthespecies.org/berms


Icelandic Ministry of Fisheries and Agriculture b. (N/A). *History - the Icelanders and the Sea*. (J. Þ. Þór, Producer) Retrieved March 1, 2011, from Icelandic Fisheries: http://www.fisheries.is/history/


# Appendix A

A Working Document of Stakeholders and Users in Ísafjarðardjúp

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<td>kayaking yachting</td>
<td>Runar Karlsson</td>
<td>co-owner</td>
<td>Borea Adventures, North Explorers</td>
<td>869-7557</td>
<td><a href="mailto:runar@boreaadventures.com">runar@boreaadventures.com</a></td>
<td>Hlíðarvegur 38, 400 Ísafjörður</td>
<td><a href="http://www.boreaadventures.com/">http://www.boreaadventures.com/</a></td>
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<td></td>
<td>boat tours</td>
<td>Elias Oddson</td>
<td>Travel Agent</td>
<td>West Tours</td>
<td>456-5111</td>
<td><a href="mailto:westtours@westtours.is">westtours@westtours.is</a></td>
<td>Adalstræti 7, 400 Ísafjörður</td>
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<td>Port of Isafjordar</td>
<td>450-8080</td>
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<td></td>
<td></td>
<td>894-6125</td>
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### Kayaking
- Martin

### Sea angling
- ?

### Diving
- Alan Deverell (Diver) 845-7409 alandeverell@aol.com

### Whaling
- Gudmundur Konradsson (Fisherman, Whaler) gek@snerpa.is

### Shrimping
- Cod fishing

### Cod fishing
- Gísli Jón Kristjánsson (Fisherman) 47@simnet.is

### Fishing Ministry (national)
- Kristján Helgason (Ad. Min of Fisheries and Ag.) Kristján.freyr.helgason@slr.stjr.is

### Fishing AQuaculture
- Kristjan G. Jóakimsson (HG fishing company) kgi@frsti.is 410 Hnífsdal http://frosti.is/
- Hlynur (Health Inspector) Ísafjarðarbær
### Non-human Use

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<td>Arctic Foxes</td>
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## Appendix B

### Aquaculture Coordinates

#### Blue Mussel Line Coordinates

Original Data from Hlynur Reynisson, líffræðingur, Biologist
Feb. 11, 2011

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Feb. 11, 2011

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# Appendix C

Common and Grey seal haul out locations in the Westfjords

## Seal Haul Outs

Original Data from Erlingur Hauksson, Marine Research Institute  
March. 1, 2011

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