Review Tools for Ecosystem-Based Marine Spatial Planning

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Keywords : EB-MSP, EBM, Ecosystem services approach, Marine spatial management tool

1. Introduction

Background

In Korea, many marine activities reports thus far have been conducted about fisheries and marine transportation. However, current uses of ocean resources are expanding to include developments of ocean renewable energy (such as tide, wave, offshore wind, etc.), seabed mineral resources, seawater resources, marine tourism, and marine biological resources. As uses and development of marine resources have increased, their impacts on ecosystems and ocean health have risen dramatically. Korea's primary marine space management tools consider 1) the coastal waters zoning system, 2) the regulations for an approval or permission, 3) the marine environmental impact assessment, and 4) marine space and resource surveys and information systems, etc. The current system and tools for marine spatial management might be inadequate to maintain the balance among marine activities and to address the impacts of increasing marine use and development.

Accordingly, the international communities and prominent ocean countries have recognized the importance of Marine Spatial Planning (MSP) and have focused on improving the health of marine ecosystems, maintaining multi-functional uses of marine resources, and developing comprehensive management. As a result, these groups have introduced MSP as a practical approach to Ecosystem-Based Management (EBM).

Method and Purpose

In this paper, we introduce Ecosystem-Based Marine Spatial Planning (EB-MSP) and then also look at the tools for effective implementation of EB-MSP. The following case studies show how these tools and decision support systems have been applied in the MSP process in western nations. Through the case studies, we look for driving forces and constraints. This paper describes the institutions, mechanisms, and decision-making structures relevant to EB-MSP in South Korea and identifies the current status and limitations of Korea's EB-MSP process.

The purpose of this research is to review social, spatial, and economic tools related to EB-MSP. It also explores an advanced mechanism for implementing EB-MSP in Korea. This research attempts to provide recommendations for an improved policy and decision-making tool for applying EB-MSP.

2. What is Ecosystem-Based MSP : Why and How

Ecosystem-Based Management

Human populations and their demands for land, energy, and natural resources are growing exponentially, creating pressures on ecosystems that were not anticipated by conventional approaches to natural resources management (Leisinger et al., 2002; Karkema et al., 2011). To address this problem, managers are developing more holistic strategies, such as EBM, which is a broad approach, involving management of species, other natural commodities, and humans as components of the larger ecosystem.

Scientists and policy makers have already thought carefully about an ecosystem-based approach and have applied it to land spatial management. EBM of terrestrial systems began in the 1950s. However, interest in marine EBM has grown, particularly in recent years. In 1992, the Earth Summit held in Rio de Janeiro, Brazil adopted measures to specifically protect and develop ocean resources (UNCED, 1992). More recent ocean policy initiatives have continued to emphasize the importance of balancing resource use with sustainability and to progress toward EBM, founded on scientific principles. In March 2005, the Communication Partnership for Science and the Sea (COMPASS) released a scientific consensus statement on marine EBM. This document reflects our scientific understanding of marine ecosystems and the concepts of EBM, specifically the use of ecosystem-level planning, cross-jurisdictional management goals, zoning, networks of marine reserves, habitat restoration, co-management, adaptive management, and long-term monitoring to achieve EBM (Mcleod et al., 2005). Since the 1992 Earth Summit, many definitions of EBM, both marine and generic, have emerged, and many practitioners are now attempting to implement this kind of management strategy. Since marine EBM has evolved through many international documents and workshops, public concerns about marine environment degradation has increased.

Ecosystem-based management is intended to replace the use of a single-sector approach to management. EBM for the oceans is an integrated approach to management that considers the entire ecosystem, including humans. The goal is to maintain an ecosystem in a healthy, productive and resilient condition so that it can provide the goods and services humans want and need. EBM differs from many current approaches that usually focus on a single species, sector, activity or concern; it considers the cumulative impacts of different sectors. Specifically, EBM (1) emphasizes the protection of ecosystem structure, functioning, and key processes, (2) explicitly accounts for the interconnectedness within systems, recognizing the importance of

interactions among many target species or other non-target species, (3) acknowledges interconnectedness among systems, such as air, land and sea, (4) integrates ecological, social, economic, and institutional perspectives, recognizing their strong interdependence, and (5) is place-based in focusing on a specific ecosystem and the range of human activities affecting it (Mcleod et al., 2005).

The EBM Roadmap (Taylor et al., 2009) defines the eight core elements of EBM, which focus on (1) sustaining nature's services[1], (2) scientific evidence, (3) geographic scales, (4) ecological linkages, (5) cumulative impacts, (6) tradeoffs among human activities, (7) adaptive management, and (8) a network of people and information (Taylor, 2009).

The oceans provide the necessary ecosystem services[2] upon which humans and all other life on Earth depend. Marine ecosystems or marine ecosystem services (such as storm protection, waste processing, and climate regulation) are affected by human activities in terms of demands for goods and services (e.g., seafood, marine transportation, energy, and recreation). The core of ecosystem-based management is to continuously maintain ecosystem services, which address the required values of humans (such as food, fisheries, climate regulation, and recreational opportunities). Valuation of marine and coastal ecosystem services is critically important to an EBM strategy that seeks to maintain and enhance the delivery of beneficial services (Meleod, Leslie, 2009). Ecosystem processes are critical to the functioning of coastal and marine systems. When they also contribute to human wellbeing, they are known as ecosystem services, or a combination of ecosystems services can be called human welfare benefits (Boyd and Banzhaf, 2007)[3]. Also, UNEP (2011) mentions that there are key things that an EBM process must accomplish: it must (1) recognize connections within and across ecosystems, (2) utilize an ecosystem services perspective, (3) address cumulative impacts, (4) manage for multiple objectives, and (5) embrace change, learning, and adapting.

All things taken together, these core concepts set EBM apart from traditional management. Particularly, EBM emphasizes social-economic sustainability and science, as well as ecosystem health. They are key considerations as the manager begins to connect concepts to practice and to implement EBM.

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1 Nature's services are called ecosystem services by scientists(Taylor, Peter H. and V. DeLauer. 2009. Ecosystem-Based Management Roadmap. Waterview Consulting, COMPASS and EBM Tools Network. www.ecosystembasedmanagement.net.), and these are called human welfare benefits by economists.

2 Ecosystem services include 'provisioning services' such as food, fresh water, fiber, biochemicals, genetic resources; 'regulating services' such as climate regulation, disease regulation, water regulation, water purification, pollination; 'cultural services' such as recreation and tourism, as well as spiritual and religious, aesthetic, inspirational, and educational benefits; and 'supporting services' such as soil formation, nutrient cycling, and primary production. _ need to cite the Millenium Assessment as the source of your categories

3 James Boyd, Spencer Banzhaf. What are ecosystem services?, Ecological economics 63, 616 – 626

Marine Spatial Planning

Many recent research results[4] report that marine ecosystem services are seriously damaged. These assessments call for a shift in marine science toward solution-driven research, and, in ocean policy, from management of individual sectoral activities toward EBM. EBM is place-based; social, cultural, economic, and political attributes overlay these biophysically defined places. Thus, approaches that integrate natural and social scientific perspectives on defining and managing places in the ocean are necessary in order to implement EBM. MSP can provide a far more promising approach to implementing EBM (Crowder & Norse, 2008). Marine Spatial Planning (MSP) is a planning process that offers an opportunity for more integrated management; recently, it has been gaining political momentum throughout the world. UNESCO (2009) defines MSP as "the 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 are usually specified through a political process" (p.18). It is important to remember that we can only plan and manage human activities in marine areas, not marine ecosystems or components of ecosystems. Characteristics of effective MSP are ecosystem-based, integrated, place-based, adaptive, strategic, anticipatory, and participatory (UNESCO, 2009). MSP aims to provide a mechanism for a strategic and integrated plan-based approach for marine management that makes it possible to look at the "bigger picture" and to manage current and potential conflicting uses, the cumulative effects of human activities, and marine protection (Douvere, 2008).

MSP is not a plan, but a planning process often utilizing spatial planning tools, such as ocean zoning and mapping, permit systems, education and encouragement as well as having an institutional framework, which links planning, policies and regulations. MSP has recently been understood to be an important tool to achieve EBM as it recognizes spatial characteristics. International usage of MSP includes marine-protected area management (Australia and US), multi-purpose ocean use promotion (Europe and China), and marine ecosystem based-management (US and Canada).

The MSP process does not lead to a one-time plan. It is a continuous, iterative, adaptive process that learns and adapts over time. The development and implementation of MSP involves a number of steps, and MSP consists of at least three ongoing phases (Figure 1).

4 US Commission on Ocean Policy. An ocean blueprint for the 21st century. Final report of the US Commission on ocean policy to the president and congress, Washington, DC, 2004.; Millennium Ecosystem Assessment. Synthesis report. Washington DC: Island Press; 2005.

Figure 1. Essential elements of a marine spatial management process & MSP process

(1) Identifying need and establishing authority
(2) Obtaining financial support
(3) Organizing the process through pre-planning
(4) Organizing stakeholder participation
(5) Defining and analyzing existing conditions
(6) Defining and analyzing future conditions
(7) Preparing and approving the spatial management plan
(8) Implementing and enforcing the spatial management plan
(9) Monitoring and evaluating performance
(10) Adapting the marine spatial management process

In the MSP process, defining spaces is one way to make MSP principles (characteristics) more tangible. Marine spatial management does this by defining the boundaries of the ecosystem to be managed, defining ocean spaces of special ecological or biological value within the ecosystem, defining ocean spaces of special economic value and potential, defining ocean spaces where the effects of human activities interact positively or negatively with ecological functions and processes, and defining where conflicts (user vs. user and user vs. environment conflicts) are occurring or might occur (Douvere, 2009). Knowing the location of marine communities, human activities, and jurisdictional borders is a key first step in spatial planning (Crowder & Norse, 2008).

Marine areas or ecosystems are affected by human activities in terms of demands for the use of the resources of the area to produce desired goods and services (seafood, marine transportation, energy, recreation, storm protection, waste processing, and climate regulation)

Demands for goods and services from a marine area usually exceed its capacity. Marine resources are often “common property resources,” which can lead to excessive use, degradation, or exhaustion of the resource. Because not all of the goods and services from marine ecosystems can be expressed in monetary terms, free markets cannot perform the allocation tasks. Some public process must be used to decide what mix of goods and services will be produced from the marine area. That process is MSP, which can affect ecosystem goods and services. Recently, a central challenge for natural resource management is developing rigorous yet practical approaches for balancing the costs and benefits of diverse human uses of ecosystems (Lester et al.,2013).

3. Science requirements (or tools) for Ecosystem-Based MSP

Tools for EB-MSP

MSP provides a framework for an integrated place-based approach that manages current and potential conflicting uses and cumulative effects of human activities and marine protection, in order to promote efficient use of marine space and resources. As mentioned earlier, the MSP process is a continuous, iterative process. Managers define goals and objectives and management strategies are evaluated and modified as needed. Monitoring[5], evaluation and adaptive management are necessary to ensure that marine management measures are both effective and efficient (Katsanevakis, 2011).

To achieve success with MSP, planners and managers need spatially-explicit tools. These tools can help (1) incorporate data from ecological, economic, and social systems; (2) transparently assess management alternatives and trade-offs; (3) involve stakeholders; and (4) evaluate progress toward management objectives. The functions of effective marine spatial planning tools are data management, mapping and visualization, alternative scenario development and analysis, management metrics options proposal, assessment plan, stakeholder participation, adaptive management and assessment of objective achievements (see Table 1). A large number of tools with these functions currently exist, or are being developed, to facilitate the planning process (OCS, 2011).

Table 1. Tool Functions

Items	Details
Data management	- Data provisioning - Data quality assessment - Data upload & archival - Data development
Mapping	- Spatial • Basemaps/Physical • Habitats/species • Ecosystem services • Temporal features • Vulnerability • Uses • Incompatibility & impacts • Jurisdictions - Non-spatial • Graphical display • Reports

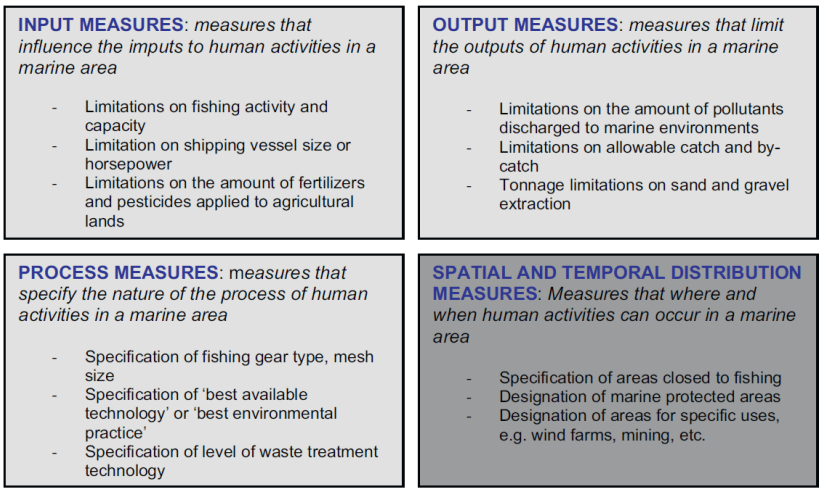
5 Monitoring results tell “what” is going on but not “why”, so monitoring serves as the basis for evaluation.

Alternative Scenario Development & Analysis	- Ecosystem service valuation - Trade-off assessment - Impact assessment - Planning option context - Optimization - Planning objectives assessment - Forecasting - Uncertainty tracking - Sensitivity assessment
Management Measure Option Proposal	- Siting conditions - Zoning proposals
Stakeholder Participation and Collaboration, and Community Outreach and Engagement	- Exploratory - Participatory interface - Incorporates local & traditional knowledge - Iterative - User collaboration - Comment & communication
Adaptive Management & Assessment of Achieving Objectives	- Use monitoring data to assess plan - effectiveness - Ground-truth assumptions in scenarios - Assess progress toward objectives

(Source : COS, Decision Guide: Selecting Decision Support Tools for Marine Spatial Planning 2011, Rearrangement)

MSP is a process that can influence where and when human activities occur in marine spaces. It is important to recognize that marine spatial management can influence the spatial and temporal distribution of human activities. To implement all steps of an ecosystem-based management approach to MSP, a range of tools will be needed including measures that influence the input, the output, and the processes of human activities (Figure. 2).

Figure 2. Types of measures for ecosystem-based, sea use management



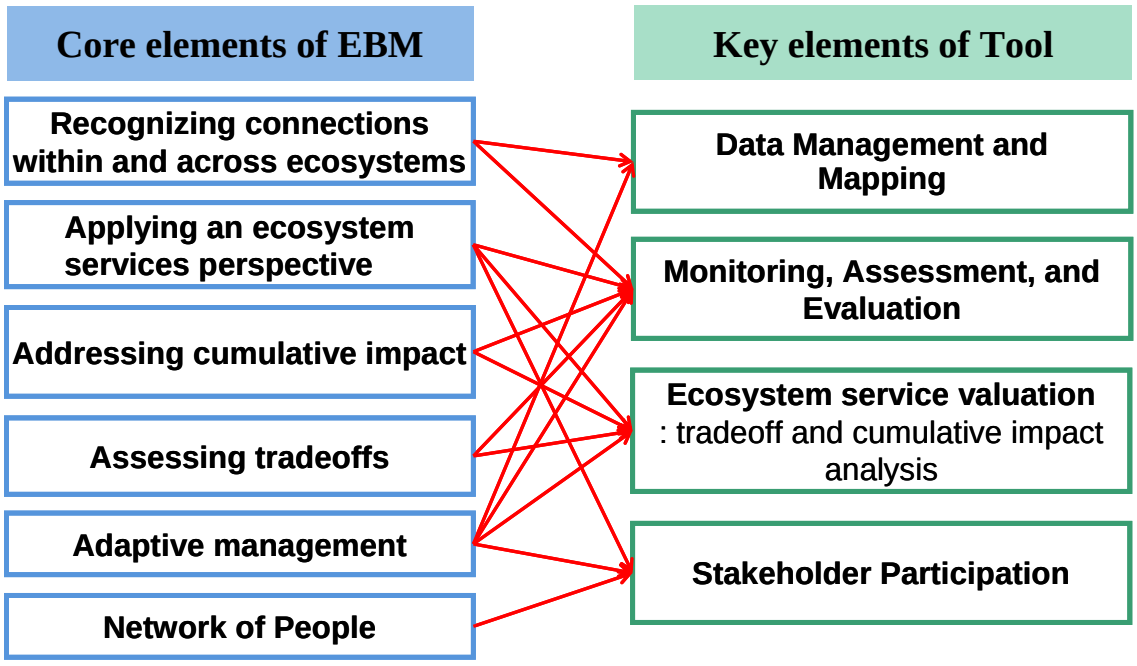
(Source: Douvere, 2008, p. 765)

The ultimate decision for what space will be allocated for what use (or non-use) is a matter of societal choice. People are central to the decision-making process and are the agents for change. As such, relevant stakeholders, including the wider public, need to be properly involved throughout the MSP process, and are in fact, critical to a successful and lasting outcome.

Tools of evaluation (e.g., ecosystem service valuation, trade-off assessment) are needed to balance diverse human uses of ecosystems. They provide a context for disparate stakeholders to focus on shared goals and work at cross-jurisdictional scales to achieve EB-MSP.

Several essential tool functions are necessary to facilitate EB-MSP (Figure 3). This figure shows links between the core elements of EBM and the key elements of the tool. As mentioned earlier, although EB-MSP core elements have been described in many different ways, these descriptions share common elements. I summed up the core components of EB-MSP, based on previous theories from relevant literature. To move from concept to practical implementation, the four key elements of tools that are useful are (1) data management and mapping, (2) monitoring, assessment, and evaluation, (3) ecosystem service valuation, and (4) stakeholder participation.

Figure 3. Links among core elements of EBM and key elements of tool



Four Case Studies

In this paper, we review four planning processes and the corresponding marine spatial management tools for implementing EB-MSP, and, if available, information about the extent to

which these tools made a difference: i) California's Marine Life Protection Act, The Network of MPAs, and MarineMap, ii) Massachusetts Ocean Management Plan and Cumulative Impacts, iii) Puget Sound Action Agenda and Integrated Ecosystem Assessment, and iv) West Coast of Vancouver Island, Marine Spatial Plan and InVEST.

Before looking into the case study, we reviewed the published literature and reports about the concepts and principles of MSP and EBM, and the need for science tools for supporting MSP and EBM. Through this process, the information about key elements for successful MSP and EBM, such as governance, planning process, public input, and scientific input, are derived.

Although the planning process for each case has concluded, it is too early to tell if the resulting marine spatial plan will meet the goals, and what contribution various science tools, including the economic analyses, made toward that success. With these considerations, we focus on lessons related to the MSP design process (not performance) and the science tools applied in the planning process. I carried out the case study based on the framework below, and Table 2 shows the analytical framework for the case study in this paper.

Table 2. Analytical Framework for the Case Study

Element of Analytical Framework		**Definition**
Governance	Goals	Setting and evaluating goal
	Institutions	Decision-making authorities and arrangements at provincial, regional, and sub-regional levels
	Mechanisms	Key policies, plans, and regulations that affect decision-making
Planning Process (Including public input, management, and decision)		How institutions operate within the case study area
Science input • Data management and mapping • Monitoring, assessment, and evaluation • Ecosystem service valuation • Stakeholder participation		Which tools they are using How tools work for EB-MSP

Case 1 : California's Marine Life Protection Act

Tool : MarineMap

PLEASE SEE MY COMMENTS AND SOMEHOW INCORPORATE THEM BECAUSE YOUR CASE AS IT IS NOW reads, is misleading ABOUT THE TOOLS AND DOESN'T SAY WHAT ACTUALLY HAPPENED. THIS WAS A HUGELY CONTENTIOUS CASE DIFFERING IN DEGREE OF CONFLICT BETWEEN AREAS, BUT JUST THE SAME VERY CONFLICT-RIDDEN AND MUCH MORE DETERMINED BY POLITICS THAN TOOLS. IT WOULD BE INTERESTING FOR YOU TO BE ABLE TO TELL HOW IMPORTANT THE MAP TOOL REALLY WAS TO THE PROCESS. WAS IT JUST ANOTHER TOOL, OR DID IT REALLY MAKE A DIFFERENCE? .

Outline

In California, the Marine Life Protections Act (MLPA) calls for the redesign of existing marine protected areas (MPAs) into a statewide network (Kirlin et al., 2013)[6]. The MLPA Initiative (public-private partnership) developed a Master Plan in the early stages of the process, outlining a planning framework that required stakeholders to understand and implement a complicated set of guidelines and scientific data for MPA design. The Initiative process needed to provide a means for stakeholders to view spatial data, run analytical tools, create MPA proposals, and get immediate feedback, in order to fully participate in this public process. The MLPA Initiative needed to make it easy for stakeholders to deal with spatial information and use it analytically; hence MarineMap was developed. MarineMap is a web-based application that allows users to visualize geographic data, design perspective MPAs, analyze those MPAs, and share their designs with other stakeholders participating in the Initiative process (Merrifield et al., 2013).[7]

Now that MPAs have been designed and implemented in each of the MLPA study regions, the process is moving into the monitoring phase of implementation (White et al., 2013[8], Gleason et al., 2013[9]).

Table 3. Outline for Using MarineMap in California's MLPA

6 Kirlin, J., Caldwell, M., Gleason, M., Weber, M., Ugoretz, J., Fox, E., Miller-Henson, M., 2013. California's Marine Life Protection Act Initiative: supporting implementation of legislation establishing a statewide network of marine protected areas. Ocean and Coastal Management 74, 3–13.

7 Merrifield, M., McClintock, W., Burt, C., Fox, E., Serpa, P., Steinback, C., Gleason, M., 2013. MarineMap: a web-based platform for collaborative marine protected area planning. Ocean and Coastal Management 74, 67–76.

8 White, J.W., Scholz, A.J., Rassweiler, A., Steinback, C., Botsford, L.W., Kruse, S., Costello, C., Mitarai, S., Siegel, D.A., Drake, P.T., Edwards, C.A., 2013. A comparison of approaches used for economic analysis in marine protected area network planning in California. Ocean and Coastal Management 74, 77–89.

9 Gleason, M., Fox, E., Ashcraft, S., Vasques, J., Whiteman, E., Serpa, P., Saarman, E., Caldwell, M., Frimodig, A., Miller-Henson, M., Kirlin, J., Ota, B., Pope, E., Weber, M., Wiseman, K., 2013. Designing a network of marine protected areas in California: achievements, costs, lessons learned, and challenges ahead. Ocean and Coastal Management 74, 90–101.

Elements of MSP	**Califonia's MLPA**
Governance	
Goal	▪ To create a network of MPAs ▪ To redesign the existing system for MPAs for meeting six ecosystem-based goals
Institution	▪ California Fish and Game commission ▪ California Department of Fish and Game ▪ MLPA Initiative ▪ Regional Stakeholder Group (RSG), Science Advisory Team (SAT), Blue Ribbon Task Force (BRTF) ▪ MPA Monitoring Enterprise
Act and Regulation	▪ MLPA ▪ MLPA Initiative MOU: Roles and Responsibilities, Deliverables ▪ Master Plan (including MPA design guidelines) ▪ MPA design guidelines: Science guidelines, feasibility guidelines
Management and Decision	▪ Multiple management scenarios: 1. State marine reserve 2. State marine park 3. State marine conservation area ▪ Stakeholder-made management scenarios
Planning Process and Public Input	▪ Iterative Initiative process: RSG, BRTF, SAT, and Commission ▪ Structured stakeholder process design: self-evaluation and formal lesson learned evaluation
Science Input	
Main Tool	**MarineMap** ▪ To access geospatial data, delineate boundary of MPAs, evaluate against science guidelines, provide analytical feedback to help stakeholders to comply with the guidelines for MPA placement
Economic Analysis (Or Ecosystem Service Framework)	▪ Static socioeconomic analysis ▪ Dynamic bioeconomic analysis
Monitoring, Assessment, and Evaluation (Or Adaptive Management)	▪ MLPA direct adaptive management to ensure that the policy goals of the MLPA are being met. ▪ Monitoring for evaluating effectiveness of the MPA network: MPA Monitoring Enterprise established by the California Ocean Science Trust ▪ Review of the network of MPAs every five years
Lessons Learned	▪ Clear legal mandate and structure of the planning process ▪ Direct stakeholder involvement in iterative planning process ▪ Interactive decision supported by MarineMap ▪ Best readily available science: ecological and socioeconomic guidelines

Lessons learned

The State of California planned a network of MPAs under the MLPA and is currently implementing it. The MLPA Initiative completed four regional public MPA planning processes characterized by robust stakeholder involvement and the incorporation of the best readily available science (Gleason et al., 2013). Gleason et al. (2013) outline that the MPA Planning process increased the protection of marine ecosystems and marine life populations, and advanced the science and practice of designing MPA networks. It also increased the coordination and capacity of stakeholders, scientists, and decision-makers for a marine spatial planning.

The MPA planning process was structured by the legislative directive of the MLPA. Under the structured planning framework, entities (for example, stakeholders, scientists and decision-makers[10]) played a clearly-defined role, were directly involved in the design of alternative MPA proposals, and made an effort to deliver outcomes. For example, stakeholders (the appointed RSG) directly made alternative MPA proposals in each study region, while scientists served as advisors and evaluated MPA proposals against science-based guidelines. Three separate volunteer groups (the RSG, SAT, and BRTF) were supported by the Initiative staff and each group had clear and distinct roles; this helped to drive MPA planning forward in an organized manner (Gleason et al., 2013). Design, evaluation, and refinement in developing MPA proposals, is an iterative process. Fox et al. (2013)[11] argued that six initial conditions facilitated successful completion of the MPA network planning process: a strong legal mandate, political support, adequate funding, firm deadlines, engagement of civil society, and an effective process design.

The Initiative applied the mechanisms for integrating scientific information to the MPA planning processes. Saarman et al. (2013)[12] selected four key conditions to support the successful integration of science into the MPA planning processes. First, the MLPA provided a strong legal mandate for the use of the best readily-available science. Policy-makers strongly supported scientific input and the use of science-based MPA in designing guidelines. Second, the structure of the public-planning process clearly identified the role of scientists, and enabled a transparent and participatory process that promoted the use of science. Third, simple science-based MPA design guidelines provided benchmarks for assessing the likely effectiveness of

10 Gleason et al.(2013), Table 3

11 Fox, E., Miller-Henson, M., Ugoretz, J., Weber, M., Gleason, M., Kirlin, J., Caldwell, M., Mastrup, S., 2013. Enabling conditions to support marine protected area network planning: California's Marine Life Protection Act Initiative as a case study. Ocean and Coastal Management 74, 14–23.

12 Saarman, E., Gleason, M., Ugoretz, J., Airame, S., Carr, M., Fox, E., Frimodig, A., Mason, T., Vasques, J., 2013. The role of science in supporting marine protected area network planning and design in California. Ocean and Coastal Management 74, 45–56.

alternative MPA proposals to achieve MLPA goals. Finally, scientists were engaged extensively and were responsive to the evolving informational needs of each regional MPA planning process. Above all, the MPA-designed guidelines and a scientific evaluation of all MPA proposals were arguably the most important elements in informing the design of California's MPA network. They compared MPA network proposals, and assessed that these proposals would satisfy the goals of the MLPA. The use of simple "rules of thumb" or guiding principles for MPA design gave stakeholders and decision-makers a way to incorporate science more directly into their planning, while still acknowledging the underlying complexities of natural and human systems (Saarman et al., 2013).

Also, the Initiative encouraged the development of several innovative tools to support MPA planning, including MarineMap and economic analysis. The MarineMap facilitates the design and evaluation of MPA. It allows users to collaborate on ideas and proposals for marine planning. The core function of the MarineMap is built around the concept of providing an easy way for stakeholders to develop ideas about the size, placement, and associated attributes of MPAs. The MarineMap that enabled stakeholder participation in the design of MPAs was a necessary component of the planning process. The MarineMap also enabled evaluation of MPA proposals in the design. The MarineMap was designed with an explicit goal; that is to say, it was exploring how ad-hoc spatial designs may or may not meet science and management guidelines (Merrifield et al., 2013). Having a set of clearly defined functional requirements is essential in order to develop the effective decision support systems and tools. The MarineMap provided an intuitive user experience that simplified complicated spatial concepts and delivered critical information immediately to allow users to receive feedback about scenarios (Merrifield et al., 2013). This tool facilitated transparency and efficiency.

The MPA implementation has not only environmental consequences, but also economic consequences for both commercial and recreational fisheries. In this planning process, the stakeholders and policymakers utilized economic analysis. The economic analyses were novel in their spatial resolution and their use directly in the MPA design process, rather than after implementation (White et al., 2013). In this process, the stakeholders and the SAT made and evaluated MPA proposals using the science-based MPA design guidelines. The guidelines were the best available approach before the development of the models. However, it is difficult to refine the MPA proposals. The SAT conducted modeling efforts that used socioeconomic impacts to evaluate the proposals. While minimizing socioeconomic impacts is not an explicit goal in the MLPA and not a formal part of the science guidelines, it was incorporated as an

important piece of information to help the stakeholders refine their proposals in the decision process. The result of economic analyses (static and bio-economic analyses)[13] could inform how their predicted impacts might affect and alter the behavior of particular stakeholder groups.

The governance structure for MPA planning in California is composed of MPA management (including Fish and Game Commission, California Department of Fish and Game, and MPA Monitoring enterprise) and MPA design (including SAT, RSG, BRTF, and MLPA Initiative and DFG staff). The Initiative process (RSG, BRTF, SAT, and Commission)[14] for the MPA design utilized many best practices for successful stakeholder engagement (Fox et al, 2013). The stakeholders in the MPA design process engaged in the MPA monitoring efforts. An engagement that is generally encouraged by California Department of Fish and Wildlife (CDFG) and the MPA Monitoring Enterprise (a state-sponsored program established to monitor MPAs)[15] because continued stakeholder involvement is viewed as essential to MPA success and longevity.

The adaptive management approach of the MLPA[16] includes monitoring and assessment of MPAs, review of the network of MPAs, and consideration of relevant new scientific findings. This approach includes evaluating the efficacy of individual MPAs and the network as well as reviewing the monitoring program(s), methods, and results and making recommendations for management adjustments in a 'test and assess' framework (CDFG, 2008; Day, 2008). Currently, California is developing mechanisms for assessing effectiveness of the MPA network, including establishing an MPA Monitoring Enterprise, and a process for periodic review and adaptive management of MPAs (Gleason et al., 2013). The regular review of the MPA network included the network's effectiveness at meeting the MLPA goals, public petitions to change MPAs, and other opportunities for public input (Saarmanet al, 2013)[17]. These MPA management reviews have attracted stakeholder interest and led stakeholders to continue involvement, particularly

13 These are two methods of considering potential socioeconomic impacts of MPA proposals. One relies on static assessment of spatially-linked use pattern data and a second utilizes dynamic bio-economic models. The static analysis only considered direct impacts on commercial and charter boat fisheries, and includes a minimal socioeconomic characterization. There is very little "social" in the socioeconomic analysis, and a more comprehensive assessment of MPA impacts on coastal users and communities would include historical, institutional, cultural, and sociological data and analysis (White et al, 2013).

14 In each study region, an appointed regional stakeholder group (RSG) developed MPA proposals that were reviewed and evaluated by a science advisory team (SAT), the California Department of Fish and Game, MLPA Initiative staff, and a policy-level blue ribbon task force (BRTF). Based on these evaluations and public input, MPA proposals were then refined by the RSG and presented to the BRTF, who made a recommendation to the California Fish and Game Commission, who had the sole authority to adopt and implement MPAs.

15 The MPA Monitoring Enterprise established by the California Ocean Science Trust in 2007, is an example of a new partnership approach to monitoring California's MPA network. The Monitoring Enterprise leads the development and implementation of MPA monitoring to evaluate the effectiveness of the new MPAs being established under the MLPA by planning MPA monitoring, implementing monitoring, analyzing data, and sharing results (ttp://monitoringenterprise.org/).

16 The Marine Life Protection Act : Section 2853(c)(3) Provisions for monitoring, research, and evaluation at selected sites to facilitate adaptive management of MPAs and ensure that the system meets the goals stated in this chapter.

17 Saarman, E., Carr, M., 2013. The California Marine Life Protection Act: A balance of top down and bottom up governance in MPA planning. Ocean and Coastal Management 74, 41–59.

those unhappy with the outcomes.

Case 2: Massachusetts ocean management plan

Using Tool: Cumulative Impacts

Outline

The Massachusetts Ocean Management Plan (OMP), which was created by the Massachusetts Executive Office of Energy and Environmental Affairs (EEA), is a comprehensive ocean management plan for Massachusetts waters according to the Massachusetts Oceans Act of 2008. Using the best available science and stakeholder engagement, the plan provides protections for critical marine habitats and natural resources in the Commonwealth's waters, and sets standards for the development of offshore renewable energy, as well as for other infrastructure, in order to foster sustainable uses in the state's ocean waters.[18] The EEA used Cumulative Impacts to support the development and implementation of the plan. The Act mandates that the plan should be reviewed at least once every five years. The review and update process started in January 2013, when EEA conducted a comprehensive review of the 2009 plan to assess what they have accomplished since 2009. Based on the findings, EEA is now making revisions and will publish the 2014 plan by the end of this year.

Table 4. Outline of using Cumulative Impact in Massachusetts OMP

Elements of MSP	**Massachusetts OMP**
Governance	
Goal	▪ To produce comprehensive ocean management for Massachusetts waters ▪ To support ecosystem health and economic vitality, balance current ocean uses, and consider future needs
Institution	▪ Executive Office of Energy and Environmental Affairs ▪ Ocean Advisory Commission ▪ Science Advisory Council ▪ Six Working Groups ▪ Massachusetts Ocean Partnership (now SeaPlan)

18 http://www.mass.gov/eea/waste-mgnt-recycling/coasts-and-oceans/mass-ocean-plan/

Act and regulation	▪ Massachusetts Oceans Act (OA) ▪ Regulation 301 CMR 28:00[19] ▪ Review and Update (in process) : A Review of the 2009 Massachusetts ocean plan & a Draft Scope for Updates
Management and Decision	▪ Management areas 1. Prohibited 2. Renewable Energy 3. Multi-use ▪ Multiple management scenarios were not generated. OMP established siting and permitting standards for development within the ocean planning area
Planning process and public input	▪ Plan Development Process: Information gathering, draft plan development, and formal public review of the draft/plan finalization ▪ Extensive public participation program
Science input	
Main tool	**Cumulative impact** ▪ To estimate and visualize the cumulative impacts of human activities on marine ecosystems ▪ Cumulative impact model: ecosystem vulnerability, ecosystem distribution, distribution and intensity of human stressors ▪ Cumulative Impacts interactive map: visualize how impacts are distributed, identify the stressors, and assess possible avenues for mitigating cumulative impacts. ▪ Massachusetts Ocean Resource Information System (MORIS): Spatial data management system for plan ▪ Compatibility assessment
Economic Analysis (or Ecosystem service framework)	▪ Ecosystem service valuation is not included. But it includes impact assessment
Monitoring, assessment, and evaluation (or Adaptive Management)	▪ OA mandates once every five years, the OMP is assessed and amended ▪ EEA evaluated management options ▪ EEA has developed Performance Indicators (in process)
Lessons learned	▪ Explicit spatial data and compatibility assessment ▪ Frameworks for multi-objective planning ▪ Establishment humans uses and impacts data

Lessons learned

19 These regulations were promulgated as a result of the MA ocean plan. Through these regulations, the permitting and siting standards outlined in the 2009 ocean plan are made into law

The Oceans Act provides strong legislative bases for action, and the EEA is implementing the law and the ocean management plan. The extensive effort and involvement of the public, input from the Ocean Advisory Commission (OAC) and the Science Advisory Council (SAC), and the effective relationship with the Massachusetts Ocean Partnership (MOP)[20] have all played a significant role in the development and implementation of the OMP.

Under good governance and with a useful planning framework, the administrative execution and communication during the planning process were seen as effective from the beginning. The MOP development proceeded in three phases: information gathering, draft plan development, and formal public review of the plan. In the early steps of plan development, agency working groups prepared the six reports synthesizing available data for the ocean planning area by topic area: (1) habitat, (2) fisheries, (3) transportation, navigation, and infrastructure, (4) sediment, (5) recreation and cultural services, and (6) renewable energy. In order to analyze marine space and visualize the cumulative impacts of human activities on coastal and marine ecosystems, most of the data in each report was transferred into visualized spatial data. A critical element of the planning process was an extensive expert, stakeholder, and public engagement effort that was developed with strong support from the MOP (EEA, 2014)[21]. The MOP sought to engage stakeholders through a number of mechanisms such as citizen review panels, public surveys, stakeholder meetings and events, opportunities for public comment, and public hearings (Nutters & Silva, 2012).[22]

The Ocean Management Plan consists of two volumes, Management and Administration, and Baseline Assessment and Science Framework. The Baseline Assessment establishes the natural, cultural, and socioeconomic context for the plan and serves as a robust point of reference for assessing change over time. In addition, all of the spatial data provided in the OMP is hosted in the Massachusetts Ocean Resource Information System (MORIS).

The OMP aims to translate the policy direction and specific requirements of the Oceans Act into a comprehensive management approach that can be implemented through existing state programs and regulations. To do this, EEA: 1) developed plan goals and strategies, 2) used the strategies to help guide the assessment of the compatibility and impacts of certain human uses

20 The Massachusetts Ocean Partnership (MOP) was established to support the development of the Massachusetts Ocean Management Plan. In 2011, MOP's advisory board voted to expand the program to advance coastal and marine spatial planning in other regions. To facilitate this expansion the name of the organization was changed from MOP to SeaPlan. SeaPlan now is a leader in scientific assessment, policy analysis and stakeholder engagement in ocean planning across the country (http://www.seaplan.org/overview/history/).

21 Formal consultative bodies

22 Heidi M. Nutters, Patricia Pinto da Silva, 2012, Fishery stakeholder engagement and marine spatial planning: Lessons from the Rhode Island Ocean SAMP and the Massachussetts Ocean Management Plan . Ocean & Coastal Management 67, 9-18.

with existing uses and marine resources, 3) used spatial data to represent the results of this compatibility/impact assessment while also identifying particularly vulnerable marine resources, 4) evaluated management options, and 5) developed an ocean management plan. Also, the OMP goals give clear direction for implementing the plan, and provide benchmarks for measuring success and developing accountability. The OMP established management and performance standards for development within the ocean planning area, and identified and protected significant marine resources. The OMP establishes three categories of management areas (Prohibited, Renewable Energy, and Multi-use). Management areas are based on specific marine resources identified as key components of the Massachusetts marine ecosystem (special, sensitive, or unique marine or estuarine life and habitat). The vulnerability of each resource to new uses, activities, and facilities was determined and ranked through compatibility assessments.[23]

Subject to adaptive management, the OMP should be revised every five years. EEA has developed a series of performance indicators (grouped by general subject matter — governance, environmental, and socioeconomic) to assess the OMP and to identify general trends in the ocean planning area. These indicators are being revised extensively to develop a performance evaluation framework that will ensure that the indicators selected are the best to assess program performance over time.

One of the main interests of the OMP is to improve understanding of resources and activities in Massachusetts' waters, by providing significant spatial data that will facilitate improved decision-making in the planning, reviewing, and permitting of specific projects. The OMP thus provides an opportunity to apply the tools and information to the planning process. In support of the plan, MOP, in cooperation with the National Center for Ecological Analysis and Synthesis (NCEAS), worked on the development of cumulative impact maps depicting the spatial extent and intensity of human activities in Massachusetts' marine waters relative to marine habitats.

Recognizing the spatial scale and full range of ecosystem services is one of the principles of ecosystem-based management. The Cumulative Impact Model combines ecosystem vulnerability, ecosystem distribution, and distribution and intensity of human stressors to map cumulative impacts of human uses (Halpern,et al, 2008)[24]. The Cumulative impacts attempted to fill knowledge gaps in Massachusetts by providing spatial information on the relative

23 EEA, 2014, Review of the Massachusetts Ocean Management Plan(http://www.mass.gov/eea/waste-mgnt-recycling/coasts-and-oceans/mass-ocean-plan/)

24 Benjamin S. Halpern a,, Karen L. McLeod b, Andrew A. Rosenberg c, Larry B. Crowder, 2008. Managing for cumulative impacts in ecosystem-based management through ocean zoning. Ocean & Coastal Management 51, 203-2011

vulnerability of marine ecosystems to human uses and cumulative human impacts. These two critical pieces of information help managers to make more informed, science-based decisions when considering proposed developments in coastal and ocean waters. This cumulative impact tool allows managers to see the effects of the many different human uses on the waters off Massachusetts[25]; it also helps managers combine human use data with ecosystems data to better understand the current and potential impacts associated with ocean use. This information provides insight into where new human uses of the oceans might best be situated (siting decision)[26]. Although it does not prescribe particular management decisions, it can be used alongside other tools that analyze ecological, economic, and social values to inform decision-making.

Case 3: Puget Sound Action Agenda
Tool: Integrated Ecosystem Assessment

Outline

In 2007, the State Legislature enacted the Engrossed Substitute House Bill 5372 with the goal of restoring the health of Puget Sound by 2020 (PSP, 2010)[27]. Washington's governor and the Washington legislature created the Puget Sound Partnership (PSP)—a public–private entity made up of citizens, governments, scientists, and businesses working to rehabilitate and conserve Puget Sound[28]—and authorized the PSP with the responsibility of restoring Puget Sound's health By employing the Integrated Ecosystem Assessment (IEA) framework[29] as a central organizing tool, the PSP and their partners developed the Action Agenda that promotes a healthy economy and thriving natural ecosystem.

The IEA framework aims to guide the process of synthesizing and analyzing relevant scientific information supporting an ecosystem approach (Levin et al., 2009).[30] The IEA framework consists of five components: (1) scoping, (2) identifying indicators and targets, (3) risk analysis, (4) evaluating management strategies, and (5) monitoring and evaluating progress

25 SeaPlan, 2013, Mapping Cumulative Impacts of Human Activities on Marine Ecosystems
26 http://www.seaplan.org/project/cumulative-impacts/
27 Puget Sound Partnership. 2010. Strategic Science Plan. June 2010 final review draft. Prepared by the Puget Sound Partnership Science Panel. Puget Sound Partnership. Olympia, Washington.
28 http://www.psp.wa.gov/
29 PSP adapted IEA approach in Strategic Science Plan.
30 Phillip S. Levin, Michael J. Fogarty, Steven A. Murawski, David Fluharty, 2009. Integrated Ecosystem Assessments: Developing the Scientific Basis for Ecosystem-Based Management of the Ocean. PLoS Biology 7(1), 23-28

toward management goals (Foley et al., 2013)[31]. The PSP has adapted the IEA framework to help guide the assessment and management framework of Puget Sound ecosystems.

Table 5. Outline of using IEA in Puget Sound Action Agenda

Elements of MSP	Puget Sound Action Agenda
Governance	
Goal	▪ To promote a healthy economy and thriving natural ecosystem
Institution	▪ Puget Sound Partnership ▪ Leadership Council ▪ Ecosystem Coordination Board and Science Panel
Act and Regulation	▪ Engrossed Substitute House Bill 5372 ▪ Puget Sound Action Agenda ▪ Science and technical program ▪ Puget Sound Science Update: the State of the Science Supporting the Work of the PSP ▪ Strategic Science Plan ▪ State of the Sound: Performance Management, Funding, Status of the Ecosystem Stewardship Program
Management and Decision	
Planning process and public input	▪ IEA process : scoping, indicator development, risk analysis, management strategy evaluation, and monitoring
Science input	
Main tool	**IEA** ▪ To guide the process, synthesizing and analyzing relevant scientific information supporting an ecosystem approach (science and framework for managing the Puget Sound ecosystem) ▪ Puget Sound Vital Sign ▪ Puget Sound Project Atlas
Economic Analysis (or Ecosystem Service Framework)	▪ Ecosystem models identifying ecosystem threats and indicators : Relative Risk Models, Mass balance food web, California Current, Human footprint ▪ Quantitative models (e.g., Ecopath with Ecosim)
Monitoring, Assessment, and Evaluation (or Adaptive	▪ 21 Ecosystem indicators and targets a) Indicators: desired future conditions b) Targets: policy statements ▪ Ecosystem service analysis: 7 most important ecosystem services

31 Melissa M. Foley , Matthew H. Armsby , Erin E. Prahler , Margaret R. Caldwell , Ashley L. Erickson , John N. Kittinger , Larry B. Crowder , and Phillip S. Levin, 2013. Improving Ocean Management through the use of Ecological Principles and Integrated Ecosystem Assessments, BioScience 63(8), 619-631

Management)	▪ The Puget Sound Ecosystem Monitoring Program (PSEMP): Coordinating the monitoring program that provided data or these indicators ▪ The Puget Sound Partnership is using the "Open Standards for the Practice of Conservation" to put the Action Agenda into a performance management framework
Lessons learned	▪ Being clear about ecosystem based goals ▪ IEA approach: science-based decision making process ▪ Indicators consistent with achieving goals ▪ Planning Science Framework ▪ Inclusion of a range of ecological processes

Lessons learned

The Puget Sound ecosystem has become a national example of implementation of ecosystem-based management since the creation of the PSP and the publication of the Action Agenda[32], which are two of the most sophisticated EBM processes underway in the U.S. (Tallis et al., 2013)[33].

First of all, the PSP has adopted measurable ecological and social goals (i.e., healthy or sufficient species and food webs, habitats, water quality, water quantity, human health, and human well-being) for the Puget Sound ecosystem as well as taken actions that are consistent with achieving those goals. The PSP presents an approach to large-scale ecosystem restoration by adopting a system-wide framework that includes humans as part of the natural ecosystem. The approach used the concept of ecosystem services to structure the challenge of achieving multiple, competing human and natural system goals.

The Ecosystem Services Approach can address environmental policy and management issues because it expands the focus beyond how human and economic activities affect ecosystems. By highlighting people's dependence on ecosystems and the services they provide, a powerful rationale can be developed for promoting sustainable stewardship of our natural resources. Through the stakeholder interview, seven ecosystem services were identified as being "most important"; (1) water, (2) water regulation, (3) water purification and waste treatment, (4) recreation and ecotourism, (5) ethical and existence values, (6) capture fisheries, and (7) aquaculture. The results have been used to suggest how the PSP might go about defining a "healthy Puget Sound," communicating the goals of the PSP, selecting priority

32 PSP, 2011. Puget Sound Science Update

33 Heather Tallis, Phillip S. Levin, Mary Ruckelshaus, Sarah E. Lester, Karen L. McLeod, David L. Fluharty, Benjamin S. Halpern, 2010. The many faces of ecosystem-based management: Making the process work today in real places, Marine Policy 34(2), 340-348

indicators for measuring and monitoring the Sound's status, and selecting priority strategies.[34]

The PSP has made ample use of the existing science and adapted the IEA approach to connect science to policy in Puget Sound. The PSP established related science plans (such as, Strategic Science Plan, Science Update, Biennial science work plan[35], and State of the Sound etc.) to summarize the state of the science about Puget Sound and support a scientific context for management decisions. It enabled the PSP to prioritize for funding and investigation. Also, the IEA approach has provided a sound scientific and strategic framework, one that considers dynamic environmental, social, and economic factors in order to make more informed decisions based on tradeoffs associated with available management strategies.[36]

Developing indicators was identified as a critical task for Puget Sound ecosystem recovery. A number of measurable outcomes are needed to describe the status of the goals adopted in the Puget Sound (Ruckelshaus et al., 2009). The PSP developed 21 indicators and targets to help them track and communicate their efforts toward Puget Sound recovery.[37] These 21 indicators are arranged into a Vital Signs dashboard (http://www.psp.wa.gov/vitalsigns/). Indicators facilitated tracking of ecosystem status and trends relative to objectives. Puget Sound's Indicators included elements of human well-being goals as well as ecosystem goals. In developing indicators, scientists shared key data collection, analysis, and modeling and worked to communicate their results to managers, policy leaders, and stakeholders. Advisors presented scientific information and stakeholders provided perspectives about socially acceptable definitions of recovery by 2020.

The IEA approach usually uses quantitative analyses of cumulative impacts and ecosystem modeling to estimate how key ecosystem components change under alternative management options.[38] In Puget Sound, a mix of analytical tools and ecosystem models was used at every IEA step. Results of analysis provided information on indicator performance and management effectiveness. Scientists have applied quantitative models (e.g., Ecopath with Ecosim) to evaluate relationships among thresholds for select ecosystem components associated with marine food webs.[39] Also, conceptual models of food webs and ecosystems have highlighted linkages among ecosystem components and pointed toward strategies likely to achieve goals.

34 Iceland C, Hanson C, Lewis C.,2008. Identifying important ecosystem goods and services in Puget Sound

35 The biennial science work plan identifies priority science actions related to improved risk analyses and development of analytical tools that will support evaluation of management strategies and monitoring of effectiveness.

36 Noaa's IEA website (http://www.noaa.gov/iea/regions/california-current-region/action/the-puget-sound-partnership.html)

37 PSP, 2012. Highlights of the 2012/2013 Action Agenda for Puget Sound

38 Mary Ruckelshaus, Timothy Essington, and Phill Levin, 2009. Puget Sound, Washington, USA, in Karen McLeod and Heather Leslie, EDS., Ecosystem-based Management for the Oceans, 2001-2006

39 Noaa's IEA website (http://www.noaa.gov/iea/regions/california-current-region/action/the-puget-sound-partnership.htmll)

Together with models, spatial analyses were conducted so as to evaluate ecosystem status and the primary threats and drivers affecting ecosystem health (such as spatial threat mapping). This work highlighted the location and relative importance of threats and drivers across the entire ecosystem, and helps identify the features of Puget Sound that are most at risk (PSP, 2009). IEA steps are iterated over a regular assessment cycle so that management strategies can be adapted over time. IEA enables the managers to increase their understanding of the ecosystem (Ruckelshaus et al., 2009). Inclusion of those ecological processes in management was able to change forecasted policy outcomes and produce a richer range of policy options.[40]

At every IEA step, there was a structured stakeholder engagement process. Existing scientific information, feedback from workshops on threats and potential strategies, and input from various scientists and policy makers all fed into the planning process. The stakeholder engagement process formalized existing knowledge. Therefore, given capacity and finances, there is always an opportunity to make progress toward EBM. Stakeholder processes come with uncertainty and require simplifying assumptions (Tallis et al., 2010), but improve the knowledge base and allow decision-making in the future.

Case 4: West Coast of Vancouver Island, British Columbia, Canada

Tool :InVEST

Outline

Marine Integrated Valuation of Ecosystem Services and Tradeoffs (Marine InVEST) is a spatially explicit decision-making tool for mapping and valuing Ecosystem Services provided by coasts and oceans. It facilitates the incorporation of nature's benefits and local priorities into resource management. The first real-world test-case for Marine InVEST is now being used in the marine spatial planning process on the West Coast of Vancouver Island (WCVI). The West Coast Aquatic Management Board (WCA) has partnered with the Natural Capital Project to explore how alternative spatial plans might affect the ecosystem services and to provide information about trade-offs among multiple key ecosystem services to governments and stakeholders (Guerry, 2012).[41]

Currently, the WCA is in the process of establishing a Marine Spatial Plan as part of their

40 Mary Ruckelshaus, Timothy Essington, and Phill Levin, 2009. Puget Sound, Washington, USA, in Karen McLeod and Heather Leslie, EDS., Ecosystem-based Management for the Oceans, 2001-2006

41 Anne D. Guerry et al., 2012. Modeling benefits from nature: using ecosystem services to inform coastal and marine spatial planning. International Journal of Biodiversity Science, Ecosystem Services & Management. 1–15

Coastal Strategy.[42] The goals of the Marine Spatial Plan are to maximize compatibilities between uses and to design a spatial plan.[43] To do this, the WCA has the zoning mechanism to match human uses and activities to areas that are suitable for them. They use three planning approaches at the planning unit scale: describing a management emphasis for the planning unit; describing recommended, not recommended and conditionally recommended uses and activities; and where appropriate, applying area designations (WCI, 2013).[44]

Table 6. Outline of using InVEST in WCVI MSP

Elements of MSP	**West Coast of Vancouver Island MSP**
Governance	
Goal	▪ To maximize compatibilities between uses, and design a spatial plan that is most successful at accomplishing the seven WCA regional goals
Institution	▪ West Coast Aquatic Management Board
Act and regulation	▪ West Coast Vancouver Island Coastal Strategy ▪ Marine Spatial Planning Framework (version 5.0) ▪ Marine Spatial Plan (in process)
Management and Decision	▪ Area designation 1. Ecologically Significant Area 2. Culturally Significant Area 3. Significant Tourism and Recreation Areas 4. Significant Aquaculture Area (shellfish and finfish) 5. Significant Marine Transportation Routes 6. Significant Community Development Area 7. Significant Industrial Use Area 8. Significant Fishing Area ▪ Ecological and social outcomes were evaluated based on ecosystem service production and how well the results of each scenario met the stated objectives of the process
Planning process and public input	▪ Planning cycle: Defining the main issue, gathering information, generating key products (such as a vision, goals, and objectives), scenario planning process (describe, evaluate, and choose among options), implementing plan (include monitoring and evaluating indicators, adapting)
Science input	
Main tool	**InVEST**

42 West Coast Aquatic, 2012, Coastal Strategy
43 West Coast Aquatic, 2013, Mairine spatial Planning Framework
44 Area designations 1) Ecologically Significant Area, 2) Culturally Significant Area, 3) Significant Tourism and Recreation Areas, 4) Significant Aquaculture Area, 5) Significant Marine Transportation Routes, 6) Significant Community Development Area, 7) Significant Industrial Use Area, and 8) Significant Fishing Area.

	▪ To use the conceptual framework of ecosystem services ▪ InVEST can assess multiple services provided by marine ecosystems, estimate changes in a suite of services under different management scenarios, and investigate trade-offs among the scenarios ▪ Marine Atlas of Clayoquot and Barkley Sounds
Economic Analysis (or Ecosystem service framework)	▪ Ecosystem services Map and Value: Food from fisheries and aquaculture, recreation, renewable energy, coastal protection, provisioning of aesthetic views, and carbon storage and sequestration. ▪ Habitat risk and water quality models ▪ Trade-off balance sheets and Multi-scale scenario maps ▪ Evaluation Metrics
Monitoring, Assessment, and Evaluation (or Adaptive Management)	▪ Steps and Methods for Identifying Indicators (in process)
Lessons Learned	▪ Ecosystem service approach: Identifying ecosystem service through stakeholder involvement ▪ Science-based collaborative scenario development process through Marine InVEST

Lessons learned

As the start of the spatial planning process, the Marine Spatial Planning Framework (the Framework) is established. Although the Marine Spatial Plan is not finalized yet, the WCA has the Framework for undertaking a multi-objective marine plan. The Framework describes the spatial planning steps, approaches, and tools and addresses key issues related to technical aspects of marine spatial planning. Especially, it presents the information and methodology for identifying significant ecological and human use areas, identifying risks to the WCVI ecosystems, reducing conflicts and increasing compatibilities between human uses. It provides a specific method and procedure to policy-makers, partners, and staff to find answers to key questions encountered in establishing the Marine Spatial Plan.

In this process, the WCA especially made an effort to identify and apply the ecosystem services in the planning process. They have focused on exploring how marine plans affect ecosystem services and on providing trade-offs among ecosystem services. The WCA conducted extensive stakeholder engagements to identify the values and visions that communities desired, and created many spatially-explicit scenarios.[45] The stakeholders' concerns are food from fisheries, food from aquaculture, coastal protection, and wave energy

45 Gordon and Betty Moore Foundation, 2011. 2011 Ecosystem services seminar series_Seminar 6 Ecosystem Services in Practice: Management Decisions in the Public Sector – From Theory to Application.

conversion services. The ecosystem service helps expand the scope of planning conversations from single-issue perspectives to more comprehensive discussions about cumulative impacts and benefits. The ecosystem service outputs (such as seafood harvest, water quality, tourist visitation rates) encouraged stakeholders to acknowledge the multiple competing uses and values (Gurerry et al., 2012). Also, it depicted gains and losses in ecological and economic benefits under alternative, spatially-explicit management scenarios. Through identifying and discussing the trade-offs, stakeholders are able to consider ecosystem benefits and compare the benefits of different management scenarios.

Marine InVEST was developed by the Natural Capital Project to help planners incorporate an ecosystem services approach into management of marine regions. Marine InVEST, based on production functions, provided biophysical outputs, ecosystem service outputs, and economic or social outputs.[46] The ecosystem services are dependent on location, namely, they are place-specific. The spatially-explicit nature of Marine InVEST allowed us to identify siting conditions that provide a range of benefits (e.g., shellfish harvest, good water quality) while minimizing conflicts among damaging uses and sensitive habitats in a first round of modeling ecosystem service changes in the WCVI (Guerry et al., 2012).

WCA has used various scientific methods for identifying and designating the significant ecological and human use areas. The key challenge is how to maximize compatibility between uses and activities as well as minimize risks to the marine environment. Two approaches are using a conflict and compatibility assessment and a habitat and species risk assessment (WCA, 2013). Also, the evaluation metrics[47] are used to help decision-makers understand the differences among alternative scenarios and evaluate their consequences.

4. Current status and limitation of Korea's MSP

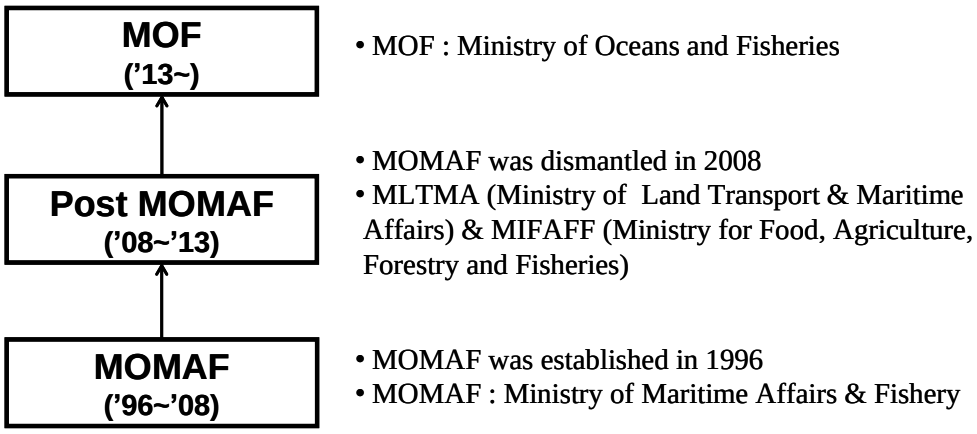
Marine-related institutions of Korea

Korea has changed the institutional system for ocean governance three times since the Ministry of Maritime and Fisheries (MOMAF) was established in 1996. Now, we have a central government for the integrated ocean governance: the MOMAF. MOMAF enacted the Basic Act on Marine and Fishery Development (BAMFD) in 2002 to promote the development of the ocean, including fishery, ocean resource, ocean R&D, marine tourism and marine heritage.

46 http://naturalcapitalproject.org/pubs/marine/MarineInVEST_Apr2010.pdf
47 The evaluation metrics are developed using InVEST models and GIS analyses (WCI, 2013).

However, the administration at that time adjusted the government system in 2008. During this course, MOMAF was dismantled and the functions of maritime transportation, marine environment policy, etc. were transferred to the Ministry of Land Transport & Maritime Affairs (MLTMA), and functions of fishery to the Ministry for Food, Agriculture, Forestry and Fisheries (MIFAFF). In 2013, Korea consolidated their marine-related functions such as fishery, maritime and port management, coast guard, marine environment, etc., into one ministry called the Ministry of Oceans and Fisheries (MOF). Korea's integrated institutional arrangement facilitates the establishment and implementation of integrated ocean policy through their internal cooperative system even though they need some help from outside related institutions (Kim, 2012).

Figure 4. Change of institutional arrangements on ocean governance in Korea



Key instruments affecting marine spatial management of Korea

Key instruments (act, plan, policy)

The Korean government has enacted many laws, plans, and tools for ocean and coastal management. The Basic Act on Marine and Fishery Development (BAMFD), the Conservation and Management of Marine Ecosystems Act (CMMEA), the Marine Environment Management Act (MEMA), and the Coastal Management Act (CMA) cover mainly spatial management and resource management of the ocean. A number of key instruments are documented in the table below (see table 8). All of these acts include methods for preserving the marine ecosystem and environment. For example, the CMA has a 'Coastal Water Zoning System' as a practical means of coastal spatial management, while the BAMFD covers the comprehensive ocean sectors and

presents a basic direction for ocean governance.

The BAMFD includes ideas about ocean development, marine tourism, ocean R&D, fishery, manpower development, etc in the ocean territory, including EEZ and coastal areas in Korea. And based on this act, the government made the first Ocean and Fishery Development Plan called “The 1st Ocean Korea (OK21),” which became a basis of integrated ocean policies in Korea. Most sub-plans under OK21 were made and implemented by MOMAF. The second plan is to be implemented between 2011 and 2020 and includes i) review of The 1st OK21, ii) a description of the current status of the Korean ocean, iii) a vision, goals, and objectives, iv) five strategies and related projects, and v) the process of implementing the plan, including details about management framework and administration. We established three goals in the 2nd OK21 as follows: extension of ocean domain both domestically and abroad, renovation of the ocean industry according to the new trends, and the establishment of a sustainable ocean management system. To support three goals, five strategies[48] and related major projects were formally incorporated into the 2nd OK21. The 2nd OK21 was especially intended to introduce “The framework of ecosystem-based marine spatial planning” for integrated spatial management of the coast and ocean.

Because the concept of MSP is based on the experience of the existing spatial planning process, a number of coastal countries have already adopted it in some form of ocean policy. In this way, we think our government has adopted a marine spatial planning policy, although currently there is no definitive prescription for moving MSP from planning to implementation. Our government has enacted and revised many laws and plans in recent years such as the CMMEA (enacted in 2006), the MEMA (enacted in 2007), and the CMA (revised in 2010) for integrated and sustainable marine management.

The CMMEA was enacted to conserve and manage marine ecosystems comprehensively by protecting marine ecosystems from artificial damage, conserving marine biological diversity, and promoting the sustainable use of marine biological resources. Based on this act, the Korean government should revisit the Marine Ecosystem Conservation and Management Plan every ten years since its establishment in 2009. Also according to this act, the Korean government has to conduct a basic investigation into marine ecosystems nationwide every ten years (beginning

48 5 strategies include :
(1) Sound and safe use and management of the ocean and coastal areas(23 projects)
(2) Promotion of marine culture and tourism(15 projects)
(3) Creation of new growth momentum through marine technology(13 projects)
(4) Realization of eco-friendly international logistics base in the East Asia(22 projects)
(5) Systematic exercise of ocean jurisdiction and development of global ocean base(8 projects)

with the first investigation in 2006), in collaboration with the relevant central administrative agencies and the Korea Marine Environment Management Corporation (KOEM). The result of the basic investigation is to obtain the data on marine ecosystems (distribution patterns of protected species/invasive species/endangered species) and apply the data to create a marine ecology map, designate MPAs, and encourage public awareness. Also, the CMMCA provides the legal basis for designating and managing Marine Protected Areas (MPAs), which are areas for protecting marine organisms, marine ecosystems, and marine landscapes. The CMMCA has provided legal and financial support, as well as encouraged active community participation.

The Marine Pollution Prevention Act (MPPA) existed from 1977 to 2007 in order to manage marine pollution. However, this act mainly concerned marine pollutant removal and oil spill treatment. It lacked a precautionary and integrated management approach for the marine environment. Therefore, in 2007, the MOMAF abolished the MPPA and enacted the MEMA as a comprehensive marine environment management act. The MEMA covers marine environmental management sectors (see Table 7)

Table 7. Main mandates and plans for management of marine environment in the MPPA

Main mandates	Related plan and agency
Establishment of Marine Environment Master Plan	Comprehensive 4th Marine Env. Mgt. Plan(2011~2020)
Monitoring of marine pollutants and environment	- Marine environmental standards - Marine environmental measurement network - MEIS(Marine Environmental Information System)
Designation and management of CEMA(Coastal Environment Management Areas)	- Designation of 9 CEMAs - Establishment & implementation of each CEMAs management plan - Application Total Pollutant Loads Management System (TPLMS) to SMAs(highly polluted area) : Masan Bay
Establishment of marine environment management organization	KOEM(Korea Marine Environment Management Corporation)

Korea's Integrated Coastal Management (ICM) legislation aims to promote sustainable development of coastal resources through the efficient management, use, and development of coastal areas. The CMA prescribes the necessary conditions and goals concerning the efficient coastal management. This act was enacted in 1996 and established "The 1st National Integrated Coastal Management Plan" at the national level in 2000. Under this national plan, Korea started the ICM and, as a result, relevant regulations and systems have been put in place.

For example, the “Local Coastal Management Plans” were established and coastal enhancement projects were implemented. Other works in progress include reclamation and management of public waters, survey of the seaside, monitoring of coastal erosion and development of the Coastal Management Information System. ICM is a continued sequence of activities, such as identification of issues, planning, adoption of plans, implementation of plans and evaluation of policies; Korea’s ICM has already gone through one cycle of the ICM process.

However, Korea’s coastal areas are facing newly emerging issues, such as coastal disasters under climate change, various new uses and developments of coastal areas, management and restoration of coastal/marine ecosystems and application of new coastal management policies. ICM was revised entirely in 2010 for more effective management of the coasts, and included new tools such as the Coastal Water Zoning System, Coastal Water Suitability Assessment, Target-based Natural Coastline Management, etc. Under the revised act, MOF established the 2nd National Integrated Coastal Management Plan (2011~2020)[49], and should review and update the plan every five years. The goals in the plan are Integrated Coast, Eco-based Coast, Attractive Coast, and Co-managed Coast. To support the four goals, the plan defined five strategies, seen below (MLTM, 2011).

1. New coastal spatial management regime application
2. Marine and coastal ecosystem health enhancement
3. Adaptation of capacity-building to climate change
4. Coastal governance advancement, sharing authorities
5. Policy infrastructure development for coastal management

Consistent with the 2nd National Integrated Coastal Management Plan, the local governments should establish the Local Coastal Management Plans, which include :

1. Scope of Jurisdictional coasts
2. Coasts subject to policy formulation
3. Policy directions for managing jurisdictional coasts
4. Necessary coasts concerning implementation of national plans
5. Designation and management of Coastal Water Zones and Coastal Water Functional Areas
6. Directions for managing Coastal Erosion Management Areas
7. Matters concerning the Target based Natural Coastline Management system
8. Directions for coast maintenance business for jurisdictional coasts?
9. Other matters recognized necessary by local government

In many respects, Korea’s ICM is very similar to MSP. Usually, MSP is an integrated approach and a public process for achieving ecological, economic and social objectives in marine areas. Korea’s ICM is also a process for the management of the coast using an

49 The 2nd plan is expected to include; First, scope of coastal areas and basic policy direction for coastal management, Second, strategies for desirable preservation, use and development of coastal areas, Third, management direction for “Coastal Waters Zoning System”, “Target-based Natural Coastline Management System”, Fourth, basic direction of coastal maintenance projects, and Last, development and utilization of coastal information system and international cooperation/education and PRs.

integrated approach. ICM is not only the sector planning process for documenting the direction for specific activities, but also the integrated planning process and management framework for achieving sustainable development through balancing development with conservation of the coast. Namely, both involve a integrated spatial planning approach, and identify areas most suitable for various activities in order to avoid conflicts among uses and enhance ocean ecosystem health. The MSP and the ICM are able to be complementary tools (EC, COM(2013) 133 final[50]).

The coastal zone boundaries tend to be defined as narrow bands of land and sea adjacent to the shoreline. The Korea Coastal Zone Boundary[51] was a strip of land and sea territory defined by CMA. The Inland boundary is 500 to 1,000m from the shoreline. The seaward boundary is within a 12-mile limit of territorial waters. However, the definition of the seaward boundaries of coastal management has been limited. As a result, there is a limitation for planning and managing the entire jurisdictional sea area of Korea through the ICM. When looking at the existing Local Coastal Management Plans, the scope of coastal management rarely extends into the territorial sea or beyond the exclusive economic zone.

As mentioned above, the Korean government has used integrated management, sustainable development, and a place-based approach to internalize the law and continue trying to build these into policy. Korea's MSP is not established institutionally because the act does not meet the full definition of ecosystem based Marine Spatial Planning.

50 A Directive establishing a framework for maritime spatial planning and integrated coastal management
51 The coastal boundary is actually determined by local government.

Table 8. Key instruments affecting EB/MSP of Korea

Name (Date enacted)	Responsible Authority	Purpose and Objectives	Related Plans and Policies	Related Tools
Basic Act on Marine and Fishery Development (2002)	MOF (Marine Policy Division)	An act respecting the ocean governance	Ocean and Fishery Development Plan(OK21)('00, '11 revised)	- Maritime Affairs and Fisheries Development Committee : to deliberate on the master plan and on important policies of marine development and the marine environment.
Conservation and Management of Marine Ecosystems Act (2006)	MOF (Marine Ecology Division)	An act respecting the conservation and management of the marine ecosysems	Marine Ecosystem Preservation and Management Plan('09)	- Basic investigation into marine ecosystems - Making marine ecology map - Designating and managing of MPAs - Establishment and operation of Marine Ecosystem Information System
Marine Environment Management Act (2007)	MOF (Marine Environment Policy Division)	An act respecting the management of the marine environment and marine pollution	Marine Environment Master Plan('96, '00, '06,'10 revised) Marine Environment Management Areas Plan('13)	- Monitoring and management of marine pollutants - Marine environmental standards & marine environmental measuring network - Marine environmental information system (http://www.meis.go.kr/) - Designation and management of Coastal Environment Management Areas - Total Pollutant Loads Management System (TPLMS) - Marine environmental improvement measures - Regulations for prevention of marine pollution - Regulations for prevention of air pollution at sea - Inspection of ships for prevention of marine pollution - Measures for response to marine pollution - Marine environmental management business - Marine pollution impact surveys - Consultation on utilization of sea areas - Establishment of KOEM
Coast Management Act (2002)	MOF (Coastal Planning and Management Division)	An act respecting management the coastal zone for the sustainable development of coastal resources	National Integrated Coastal Management Plan('00, '11 revised) Intergrated Coastal Management(ICM) Local Coastal Management Plan(in process by each local government)	- Basic survey on coasts - Coastal Water Zoning System('10) • 4 Zones : Using, Special, Preserved, and Managed coastal water zone) - Coastal Water Suitability Assessment('10) - Local Coastal Management Plans - Target-based Natural Coastline Management System - Coastal enhancement projects - Coastal management information system(http://www.coast.kr) - Central Committee for Deliberation on Coastal Management

Planning process

Typically in the marine planning process in Korea, each law and plan is enforced by the MOF, and other relevant ministries and institutions participate in the implementation of the law and the plan through review, consultation, and cooperation. When the Korean government establishes a national plan, they have a prior consultation with the relevant central administrative agencies after hearing opinions of local government and relevant experts (Table 9). For example, the final 2nd National Integrated Coastal Management Plan is to be completed in 2011 after securing the agreement of relevant administrative organizations and allowing the deliberation of the Central Committee for Coastal Management under the CMA. Also, the Korean government has made an effort to involve the stakeholder in the planning process through the public hearing. In most cases, the public hearing is held after the establishment of the plan draft (the last step of the planning). As a result, it is difficult to reflect the opinion of stakeholders in the plan. During the planning process, stakeholders' participation is very limited. It is important that managers take into account stakeholders' views on how to ensure their participation at appropriate stages in the planning process. The relevant law prescribes only the need for stakeholder involvement; it does not explain how the government will do this, when it will do this and what it will do with the outcomes of stakeholder's views and opinions.

Table 9. Current stakeholder's involvement in the each planning process

Act	Plans	Stakeholder Involvement
Basic Act on Marine and Fishery Development	Ocean and Fishery Development Plan	Consulting with the relevant central administrative agencies
Conservation and Management of Marine Ecosystems Act	Marine Ecosystem Preservation and Management Plan	Consulting with the relevant central administrative agencies and the provinces
Marine Environment Management Act	Marine Environment Master Plan	Consulting with the relevant central administrative agencies
	Marine Environment Management Areas Plan	Consulting with the relevant central administrative agencies
Coast Management Act	National Integrated Coastal Management Plan	• Consulting with the relevant central administrative agencies • Hearing opinions of local government and relavant experts
	Local Coastal Management Plan	• Holding a public hearing • Counsulting with the relevant administrative agencies

Until now, we have described the legislative mandates and the main plans with regard to the marine spatial management in Korea. We have examined how the goals and the objectives for each plan are defined. The goals and the objectives for the plan are important because they give clear directions for all participants, focus work and resources on common ends, provide benchmarks for measuring "success" and developing accountability, help to constrain or delineate the boundaries of the process and the scope of work to be undertaken, and set clear expectations for all involved (Osmond et al., 2010)[52]. We have somewhat incorporated ecosystem elements into the goals of plans (see the underlined parts in the Table 10); these goals don't take into account the multiple management objectives across different sectors. In other words, the act does not explicitly mention economic impact or direct ecosystem services. The ecosystem services concept provides both an analytical and communicative tool to identify and quantify the link between human welfare and the environment, and thus to evaluate the effects of management interventions (Bohnke-Henrichs etc., 2013).

Table 10. Summary of the goal of the relevant plans

Act	Plans	Goal of Plans
Basic Act on Marine and Fishery Development	Ocean and Fishery Development Plan	• Extension of ocean domain in domestic and abroad • Renovation of ocean industry according to the new trends • Establishment of **sustainable ocean management system**
Conservation and Management of Marine Ecosystems Act	Marine Ecosystem Preservation and Management Plan	• **Conservation and Sustainable Use of Mairne Ecosystem.**

Marine Environment Management Act	Marine Environment Master Plan	• Ecologically healthy marine environment
		  • Establishment a management framework for the protection of marine environment from land-based activities
		  • Extension of response capacity on marine pollution
		  • **Maintenace and conservation of marine ecosystems health**
		  • Enhancement the marine environment policy infrastructure
		  • Enhancement the climate-friendly marine environment management

Coast Management Act	National Integrated Coastal Management Plan	• Intergrated-coast • **Eco-based coast,** • Attractive coast, • Co-managed coast

[52] Lessons for marine conservation planning: A comparison of three marine protected area planning process

Scientific inputs

Lastly, we describe science inputs in Korea for the marine spatial management, such as data management, monitoring, assessment, and evaluation. etc. The role of scientific inputs in carrying out ocean policy is important because planners must identify the characteristics and vulnerabilities of marine ecosystem in order to support human activities that depend on marine ecosystem, and consider the diverse human impacts that affect an ecosystem. They must focus on compiling relevant information on the ecological and socioeconomic context of the ocean.

The surveys and tools for identifying the coast and the ocean was defined for achieving the goal of each act in Korea (see Table 11). The KOEM conducts the investigations such as the marine ecosystem survey and the marine environment monitoring etc. And the MOF conducts the basic coastal survey. Also, the MOF must establish a marine ecology map, which classifies an ecological value across the entire Korea marine ecosystem, so as to utilize the map for establishment of the Marine Ecosystem Preservation and Management Plan, the development of new economic activities, and assessing the impact of these activities on the marine environment (Article 12). The study of the marine ecology map is currently underway. The MOF is developing “the Coastal water suitability assessment” to support the development and implementation of the Coastal Water Zoning System (4 zones : Using, Special, Preserved, and Managed coastal water zone), that evaluate the appropriateness of coast sea areas concerning the characteristics, location, possibility of utilization, etc[53]. The results of the Coastal water suitability assessment would be able to provide managers the information which coastal sea waters are conservations and which are human uses (or exploitation).

Despite of the monitoring and the survey programs under the acts, we have limited survey areas or items (particularly, the socio-economic data such as human uses and human impacts on the coastal and marine ecosystem and the knowledge on the ecological functions and structure of interesting species and habitats) for solving the problem in ocean. Also, we have a lack of the collaboration as well as the coordination framework among individual monitoring and survey programs at the national level. The results of the monitoring and the survey programs are not the result of assessment and evaluation but the result of measurement (fact-finding survey). So, the mismatches between available data and the management could not facilitate implementation of the ocean policy and still provide manager the information such as the

53 This assessment might be considered in its current biophysical status, current use, future use availability (future use potentiality)
(1) Current biophysical status : legally protected species, water quality, tidal flats, 1st grade landscapes, estuaries
(2) Current use : public water usage
(3) Future use availability : protected area, development areas

characteristics of marine ecosystem and the human impacts on it. We don't have the framework of assessment and evaluation. That is one of the reason we have insufficient scientific information for effective supporting decision-making in the marine planning process.

Table 11. the monitoring and the survey programs for marine spatial management of the relevant acts

Act	the monitoring and the survey programs	Executing organization	Investigation Result and Output
Conservation and Management of Marine Ecosystems Act	- Basic investigation into marine ecosystems - Marine ecology map	KOEM	Distribution of marine organisms, water quality, bottom sediment, topography and landscape, Habitats of marine organisms under protection
Marine Environment Management Act	- Marine environmental monitoring - Marine environmental information system (http://www.meis.go.kr/)	KOEM	Chemical parateter-based and water column-oriented data(COD, TN, TP, etc.)
Coast Management Act	- Basic survey on coasts (Coastal fact-finding survey) - Coastal water suitability assessment - Coastal management information system(http://www.coast.kr)	MOMAF (Coastal Planning and Management Division)	Coastal natural environment, socioeconomic utilization and/or development plans, and pollution

5. Recommendations for Korea's MSP Improvement

Opportunities and Obstacles for Korea

Through the case studies, we see that, while the EB-MSP process has been implemented, it is too soon to say whether implementing the EB-MSP will achieve the legislated goals or plans and what successful contributions the tools described herein will make. We focused on lessons associated with the EB-MSP design process. In the case studies, the key findings facilitating the completion of the EB-MSP are i) a strong legal mandate, ii) a clear setting and tracking of goals, iii) a science-based collaborative planning process, iv) spatially explicit tools, v) a method of identifying ecosystem services, vi) a mechanism for stakeholder involvement, and vii) an effective planning process design. Throughout the findings and insights of various case studies, the Korean government has both opportunities and obstacles in moving towards Korea's EB-MSP.

As mentioned in the previous chapter (see Table 8), we have the legal and institutional approaches to support marine spatial management, including integrated organizations, such as MOF and KOEM. Furthermore, MOF and KOEM have gathered the information on the marine environment and ecosystems and have developed marine spatial management tools, such as the Marine Ecology Map, Coastal Water Suitability Assessment, etc. Our government has begun to make an effort to apply the spatial management tools in the management of the marine ecosystem. This is an important opportunity for the Korean Government in facilitating the implementation of EB-MSP.

However, EB-MSP has not been fully applied in the Korean ocean, although the 2nd OK21 has introduced options for integrated spatial management of the ocean, including "The framework of ecosystem-based marine spatial planning"[54]. Also, there are no clear national goals nor is there a planning framework for MSP at the whole-ocean level in Korea. This lack of goals and framework is making it difficult for MSP to effectively move forward. So far, EB-MSP has occurred through the Local Coastal Management Plan and the MPA designation, etc.

At the national level in Korea, the public response towards the planning process is limited, because public involvement is not specified in the Act. The government looks at the public response as something that has to be done, rather than as an effective way to engage stakeholders in a discussion of the issues. These mandatory opportunities are not satisfying the interests and desires expressed by stakeholders. However, at the local level, the Local Coastal Management Plan has a more effective process. In advance the coastal managers hold a public meeting, to listen to, to understand, and to discuss the opinions of local residents and relevant experts. They also consult with the heads of the administrative agencies. Finally they obtain approval of the MOF following a deliberation with the Committee for Deliberation of the Local Coastal Management Plan. How to involve local stakeholders is specified in the CMA, and needs to be specified at the national level.

As mentioned above, we have various spatial management tools and spatial data, such as marine ecology maps, marine ecosystem monitoring, and coastal water suitability assessment, etc. Though these tools are in the introductory stage or experimental they need to be better developed for a more precise practical management. In reviewing how the case studies focused

54 While this is not MSP in the fullest sense, this introduction could provide a direction for MSP in Korea.

on evaluating human impact, and identifying ecosystem status for marine spatial management, one comes to the conclusion that Korea needs to improve their human use and ecosystem service valuation. Moreover, Korea needs to develop better evaluation tools for the planning process.

Moving forward with Korea's EB-MSP

The EB-MSP needs well regulated public and science input. Therefore, it is necessary to benchmark other countries advanced marine spatial management tools and systems to increase Korea's efficiency. As to governance, planning process, and science input, several marine policy options and tools are suggested herein for implementing EB-MSP in Korea. One must note, however, that Korea will need to be very creative in designing or changing their system, as it is effective, but operates differently than the countries reviewed herein.

Governance

First, measurable social and ecological goals are required for implementing EB-MSP at the national level in Korea. Setting goals is important in the initial step of implementing the EB-MSP. In this process, our governments should specify ecosystem objectives and identify threats to the environment. Second, designations of the leading agency for EB-MSP need to implement an effective EB-MSP approach. Strong leadership, both in the legal mandates and from key government officials, plays an integral role in the planning and implementation of EB-MSP. In the case studies, there were public-private partnerships (such as, MLPA Initiative, SeaPlan, PSP, and WCA), which provided the funding and capacity to succeed, in the context of specific mandates and time frames, to help the relative government comply with its statutory requirements. Also, under the partnerships, entities (e.g., stakeholders, scientists, planners, and managers) were directly involved in the MSP process. The integrated organization may include (1) 'The Korean Marine Environment Management Corporation' for conducting marine surveys and managing information, (2) 'The Korean Maritime Institute' for the establishment of EB-MSP framework, and (3) the relevant departments of the Ministry of Ocean and Fisheries should serve as the headquarters. The organization should aim to (1) improve and clarify the related laws as established by governance, (2) establish integrated marine spatial data, (3) establish effective networking and enhance the collaboration of stakeholders and involved entities, and (4) managing and sustaining planning processes to turn plans into action.

Planning process

First, our government should provide guidance on how to conduct matters with more practical approaches. Namely, we have to establish the development of a MSP Framework for EB-MSP, which will include the spatial planning procedures (key elements and steps in the process of implementing EB-MSP) and methods. The Framework will enable managers to find answers to questions encountered in the implementation of the EBMSP.

Second, stakeholder involvement should be accepted as part of the planning framework. To do this, the government is to establish a stakeholder involvement process (defining the stakeholders, designing the stakeholder processes, using the interactive decision supporting system[55] and evaluating the stakeholder involvement). In Korea, existing public participation in government planning processes has been low, especially among ocean user groups (or ocean dependent business groups). Methods of public input, e.g. public hearings and comments, have not been incorporated in each step of the planning process. However, in most of the case studies, managers and partnerships have conducted communication with more interactive approaches regarding stakeholder engagement, from the identification of issues and the setting of goals to the evaluation of the effectiveness in achieving the goals. One should encourage the stakeholders to participate from the initial stages of the planning process and they are not to be looked at as afterthoughts. When stakeholder involvement is incorporated into the planning process, their participation and concerns will be kept up with constantly. In making the Framework, it is very important to consider how to integrate the EB-MSP approaches into the existing marine and coastal spatial management framework, plans, and authorities.

Science input

First, identifying the state of the science for EB-MSP is very important in the initial stage of linking science into the EB-MSP. Also, our government should authorize a Science Advisory Group (tentative name) as an interface between the stakeholders and policy makers. For example, PSP in Puget Sound established related science documents (such as, The Puget Sound Science Update, The Strategic Science Plan, and The State of the Sound). These science documents have identified the current state of the ocean, have supported the proper scientific context, and have identified and prioritized science actions for practical management.

55 EB-MSP requires spatial data and non-spatial data on ecological, social, economic, and cultural issues. This creates both a need and an opportunity for broad stakeholder outreach. Managers should conduct data gap analyses and focus data collection on issues where there is the greatest conflict or uncertainty. Planners will take full advantage of available software and internetbased tools to make all data accessible, easily visualized, and available for feedback and improvement (Gopnik et al., 2012)

Second, the performance indicator is needed to identify trends and assess goals, namely to monitor the ecological or socio-economic condition, measure progress, inform adaptation, and communicate results. Once the goals are set, indicators should be chosen to facilitate the tracking of the natural ecological and human social status and trends relative to the objectives (Levin et al., 2009). From case studies, we have learned that they have made an effort so that the indicators reflect the ecological principles and ecosystem vulnerability, including the climate change ramifications. As mentioned above, our limited data and resources on marine ecosystems and human impacts may be perceived as barriers for effectively implementing the EB-MSP approaches. However, if we are going to wait for perfect science and data, important progress will be delayed. Given the current capacity to improve the starting points of the developing indicators helps one focus on selecting the pertinent biophysical and human-use data that is available, albeit distributed across agencies and institutes.

In the third context, the Establishing Coordinated Marine Monitoring Program (tentative name) is required to secure appropriately available spatial data, and to interpret and share the existing data with all involved. A key role of this program is to gather, interpret, visualize, and sustain issue-oriented data as in the Puget Sound case study.

Forth, we need spatially-explicit tools including a well developed ecosystem model for supporting the EB-MSP approach. From case studies, we have learned that models are used to help one visualize the data, save time, inspire the exploration of multiple alternatives, and increase the understanding of the requirements and limitations of multiple human activities in the spatial planning process. Korea has the Coastal Water Suitability Assessment as an appropriate spatially-explicit tool. However, currently limited assessment parameters are in place. It is recommended that Korea secures the data of the distribution of ecological attributes and human activities in the ocean and that they develop a model that includes ecosystem vulnerability, cumulative effects, and resilience. This information can support sustainable management decisions by visually documenting where marine resources and activities are located, needed, where they overlap, and where potential conflicts exist (Foley et al., 2013)[56].

Fifth, we should introduce an Ecosystem Service Approach involving legal specifications to inform the EB-MSP. An effective EB-MSP regime must understand socio-economic valuation of spatially managed areas (Katsanevakis et al., 2011)[57]. In Korea, as many people consider

56 Melissa M. Foley. 2013, Improving Ocean Management through the use of Ecological Principles and Integrated Ecosystem ssessments

57 Katsanevakis et al . 2011, Ecosystem-based marine spatial management: Review of concepts, policies, tools, and critical issues, Ocean & Coastal Management 54, 807-820

expanding current marine uses and investing in new ones, new management approaches will be needed that will maintain and enhance the delivery of multiple benefits for a sustainable society. Since promulgating the 2nd National Integrated Coastal Management Plan, the Korean government has introduced the coastal water zoning mechanism[58] , which will allocate the spatial distribution of human activities based on biophysical status, current uses, and future use availability in coastal areas. Because of certain competing issues when dividing and allocating the spatial areas, it is important to analyze alternative measures for managing these interactions, whether positive or negative, to reduce impacts, restore ecosystem functioning, and deliver sustainable use. It is therefore axiomatic that MSP encompasses all sectors of economic use as well as environmental and social issues (Gilliland & Laffoley, 2008)[59]. So, we need to implement the Ecosystem Service Approach, which is the best way of assessing the quantity, quality, and value of shared benefits obtained from multiple usage, and to guide the patterns and types of uses in sustaining ocean productivity for the needs and desires of present and future generations (Guerry et al., 2012). This Ecosystem Service Approach will enable manager and policy makers to support effective decision making and provide a powerful rationale for promoting a sustainable stewardship for future generations.

58 Coastal Water Zoning System consist of 4 Zones (Using, Special, Preserved, and Managed Coastal Water Zone).

59 Paul M. Gilliland,, Dan Laffoley, 2008, Key elements and steps in the process of developing ecosystem-based marine spatial planning, Marine Policy 32, 787– 796