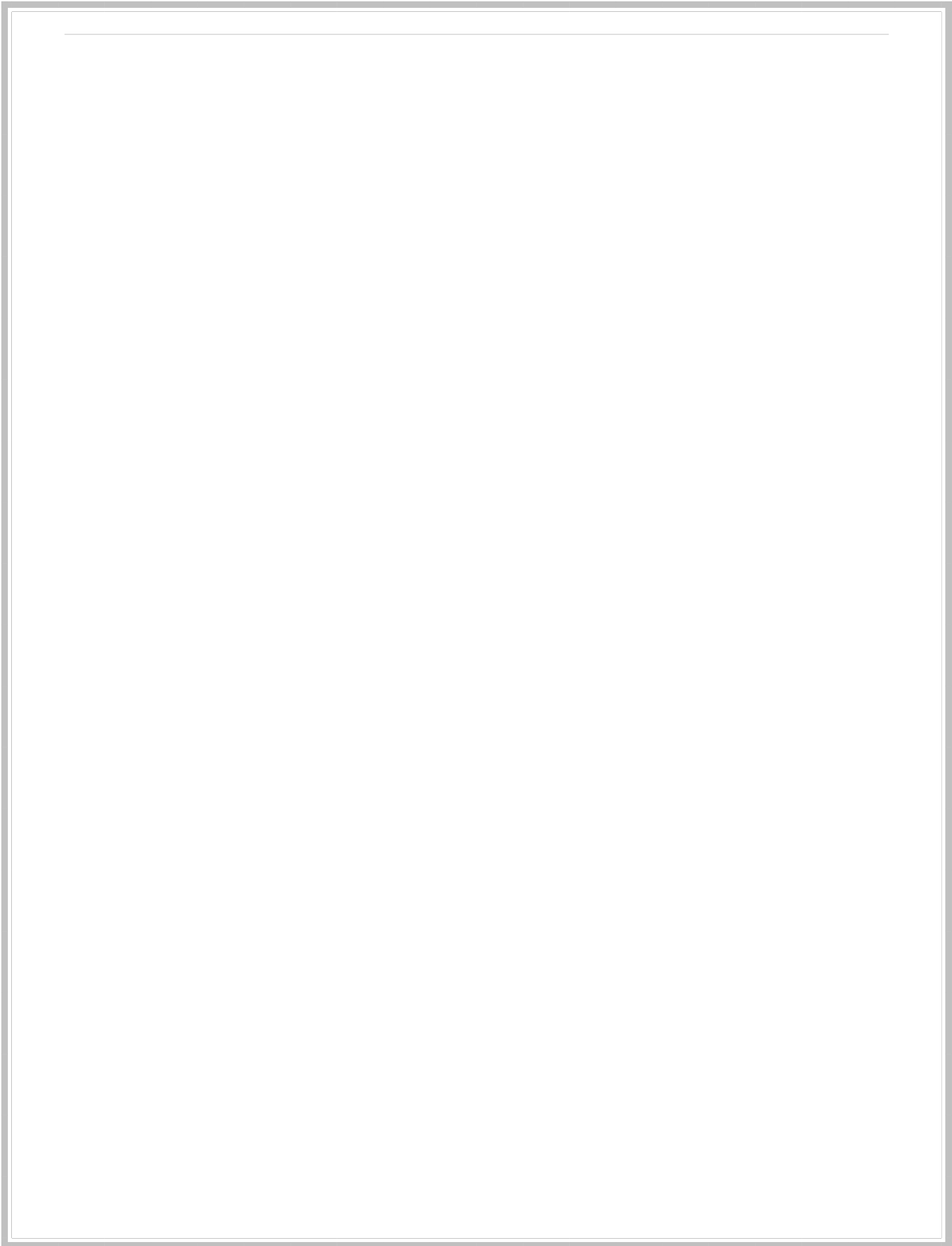

Implementing Ecosystem-Based Management

A Report to the National Ocean Council



Ocean Research Advisory Panel

December 2013



Implementing Ecosystem-Based Management

CONTENTS

| | |
|--|---------|
| 1. Executive Summary | Page 4 |
| 2. Introduction | Page 5 |
| 3. Principles of Ecosystem-based Management | Page 6 |
| 4. Strategies to Enhance Implementation of Ecosystem-based Management | Page 8 |
| <i>A. Challenge: Unclear and inconsistent explanations and understanding of ecosystem-based management</i> | Page 8 |
| <i>B. Challenge: Improving federal, state and tribal interaction</i> | Page 11 |
| <i>C. Challenge: Robust Information, Observations and Assessments</i> | Page 15 |
| <i>D. Challenge: Successfully Engaging Stakeholders</i> | Page 18 |
| 5. Decision Support Tools | Page 20 |
| 6. Criteria for Pilot Projects | Page 22 |
| 7. Key Findings & Recommendations | Page 23 |

APPENDIX: GEOGRAPHIC CASE STUDIES

| | |
|---|---------|
| a. Chesapeake Bay | Page 26 |
| b. Great Lakes | Page 27 |
| c. Gulf of Mexico: Barataria-Terrebonne National Estuary | Page 29 |
| d. Arctic Case Studies | Page 31 |

1. Executive Summary

Ecosystem-based management (EBM) is an important component of the National Ocean Policy (NOP) that forms a basis for inter-agency as well as state-federal-tribal collaborative work for coastal ocean planning and management. At the request of the National Ocean Council, the Ocean Research Advisory Panel (ORAP) convened a small working group to identify strategies and recommendations to advance national implementation of EBM. These recommendations were then reviewed and adopted by the full ORAP.

A key finding is that greater clarity and understanding across the various stakeholder groups about the concept of EBM is critical to its broader and more consistent application. While there have been numerous efforts to describe EBM in the course of developing the National Ocean Policy, it is essential that the messaging across Federal agencies be consistent and clear and that a coordinated communication plan be implemented to address past inconsistencies and confusion.

This report provides a set of examples – not to be considered exhaustive – of collaborative frameworks that can be built upon to implement EBM around the U.S. In implementing the NOP these existing arrangements should be fully used in pilot projects and for long-term efforts to develop better coastal and ocean management. They give the states, and in some cases tribes, a leading role in developing science and management efforts and provide good connections, as well as further opportunities for state, tribal and federal collaboration.

The report emphasizes that instituting EBM under the National Ocean Policy is not an additional layer of regulation, but a re-engineering of current inter-agency consultation and state-federal interactions. This can be a nuance lost on state agencies, tribes and other stakeholders who increasingly see “ecosystem-based management” terminology appearing in permitting and regulatory documents. For that reason, consistent messaging and collaboration among federal agencies is critically important if EBM is to become a key organizing principle for managing the nation’s coastal and ocean resources. In effect this means re-engineering existing processes between agencies, strengthening collaborative work, reducing agency stovepipes and becoming more “forward thinking” in these collaborations rather than “reactive,” for both federal science and management efforts.

Criteria for pilot projects are described in the report but can be simply summarized thus: build upon what is already underway and improve data, science and management collaborative efforts to be more effective and efficient. While we recognize that greater consistency in EBM approach and tools would be beneficial, a single uniform structure nation-wide is not needed, and regional efforts around the country, with strong federal agency support, should lead much of the effort.

2. Introduction

This report responds to the National Ocean Council's request for input regarding ecosystem-based management (EBM) of the U.S. marine environment as called for in the National Ocean Policy:

“Adopt ecosystem-based management as a foundational principle for the comprehensive management of the ocean, our coasts, and the Great Lakes” (NOP 2010).

The Council asked the Ocean Research Advisory Panel to:

“Provide input on:

- Principles, goals, and best practices for EBM implementation especially in cross- or multi-sectoral situations.
- Strategies to enhance a common understanding of EBM principles, best practices, and latest decision-support tools among decision-makers from multiple levels of government; and mechanisms federal agencies may use to engage non-federal partners and stakeholders, including opportunities for outreach and education on the societal benefits of EBM.
- Criteria for identifying EBM pilot projects and priority geographic areas for hosting these projects.
- Existing and new decision-support tools to implement EBM across multiple sectors.”

In this report, adopted by the full Ocean Research Advisory Panel on December 3, 2013, we briefly discuss the overarching principles of EBM based on the extensive scientific literature, which is well summarized in Leslie and MacLeod (2009). We then focus on what we view as key challenges to the implementation of EBM in the U.S. and strategies to address these challenges and enhance implementation. To support the ongoing work of the National Ocean Council on EBM, we illustrate our points with lessons learned from around the country. We briefly address decision support tools and criteria for potential pilot projects and conclude with key findings and recommendations. Potential case studies or pilot projects are described in an Appendix.

3. Principles of Ecosystem-based Management

The National Ocean Policy (NOP) describes ecosystem-based management (EBM) as follows:

“Ecosystem-based management (EBM) is an integrated approach to resource management that considers the entire ecosystem, including humans. It requires managing ecosystems as a whole instead of separately managing their individual components or uses. EBM considers all the elements that are integral to ecosystem functions and accounts for economic and social benefits as well as environmental stewardship concerns. It also recognizes that ecosystems are not defined or constrained by political boundaries. The concept of EBM is underpinned by sound science and adaptive management as information or changing conditions present new challenges and opportunities.”

This general statement of principles is consistent with the academic literature on ecosystem-based management. For implementation, however, it may not give sufficient guidance for agencies and stakeholder groups to proceed. Federal agencies are drafting an interagency work plan for implementing EBM and are considering a slightly modified definition of EBM intended to help them operationalize the concept in federal planning and actions:

“EBM is an integrated approach to management that drives decisions at the ecosystem level to protect the resilience and ensure the health of the ocean, our coasts and the Great Lakes. EBM is informed by science and draws heavily on natural and social science to conserve and protect our cultural and natural heritage, sustaining diverse, productive, resilient ecosystems and the services they provide, thereby promoting the long-term health, security, and well-being of our Nation.”

Regardless of the ongoing development of definitional language, it may be more helpful to consider how ecosystem-based management differs from the current approach to management that is widely applied across the country and indeed around the world for the management of ocean and coastal resources. Based on a review of the literature and current practices, the fundamental differences are:

- a. EBM is cross-sectoral, explicitly considering the interactions between sectors of human activity that co-occur in the coastal and marine environment. By the term sector, we refer to such human activities as oil and gas, transportation, fishing, coastal development or other marine activities. Current government management (whether by federal or state agency, local or tribal government) is largely of a single sector. In many cases, management of the sector is called for by a statute (state or federal or both) specific to that sector, which may or may not guide how interactions with other sectors should be handled. For example, the Magnuson-Stevens Fishery Conservation and Management Act (reauthorized in 2006) sets out the goals, standards and authorities for management of fisheries in federal waters, and coastal states have proscribed these for state waters. The federal fisheries statute does require consideration of some other sectors by

referring to “other applicable laws”. It also requires consideration of some ecosystem parameters, such as habitat and protected species conservation, as they pertain to fishing activity. But, the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) and other sector statutes do not lay out explicit goals, standards and authorities for working with other sectors such as transportation or energy development, or even port development. Ecosystem-based management calls for such goals and standards to be implemented between sectors, either under existing or new authority as needed.

- b.** EBM highlights the need for the management of cumulative impacts on the marine environment, across sectors. Current management practices focus on the environmental impacts of single-sector activities and set standards for those impacts. Using fisheries as an example again, the Magnuson-Stevens Act sets as one of its standards that overfishing shall not be allowed, and defines a quantitative standard for overfishing in the Act. But the Act does not address the loss of fishery productivity due to activities other than fishing, other than a requirement for consultation on activities authorized by federal agencies that may impact essential fish habitat. In other words, the fishery statute is not intended to fully address the impacts of other activities in the same environment, presumably because those are dealt with in other sectoral statutes. In an EBM framework, joint consideration of impacts would be required along with management measures to address those impacts across sectors. For example, if development of energy infrastructure were impacting fishery productivity, there would be direct consideration of those impacts, again under existing or new authority as needed. Note, this requirement for consideration of cumulative impacts is contained, but only nominally addressed in practice, under the National Environmental Policy Act, but no guidance is given concerning if and how such impacts are to be addressed as would be needed to fully implement EBM.
- c.** EBM principles include the recognition that tradeoffs may need to be made in the management of human activities and impacts on the ocean. In simple terms, it is rarely possible to optimize all activities at once without some tradeoff in goals. For example, the need for additional energy infrastructure might result in some loss of habitat, recreational area or fishing grounds. Under current management practices these tradeoffs are implicit, but not explicit, and the interaction between sectors is often contentious and difficult to resolve. In practice, such tradeoffs are often dealt with after the initial planning and perhaps even after permitting of an activity occurs, meaning that problems such as loss of fishing or recreational areas must be addressed in arrears. In an EBM framework, these tradeoffs become explicit and are dealt with as part of the planning and permitting efforts, affording a clearer opportunity for stakeholder engagement and resolution of issues prospectively rather than retrospectively.

Consideration of these three areas – cross-sectoral interactions, cumulative impacts and explicit consideration of tradeoffs – is the fundamental difference between EBM and most current management practices. It is important to note that in many cases such consideration can probably be addressed under existing authorities at state and federal levels by changing

practices, not statutes. For example, using tools provided under the National Environmental Policy Act, Coastal Zone Management Act, Clean Water Act and Magnuson-Stevens Act, many interactions between sectors could be considered routinely, and indeed are partially considered currently through consultation processes. Similarly, there is nothing to prevent consideration of tradeoffs as a matter of regular practice in advance of any major actions. It requires stakeholders and practitioners to change current approaches, and to discern benefit from doing so. **As such, instituting EBM under the National Ocean Policy is not an additional layer of regulation, but a re-engineering of current inter-agency consultation and state-federal interactions.** A key potential benefit of such a re-engineering is the opportunity to make these processes more effective and efficient for all concerned, including stakeholders as well as state and federal agencies, and thereby reduce duplication and improve clarity and timeliness.

In order to effectively implement EBM, some key challenges must be addressed as discussed below. Just as importantly, agencies and stakeholders must be willing to embrace changes in practice and use the opportunity presented by the NOP to consider how all of our management processes concerning ocean and coastal activities and environments can be improved. In effect, that means that EBM as an organizing principle must become part of the culture of federal agencies and their counterparts in the states and tribes. While parts of this culture are already in place among some entities, the NOP should more fully motivate this re-thinking of goals, strategies and processes.

Of course, consideration of cross-sectoral interactions, cumulative impacts and tradeoffs immediately raises questions about the scope of an EBM effort. Should all potential stressors on the environment be considered? How should issues be prioritized? In principle, managers may consider all stressors to the extent practicable, but some prioritization is of course necessary to “bound” the effort. In addition, managers should not be caught in the trap of “waiting” for all information on all sectors to be available and complete before taking action on interactions and cumulative impacts. Thus, building up to a fuller consideration of impacts at the ecosystem level is appropriate by incorporating cross-sectoral effects as they arise. For example, an EBM plan may begin with two or three sectors collaborating, such as fisheries, habitat protection and coastal pollution, or fisheries and offshore energy development. Other effects, such as climate change, could be considered further on in the course of plan development.

4. Strategies to Enhance Implementation of Ecosystem-based Management

A. Challenge: Unclear and inconsistent explanations and understanding of ecosystem-based management

Because the literature and “science” of ecosystem-based management principles described above is relatively new and still evolving, there is a lack of clarity and some inconsistency in explanations and definitions of EBM. This has contributed to confusion and skepticism among those tasked with promoting and implementing EBM as well as among stakeholders who might be impacted by EBM implementation.

A basic strategy for EBM consists of identifying key players and interactions within a particular ecosystem whose impacts must be managed. Managers should identify interactions between those key impacts and actors that could be addressed within a management plan prospectively, rather than after conflict becomes apparent or is leading to problems. Of course, putting in place the capability to collect more comprehensive information on ecosystem impacts from human activities is important, as is ensuring that information is related across the sectors of activities so that cumulative impacts can be considered. The resulting, evolving EBM plan should incorporate more sectors and more information as it becomes available and possible to address emerging issues.

A key strategy to enhance implementation of EBM is for the Federal Government to develop a clear and easily understandable set of EBM messaging materials that are used by all parties on a consistent basis and as part of a national EBM communications plan.

These materials would not only provide clear definitions and principles of EBM, they would also respond in a consistent manner to frequently asked questions and concerns relating to EBM implementation. The current federal interagency working group effort is addressing this need and should engage with states, tribes and other stakeholders as soon as practicable. A well-thought out and strategic communications plan could help address many questions and concerns.

Here we note some frequently asked questions and attempt to briefly address them to help enhance common understanding of EBM principles:

1. How does one actually manage ecosystems?

Ecosystem-based management is so named to distinguish it from ecosystem management. The latter may be more easily thought of as ecosystem engineering. The former, managing on an ecosystem basis, refers to the need to consider the structure and function of natural ecosystems in managing the human activities that may affect that structure and function. People and their actions can be managed by society to some degree, not ecosystems per se.

2. How does this type of management differ from current management that must respond to statutory and regulatory requirements of the National Environmental Protection Act (NEPA), the Marine Mammal Protection Act, (MMPA) and the Endangered Species Act (ESA)?

The existing federal statutory structure is not generally at odds with EBM, but does not fully deal with the interactions between different sectors of human activity, nor the tradeoff decisions that must be made in the course of managing activities that affect a given ecosystem. While the full set of statutory authorities for marine systems is quite comprehensive, management will only be “ecosystem-based” if those authorities are exercised in an integrated manner. The MMPA and ESA in particular require activities related to single species. The NEPA requires cumulative impacts on the affected

environment to be analyzed but agency ability to do so is weak or spotty, tools to do so are in their infancy, and the statute doesn't give authority for any specific management action to deal with issues of tradeoffs between different ecosystem services.

3. Why is this not an additional layer of regulation added to the mix, and if not, what is the value to be added from the EBM approach?

There is no new statutory authority proposed for EBM, although it is being explicitly incorporated into some existing regulatory processes, which may give the "impression" of a new statutory requirement (and which also may lead to increased confusion on the part of stakeholders). Rather than an additional layer, the EBM approach calls for modifying the current implementation approaches under existing statutes and regulations to account for multi-sector interactions, cumulative impacts and tradeoffs. The goal is to make these aspects explicit in policy, rather than implicit, so that issues can be dealt with prospectively, rather than after the fact. For example, as energy siting is considered in coastal waters, an EBM approach would include consideration of impacts on other activities as part of management planning from the outset, as well as consideration of which tradeoffs might be needed to pursue a course of action. This differs from consultation after a plan has been developed to address impacts, because it means that planning is pro-active not reactive.

4. If EBM is not required in statutes or regulations, why do proponents continue to say that to be successful, it must be mandated?

To be successfully implemented as a policy among the multitude of federal agencies given their existing authorities, EBM as a "policy" must be instituted as a requirement for federal planning purposes by all federal agencies. States and tribes would not be "required" to institute EBM, but could certainly be encouraged to do so.

5. What group has the current statutory authority to consider all sectors of activities when making decisions?

At the federal level, the National Ocean Council has this authority, because it comprises of all the federal ocean agencies and inherently brings the existing statutory authorities together for planning purposes. At the state and regional level, these discussion forums can be held in regional ocean councils, state coastal zone management agencies and other existing integrative bodies. A new body for federal agencies to integrate their planning activities might be needed. It is not the case that the authority shifts to a new group, but that planning is done among the existing authorities in an integrated manner.

6. Does EBM require the use of a precautionary approach to management and what does this mean in practice?

Resource managers already make decisions under uncertainty using imperfect scientific information. A precautionary approach to management calls for managers to be more cautious when uncertainty about the potential impacts of an activity is greater, and to allow an ample margin of safety and evaluate potential impacts before allowing activities to move forward rather than allowing them to occur first and trying to recover later. This is a general approach to management, not specific to EBM, although they are often talked about together. Some see the precautionary approach becoming more of a red stoplight rather than a yellow, “go slow” light. However, descriptions of the application of the precautionary approach, including in the U.S. Commission on Ocean Policy report, refer to it as exercising prudent foresight (i.e. common sense), not setting up barriers to any action.

B. Challenge: Improving federal, state and tribal interaction

“Fundamentally, the National Ocean Policy coordinates, through establishment of the National Ocean Council, the ocean-related activities of Federal agencies to achieve greater efficiency and effectiveness, with a focus on reduced bureaucracy, improved coordination and integration, and fiscal responsibility. The Policy does not create new regulations, supersede current regulations, or modify any agency’s established mission, jurisdiction, or authority. Rather, it helps coordinate the implementation of existing regulations and authorities by all Federal agencies in the interest of more efficient decision-making. The Policy does not redirect congressionally appropriated funds, or direct agencies to divert funds from existing programs. Instead, it improves interagency collaboration and prioritization to help focus limited resources and use taxpayer dollars more efficiently.

... The Plan reflects a commitment to develop and apply the latest science and information, conduct the business of government more efficiently, and collaborate more effectively with State, tribal, and local authorities, marine industries, and other stakeholders.”

(National Ocean Policy Implementation Plan, National Ocean Council 2013).

We include this passage from the National Ocean Policy Implementation Plan because it clearly articulates the need for coordination and collaboration in order to accomplish ecosystem-based management. Deficiencies in the needed collaboration constitute the most significant institutional barrier – other than statutory – to effective implementation of EBM. If anything, the passage understates the challenge because critical non-governmental constituencies, including user groups, conservation organizations and the scientific community, must also be engaged as is recognized elsewhere in the implementation plan. The Implementation Plan directs most of its attention to collaboration and shared goals for federal implementation of ecosystem-based management, and this is an appropriate first step. However, EBM in the U.S. Exclusive Economic Zone invariably involves the states and tribes, even if resource and ocean management is a federal responsibility. Requirements for consistency with state objectives under the Coastal Zone Management Act, engagement through the National Environmental Policy Act, and regional Congressional interests assure that. In many other cases, there are co-management responsibilities (e.g., migratory fisheries) or delegated authorities (e.g., under the

Clean Water Act) that require Federal-State collaboration to achieve ecosystem-based management.

Collaboration among federal agencies is challenging enough because of their different statutory and regulatory responsibilities, budgetary authorities (different OMB examiners and Congressional subcommittees), and cultures for both science and management. From the perspective of the states, this can lead to incoherent, and even inconsistent, positions on EBM objectives among federal agencies, diffuse information that is difficult to access, and specialized scientific capabilities that do not address critical interactions within ecosystems. Even more troubling than duplications and inefficiencies, this specialization leaves tremendous gaps in the very kind of interdisciplinary knowledge needed for ecosystem-based management.

Over the past two decades, most federal agencies have adopted policies of ecosystem-based management. Most agencies will also say they are implementing ecosystem-based management, but the degree of implementation varies from agency to agency and from region to region. Often such policy mandates are “top-down” from directors and supervisors, but the two-way communication with employees “bottom-up” is sometimes insufficient. Agency staffs feel they are already spread thin with their assigned duties and responsibilities and view ecosystem-based management as an added layer of unfunded responsibility. Such problems can and are being overcome with structural changes in agency organization and training.

The “stove pipes” of many organizations often minimize opportunities for scientists and managers to interact on common problems and issues in an ecosystem-based manner, and agencies must develop strategies to counteract this trend. Some agencies are doing so. For example, the U.S. Fish and Wildlife Service has articulated ecosystem-based management as their *modus operandi* with clear directives throughout the organization. Agency management developed a policy document entitled, “An Ecosystem Approach to Fish and Wildlife Conservation.” To facilitate implementation, ecosystem teams were formed in each geographic region. This fostered regional interaction and cooperation across the traditional “stove pipes” of refuges, fisheries, wildlife, ecological services and law enforcement (see for example, www.fws.gov/charleston/ecosystemteam.html). Many state natural resources agencies have also made structural changes in their organizations to facilitate ecosystem-based management by dissolving the traditional divisions of fisheries, wildlife, geology, etc. in favor of interdisciplinary, geographical regional units.

For federal agencies to cooperate with state and local units of government in ecosystem-based management, memoranda of agreement or similar documents may be necessary to formalize interactions, clarify roles and responsibilities, and improve “top-down/bottom-up” communication and cooperation. To implement the National Ocean Policy, such agreements may be especially important in marine coastal areas where aquatic scientists and managers and their land-based counterparts in other agencies and organizations traditionally have not interacted in more than a superficial manner. Additionally, federal agencies should be encouraged to use, to a much greater extent, routine regulatory processes and rulemaking to further operationalize EBM in a transparent public process.

Another aid to improving EBM implementation could be additional training in ecosystem-based management. Many in the agency work force received academic training in “stove pipe” disciplines that carried over into the work place. Training in ecosystem-based management, adaptive management, inter-disciplinary teamwork, etc. often will facilitate implementation of ecosystem-based management. EBM and multi-disciplinary classroom instruction and team-based fieldwork are becoming more prevalent in the academic curriculum, which will benefit inter-disciplinary science and management.

Examples of Regional Cooperation and Lessons Learned

There is no “iconic” example of EBM. Each region faces different challenges when it comes to enhancing collaboration on ecosystem-based management. Given the different states laws, organizations, types of industries, histories and cultural aspects in regions, each region or state will need unique solutions to facilitate collaboration. Indeed, there are already several programs in place that have implemented successful strategies for collaboration based on the strengths already present in each region. We highlight a few of these to illustrate progress underway to implement EBM.

The Environmental Protection Agency’s ***National Estuary Program (NEP)*** (<http://water.epa.gov/type/oceb/nep>) uses an approach that is non-regulatory and emphasizes the importance of collaboration among multiple users as well as federal and state agencies, citizens, and environmental, business and industry groups. It also endorses education and research as essential components of long-term efforts to restore and manage estuaries. Although the NEPs are administered through EPA, each strives to maintain independence from that agency. It is essential to the ecosystem-based management approach that NEP projects be implemented, not by one agency, but according to the wishes of the collective partners on the individual estuary’s Management Conference and its Comprehensive Conservation and Management Plan.

The nation’s estuaries and bays cry out for ecosystem-based management because of the intensity of their uses and conflicts, degraded resources, and multiple and overlapping management responsibilities. The Chesapeake Bay, the nation’s largest estuary, has been the subject of a 30-year management effort that has broken new ground in ecosystem-based management. Twenty-eight other estuaries and bays have been included in the National Estuary Program, authorized under Section 320 of the Clean Water Act and administered by the U.S. Environmental Protection Agency. These water bodies range from large, open embayments along the coast, such as Santa Monica Bay, to small coastal lagoons along the Delaware and Maryland coast. Although these programs have a large focus on water quality, each also has independently developed a Comprehensive Conservation and Management Plan (CCMP), a long-term plan that contains specific targeted actions designed to address water quality, habitat, and living resource challenges in its estuarine watershed, thus providing the basis for ecosystem-based management.

Landscape Conservation Cooperatives (LCCs) are applied conservation science partnerships between the U.S. Fish and Wildlife Service within the Department of Interior and other federal agencies, states, tribes, NGOs, universities and stakeholders within a geographically defined area. These are relatively new, applied conservation science partnerships with two main functions. The first is to provide the science and technical expertise needed to support conservation planning at landscape scales – beyond the reach or resources of any one organization. The second function of LCCs is to promote collaboration among their members in defining shared conservation goals. With these goals in mind, partners can identify where and how they will take action, within their own authorities and organizational priorities, to best contribute to the larger conservation effort. LCCs don't place limits on partners; rather, they help partners to see how their activities can "fit" with those of other partners to achieve a bigger and more lasting impact.

The *Arctic* is a region where numerous federal agencies have a role in activities in the ocean, governed by a multitude of federal laws and regulations with different timelines and requirements for scientific and other information. A more integrated approach to management across multiple federal agencies, and in coordination with state and local laws and regulations, would be beneficial and mark progress towards implementation of EBM. An example of this is an effort recently conducted in Alaska on behalf of the National Ocean Council and the **Interagency Working Group on Coordination of Domestic Energy Development and Permitting in Alaska**. The latter was created by the White House to “facilitate orderly and efficient decision-making regarding the issuance of permits and conduct of environmental reviews for onshore and offshore energy development projects in Alaska” and to ensure that schedules, information gathering, planning efforts and stakeholder engagement are coordinated.

The report – *Managing for the Future in a Rapidly Changing Arctic* – was issued in April 2013 and recommends integrating management, continuing high-level attention on the Arctic, strengthening state and tribal partnerships, encouraging more stakeholder engagement, undertaking more organized and inclusive scenario planning, and coordinating and potentially consolidating environmental reviews that are now being prepared by multiple agencies. The report does not recommend new regulations or represent new policy decisions, but it does call for a review of the activities of over 20 federal agencies involved in the U.S. Arctic by the end of 2013 with an eye toward increased coordination and the elimination of duplication of efforts.

The recently enacted Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economy (RESTORE) of the Gulf Coast Act presents a substantial opportunity for advancing collaborative ecosystem-based management in the Gulf of Mexico region. The act establishes a **Gulf Coast Ecosystem Restoration Council** comprising agency and state representatives to guide ecosystem restoration efforts and dedicates for these purposes potentially significant funds that come from penalties resulting from the BP Deepwater Horizon blowout and oil spill. In December 2011, a Presidential task force developed the Gulf of Mexico Ecosystem Restoration Strategy, which takes an ecosystem approach to restoration, including science-based, adaptive management. The RESTORE Act also

establishes a program for Centers of Excellence for Ecosystem Restoration Science, Monitoring and Technology, and an endowment for fisheries and ecosystems research, monitoring and assessment. The Council has the challenge and opportunity to manage these resources to provide the technical support required for ecosystem-based management related to restoration objectives.

The *Great Lakes* also offer some examples of cooperation between Federal and State actors. International agreements provide the framework for ecosystem-based management in the Great Lakes, but, in addition, there are domestic, regional agreements in specific locations to coalesce cooperation and collaboration between agencies. For example, the Maumee River watershed at the western end of Lake Erie is one of the largest and most important agricultural areas in the Great Lakes basin. With Lake Erie experiencing an increase in nuisance algal blooms, the Maumee River's role as a major source of nutrient loading is expected to be a significant cause of the problem. There are multiple agencies involved in addressing the issue. The U.S. Army Corps of Engineers is responsible for navigation on the lower river, including dredging and removal of sediments. Meanwhile, the U.S. Department of Agriculture's Natural Resources Conservation Service works with the agricultural community to, among other things, keep the soil on the land. To address this issue, the Western Lake Erie Basin Ecosystem Team was formed to provide a framework for improving cooperation and collaboration among all federal agencies, the States of Ohio, Michigan and Indiana and local agencies and stakeholders for nutrient and sediment management.

C. Challenge: Robust Information, Observations and Assessments

Needs for science

Decision-making informed by science is an essential aspect of EBM. Implementation of a robust EBM policy depends on detailed knowledge of ecosystem structure, functioning and dynamics, as well as mechanisms and models for projecting change and predicting outcomes. Adequate scientific information is also critical for adaptive management that requires ongoing assessment of the effectiveness of actions and responses to changes over time. While scientific knowledge of marine ecosystems will always be incomplete and uncertain, existing laws (e.g., Magnuson Stevens Fisheries Conservation Act and Marine Mammal Protection Act) require decisions to be made based upon the best scientific information available. However, policies do not mandate the synthesis of scientific knowledge across sectors to support EBM efforts. Effective integration and synthesis is a critical deficiency.

Funding for long-term monitoring of individual species, let alone ecosystem function and health, is nearly always a challenge. This is due to differences in agency funding priorities, to the short-term funding cycle of sponsoring agencies, and to the fact that most of the benefits of long-term monitoring are also long-term. Funding is even more of a challenge given current Congressional interest in reducing government spending. Current federal budget reductions no longer exempt even biennial and triennial fishery surveys, typically "held harmless".

Integrated ocean observing systems initiated in the 1990s and codified in statute under the 2009 Integrated Coastal and Ocean Observing System Act, have been slowly growing, but face constant funding and institutional challenges and are not yet effectively used in regional EBM.

The need to synthesize and integrate data across multiple species and sectors to provide greater ecosystem understanding and evaluate cumulative human impacts is greater than ever. New efforts are underway to develop computer-based methods to quantitatively evaluate multiple human impacts on different marine habitats, but these are still in their infancy. Decision makers are looking towards integrated maps of data to help inform decision-making. But integration faces the usual challenges of sharing data among multiple participants. Even though federal agencies are subject to Presidential executive orders requiring public access to federal data, these orders are often not enforced or inconsistently interpreted and applied. Data are often collected by multiple investigators using different data collection protocols and standards. Metadata are often incomplete or non-existent. Often, agency researchers want to comply with federal regulations, but the obstacles they face to doing so can be daunting. **The national Integrated Ocean Observing System (IOOS) program and the regional ocean observing systems could play a larger role in assisting federal agencies to meet their data sharing and integration mandates. A more coordinated vision for doing so, that addresses the role of the emerging ocean data portal (www.ocean.data.gov) and the regional IOOS data centers, should be developed.**

Role of agency managers

Managers play an important role in responding to the research needs for ecosystem-based management. An important function is prioritizing pending management decisions across agencies, identifying the scientific information needed for those decisions, and communicating those needs to the science community. In addition, **managers across sectors should develop research plans based on regional needs; fund targeted research that informs management decisions; be timely with data sharing; share information across jurisdiction and sectors; standardize information for data collection and storage; and develop regional information systems to meet their decision-making needs.**

In its 2004 report, the U.S. Commission on Ocean Policy identified adaptive management as a critical component of its ecosystem-based ocean blueprint for the 21st century. An EBM approach that supports adaptive, iterative management is responsive to new information and to changing conditions. However, the concept of adaptive management is more than just responding to new information or changing conditions. Adaptive management requires a more anticipatory and structured approach than simple trial-and-error and includes use of conceptual models, careful monitoring of implemented actions, timely analysis and responsive adaptation and institutionalized learning. Careful consideration must be given to whether adaptive management is possible and if so, whether it should be passive or active and more experimental (Gregory et al., 2006). Adaptive management places a premium on modeling, strategic monitoring and integrated assessment.

Adaptive management approaches are particularly important given the clear and ongoing effects of a changing climate. The evidence so far indicates that as the ocean warms and acidifies, there are shifts in species ranges, productivity and ecosystem connections. The simplest pattern is the shift of species poleward and to deeper water as warming proceeds. There are also indications that oxygen minimum zones are changing as the chemistry of the water changes along with climate. These impacts are documented in recent Intergovernmental Panel on Climate Change reports, the drafts of the soon-to-be released U.S. National Climate Assessment and the academic literature. Climate change impacts will require that managers implement EBM to incorporate these expected changes and adjust to new information in management plans. This will be the case in individual sectors such as fisheries, where fish distribution and productivity are shifting. An example is the Gulf of Maine, where the effects of climate appear to be changing the productivity of cod, lobster and other key species. Incorporating climate change impacts will also be important in considering the interactions between sectors such as runoff pollution (due to precipitation changes) and fisheries.

Interagency Research

Improving interagency research can be a powerful and efficient tool for EBM. Despite mechanisms for federal interagency research collaboration, such as by the Subcommittee on Ocean Science and Technology of the National Ocean Council, the Interagency Arctic Research Policy Committee and the National Ocean Partnership Program, effective and sustained science programs involving two or more agencies are still relatively uncommon. The National Ocean Policy Implementation Plan identifies an action to establish a science framework to support science-based EBM implementation and identifies 22 agencies, in addition to OSTP and CEQ, for this task. The 2007 Ocean Research Priorities Plan – updated in February 2013 – is organized around six thematic priorities, including stewardship of ocean resources and improving ecosystem health. **Now that ecosystem-based management is one of the priority objectives in the National Ocean Policy, it also should be seen as a key principle in implementing the updated research priorities plan and federal agencies should be encouraged and rewarded for integrating science programs across multiple agencies.**

Ecosystem-based fisheries management

The fisheries science and management community has made extensive progress incorporating “ecosystem considerations” into fisheries analysis and management actions. This includes measures for reducing bycatch of unwanted fish and invertebrates and the impact of fishing on habitat and threatened and endangered species. These efforts have confronted, and in some cases overcome, resistance from various stakeholder groups to the need for additional restrictions, especially in circumstances where fisheries are already under stress due to overharvesting. However, ecosystem-based fishery management (EBFM) should not be confused with ecosystem-based management (EBM) in any of the ecosystems including the Great Lakes. The former is effectively a single sector approach to address a broader range of concerns about the impacts of fishing on the ability of a given marine ecosystem to continue to support fishing activity – i.e., on fisheries productivity. The latter, EBM, is a multi-sector

approach intended to deal with the interaction, cumulative effects and tradeoffs between sectors with the overall goal of sustaining a full range of ecosystem services that support human well-being, not just fishery production. So, while EBFM is an important effort, it is necessary but not sufficient to sustain marine systems.

D. Challenge: Successfully Engaging Stakeholders

To be successful in achieving the national priority objective for ecosystem-based management, substantial improvements are needed in federal agency efforts to empower and facilitate collaboration with the States, Tribes and key stakeholders. These include improved mechanisms to develop Federal coherence; streamline interactions with the Federal Government, such as regional “one-stop shops” for EBM information and regulations; and provide appropriate scientific and technical support responsive to stakeholder needs. These should be explored by considering several existing or emerging federal-state mechanisms for collaborative management. Multi-state regional ocean alliances have recently developed that could provide frameworks for ecosystem-based management requiring Federal-state collaboration. These include the West Coast Governor’s Alliance on Ocean Health, the Mid-Atlantic Regional Council on the Ocean, the New England Regional Ocean Council and the Gulf of Mexico Alliance. Promoting regional ecosystem protection and restoration is one of the nine priority objectives of the National Ocean Policy.

Involving appropriate stakeholders in an EBM process is one of the first and most critical elements of success. However, this step is sometimes given scant attention. Participation in the planning of marine and coastal management has often involved only the most obvious resource users (usually fishers) and the government agencies with direct jurisdiction over the area in question. The result of such limited participation can be a backlash against the emergent regulations from user groups (and even agencies) not included in the original planning. In the interest of achieving an adequate management plan, with buy-in from those it will affect, planners should broaden the community of practice to involve all relevant stakeholders as early in the process as possible.

Current management practices for marine and coastal sectors necessarily include engagement with various user and interest groups of constituents. So, fishers and environmental NGOs are involved in discussions on fisheries issues, and landowners, coastal businesses, builders and environmental groups are involved on coastal development issues. This engagement can be, of course, contentious and is often in the context of specific regulatory actions. Thus, the users who are immediately affected are generally involved, rather than the broader public, which may not perceive the effects but nevertheless has an interest in the public trust resources of the ocean.

Ecosystem-based management is a planning process and should engage more than one sector and related stakeholders. As a planning process there is an opportunity to explore a broader set of options than in the context of specific sectoral regulatory proposals. Importantly, some issues of conflicting uses and goals across sectors may be brought to

the fore and dealt with early in the planning process rather than late, as regulations, permits and conflicts are far along.

The scale of the planning exercise has important implications for stakeholder engagement. Large scale and complicated arenas of maritime use often result in unwieldy and inefficient processes. Working initially with stakeholders at a local scale and then scaling up to a larger region will likely be more productive. Regardless of the scope and scale of the area being managed, a transparent hierarchy of engagement is needed. Two typical tiers of engagement include an implementing group and a broader constituent group.

The implementing group includes the organizations that are responsible and accountable for the work. Engaging in the EBM process is often a part of institutional work plans. This group generally includes management agencies, relevant biophysical and socioeconomic scientists, active for-profit sectors like a tourism board, water resources boards, and, often, environmental NGOs.

The constituent group includes the stakeholders who have a vested interest in the focus area, and may already have a voice in determining and assessing management strategies. A successful move toward EBM will mean engaging a broad base of people and/or organizations that have a stake in how the ecosystem is being managed – from the private sector, public sector, science and conservation communities, and policymaking arena. Not every organization in this group may need to be involved in every stage of the EBM process; some may simply need to be informed of decisions.

Early and consistent engagement of both types of groups will help to break down sectoral barriers, facilitate trust and information sharing, and allow for a broad understanding and vision of the region being managed. Each organization's role and responsibilities must be agreed upon and made transparent at the start of the process. Ideally this is done through the development of a framework for collaboration and communication. In the case of large areas, the framework should incorporate overall sectoral and research expertise, as well as local consultative groups with detailed understanding of the nature and usage of subunits of the larger area.

Another issue that needs to be addressed is the role of the States and Tribes as “stakeholders” versus their participation as “sovereigns” in federally mandated consultation processes. Federal agencies, as well as the States and Tribes, often confuse these roles, resulting in unnecessary contention and mistrust.

Strong leadership and binding timelines are important in planning, if not essential. It is also important to accept that not all EBM processes will be able to launch robust and comprehensive participatory processes immediately.

5. Decision Support Tools

A key component to implementing Ecosystem-based Management practices is the availability of tools that enable managers and decision-makers to evaluate the impacts of human activities on marine ecosystems and to assess trade-offs among different activities and ecosystem services. These tools can be classified into two categories. Those noted below are some of the most comprehensive or innovative tools available, though others exist. Many of these have been reviewed in a recent 2013 assessment by The Nature Conservancy conducted for the Alaska Ocean Observing System: www.aos.org/wp-content/uploads/2012/08/STAMP-Tools-Report-FINAL-low-res.pdf.

Methodological tools (from Leslie and McLeod, 2007):

- Comparative analysis of case studies (Arkema et al. 2006)
- Ecosystem service valuation (Daily et al. 2000)
- Scenario development (Bennett et al. 2003)
- Ecosystem models (Christensen and Walters 2004)
- Reserve selection algorithms (Margules and Pressey 2000)
- Trade-off analysis (Brown et al. 2002)

Geospatial Decision Support Tools (Center for Ocean Solutions, 2009)

MarineMap Decision Support Tool, <http://www.marinemap.org/>
MarineMap was created by the Marine Science Institute at UC Santa Barbara with help from Ecotrust and The Nature Conservancy. It offers users web-based access to data, methods and analyses that scientists utilize to evaluate Marine Protected Areas (MPAs).

Multipurpose Marine Cadastre, <http://www.marinecadastre.gov>
The Multipurpose Marine Cadastre (MMC) is a marine information system for the outer continental shelf and state waters developed by NOAA and the Department of the Interior's Bureau of Ocean Energy Management (BOEM). It provides regularly updated ocean information including offshore boundaries, infrastructure, human use, energy potential and other datasets. It is useful for those looking to assess suitability for ocean uses.

The Nature Conservancy Ecoregional Assessment and TNC Maps, <http://www.nature.org>
Provides GIS data and maps to assist in conservation planning.

Several entities have created “portals” that house a variety of decision support tools for Ecosystem-based Management:

The non-profit organization NatureServe coordinates the **Ecosystem-Based Management Tools Network**, a voluntary alliance of EBM practitioners and tool providers organized to share knowledge about EBM tools. The network's website provides comprehensive information on EBM tools, including a searchable database, case studies, training materials, best practices, funding opportunities, and more. www.ebmtools.org

The **Center for Ocean Solutions** has created a webpage with resources primarily intended for marine spatial planning, including decision support tools, but also potentially useful for Ecosystem-Based Management. The COS initiative largely focuses on the California Coast, but has information relevant for all geographic areas. <http://www.centerforoceansolutions.org/initiatives/marine-spatial-planning>

Seaplan (formerly the Massachusetts Ocean Partnership) provides a wide variety of services and tools including Ecosystem Services Tradeoff Modeling and the Northeast Data Portal. <http://www.seaplan.org/>

NOAA's **Digital Coast** website is a partnership of nine organizations that provides data, tools and training for managing coastal resources. <http://www.csc.noaa.gov/digitalcoast/>

The **Marine Ecosystem Services Partnership (MESP)** is a virtual center for information and communication on the human uses of marine ecosystems around the world. It hosts a large database of economic valuation studies.

While most of the current decision support tools available are focused on coasts and within Exclusive Economic Zones (EEZs), there have been strides made to produce tools for open ocean and deep sea management. The Global Ocean Biodiversity Initiative (GOBI) is working with the UN Convention on Biological Diversity to identify and produce maps of Ecologically and Biologically Significant Areas (EBSAs) throughout the world. (<http://www.gobi.org/>). Decision support tools for ecosystem-based management of the open ocean and deep sea are not widely available, but the need for them is increasing as these previously hard to reach areas become more accessible.

Key gaps in decision support tools are those that can incorporate socio-economic data and traditional ecological knowledge. In addition, Internet provisions and bandwidth are changing quickly, especially in rural areas, and create challenges with use of more sophisticated tools. Some federal and state agencies restrict use of tools such as You Tube videos, Facebook and other social media that are commonly used, or restrict use of particular search engines browsers, thereby limiting access to tools. Other agencies require their employees to use specific tools, without considering other agency requirements or access.

We also note that no decision support tool is perfect; they all have limitations and do not provide a complete or sole answer to challenges to implementing EBM. **We encourage federal**

agencies to more comprehensively and collaboratively (with other agencies) to identify shortcomings and gaps in the existing suite of tools.

6. Criteria for Pilot Projects

EBM demonstration pilot projects are recommended as a mechanism to advance technical and procedural improvements, improved resource management decision-making and acceptance by commercial, conservation and public interests.

Development of more uniform criteria to evaluate and select pilot projects could help advance the continuing evolution of EBM as a practical planning and management platform. Such criteria may also provide a basis for project performance evaluation.

We recommended that project selection consider:

- Geographic distribution;
- Ecosystem type distribution;
- Nature of human use and level of user engagement;
- Ability to manage and implement operationally;
- Association with resource management or regulatory decision-making and consideration for multi-agency, jurisdiction coordination;
- Opportunity for leading to ecosystem improvement;
- Potential for sustainability of project reflecting both short and longer-term needs with sufficient relevance/interest/support to ensure stable funding;
- Ability to illustrate the benefits of EBM and help clarify practical steps and actions;
- Ability to advance resource management decisions including evaluation of ecosystem status in complex situations with confounded data and uncertainty;
- Use of existing data integration structure that can be expanded to support EBM;

- Sufficient consultation mechanisms to ensure engagement by resource managers, technical experts and interested/impacted parties; and
- Clear project ownership/accountability with associated project performance metrics.

7. Key Findings & Recommendations

A. Those regions that are seeing new offshore wind development, aquaculture, exportation of natural gas, and expansion of ports to accommodate post-Panamax ships, and that are without a long history of conflicts and entrenched special interests, may be more open to trying new approaches to management. (See section VI on criteria for pilot projects)

Recommendation: *Federal agencies should consider testing implementation of ecosystem-based management in regions that are facing forms of new sector development.*

B. There is still a lack of clarity and some inconsistency in explanations and definitions of EBM, which has contributed to confusion and skepticism among those tasked with promoting and implementing EBM as well as among stakeholders who might be impacted by EBM implementation. (See section IV on strategies)

Recommendation: *The Federal Government should develop a clear and easily understandable set of EBM messaging materials that are used by all parties on a consistent basis and as part of a national communications plan to advance use of EBM. These materials should clarify that EBM is not a new regulatory process, but rather, a consultative process to be incorporated into existing statutory and regulatory requirements.*

C. Skeptics of ecosystem-based management planning and processes need incentives to participate in the process. (See section IV D)

Recommendation: *Implementers of EBM should make real changes in management practices and should consider using routine rulemaking processes and memoranda of agreement to advance the practical use of EBM, formalize interactions, clarify roles and responsibilities, and improve “top-down/bottom-up” communication and cooperation.*

D. Agency managers are often not skilled or educated in the practice of ecosystem-based management. (See section IV A)

Recommendation: *Training in ecosystem-based management, how and where it can be applied in existing authorities, adaptive management, inter-disciplinary teamwork, etc. should be advanced and encouraged, using existing or developing new resources.*

E. Robust, integrated and synthesized scientific information – available on widely accessible data portals – is essential for successful implementation of ecosystem-based management. (See section IV C)

Recommendation: *Managers across sectors should develop research plans based on regional needs; fund targeted research that informs management decisions; be timely with data sharing; share information across jurisdiction and sectors; standardize information for data collection and storage; and develop regional information systems to meet their decision-making needs.*

F. Ecosystem-based management, one of the priority objectives of the National Ocean Policy, would benefit from developing science programs that cut across multiple agencies. (See section IV C)

Recommendation: *Federal agencies should be encouraged and rewarded for integrating science programs across multiple agencies, especially those that provide information relevant to management.*

G. In some cases, not all affected stakeholders are included at the appropriate stage of an EBM process, thereby creating mistrust and lack of buy-in to EBM. (See section IV D)

Recommendation: *Planners should broaden participation to involve – and give equal standing – to all relevant stakeholders as early in the process as possible, with a transparent hierarchy of engagement.*

H. Not all EBM processes will be able to launch robust and comprehensive participatory processes immediately. (See section IV A)

Recommendation: *Planners should build on existing regional structures (e.g., regional ocean partnerships, state coastal management programs, other regional collaboratives) whenever possible, supporting and enhancing them, rather than creating a new organization or entity.*

References

Collaborative Geospatial Information and Tools for California Coastal and Ocean Managers: Workshop report, November 2009. Palo Alto, CA: Center for Ocean Solutions. 2009. http://www.centerforoceansolutions.org/Spatial-Data-and-Tools/Workshop-2009/Geospatial_Report_Lo_res.pdf

Clement, J. P., J. L. Bengtson, and B. P. Kelly. *Managing For the Future in a Rapidly Changing Arctic. A Report to the President.* Washington, DC: Interagency Working Group on

Coordination of Domestic Energy Development and Permitting in Alaska (D. J. Hayes, Chair), 2013. <http://www.doi.gov/news/upload/ArcticReport-03April2013PMsm.pdf>

Gregory, R., D. Ohlson, and J. Arvai. "Deconstructing Adaptive Management: Criteria for Applications to Environmental Management." *Ecological Applications* 16:2411–2425. 2006. http://training.fws.gov/CSP/Resources/Decision_Analysis/Articles_from_Seminar/Gregory,_Ohlson,_Arvai_InPress.pdf

Leslie, H.M. and K. O. MacLeod. "Confronting the Challenges of Implementing Marine Ecosystem-Based Management." *Frontiers Ecol. Env.* 5(10):540-548. 2007. <http://www.jstor.org/discover/10.2307/20440766?uid=3739936&uid=2&uid=4&uid=3739256&sid=21103116412117>

MacLeod, K. O. and H. M. Leslie (eds.). *Ecosystem-based management for the oceans*. Washington, DC: Island Press, 2009.

National Ocean Policy Implementation Plan. Washington, DC: National Ocean Council, 2013 <http://www.whitehouse.gov/administration/eop/oceans/implementationplan>

An Ocean Blueprint for the 21st Century: Final Report. Washington, DC: U.S. Commission on Ocean Policy, 2004. http://govinfo.library.unt.edu/oceancommission/documents/full_color_rpt/welcome.html

U.S. Executive Order 13547 of July 19th, 2010: Stewardship of the Ocean, Our Coasts, and the Great Lakes. C.F.R. code 75 FR 43021. <https://federalregister.gov/a/2010-18169>

Science for an Ocean Nation: Update of the Ocean Research Priorities Plan. U.S. Office of Science and Technology Policy, 2013. www.whitehouse.gov/sites/default/files/microsites/ostp/2013_ocean_nation.pdf

APPENDIX: GEOGRAPHIC CASE STUDIES

a. **Chesapeake Bay, by Dr. Donald Boesch, University of Maryland Center for Environmental Science, former ORAP member**

The Chesapeake Bay, the nation's largest estuary, is the focus of one of the world's most comprehensive, sustained and institutionalized efforts to develop and apply ecosystem-based management (Boesch and Goldman, 2009). The Chesapeake Bay Program began in the 1980s through agreements among the Federal government, represented by the Environmental Protection Agency, three states and the District of Columbia that focused mainly on improving water quality. However, the approaches to managing and restoring the Bay have become increasingly "ecosystemic" through: integration across resources and uses; assessments of species interactions; and transcending individual atmospheric, terrestrial, freshwater and estuarine environments. The Chesapeake 2000 agreement included specific objectives and actions under goals for living resource protection and restoration, vital habitat protection and restoration, water quality protection and restoration, sound land use, and stewardship and community engagement.

The Chesapeake Bay Program is notable in its longevity of coordination across federal and state agencies (with a high level of governmental engagement), focus on regional ecosystem protection and restoration, connection between sustainable practices on land (extending throughout a 64,000 square mile watershed) and coastal water quality, infrastructure for observations and mapping, and information and decision support systems.

In 2009 President Obama issued an executive order to foster leadership among federal agencies in order to accelerate the restoration of the Chesapeake Bay. The order created a Federal Leadership Committee including the U.S. Environmental Protection Agency and the Departments of Agriculture, Commerce, Defense, Homeland Security, Interior and Transportation and tasked it with creating a plan to restore the bay. The resulting strategy (Federal Leadership Committee for the Chesapeake Bay, 2010) focused on achieving four essential priorities for a healthy Chesapeake ecosystem: restore clean water, recover habitat, sustain fish and wildlife and conserve land and increase public access. Four supporting strategies were also included: expand citizen stewardship, develop environmental markets, respond to climate change and strengthen science. The overall federal strategy calls for two-year milestones, an annual action plan and progress report, independent evaluation and adaptive management. The development of a federal strategy and annual action plans (e.g., Federal Leadership Committee for the Chesapeake Bay, 2012) has resulted in improved interagency communication and planning, although this has been somewhat disconnected from the critical state partners who bear most of the responsibility for implementation of management actions. The strategy presents a broad and appropriate framework, but funding required for its implementation has fallen short. Lessons learned from this substantial interagency planning effort, with goals to increase efficiency in "eroding divisions between Federal agencies" and provide a unified planning framework, would prove useful for developing effective federal approaches to the ecosystem-based management actions included in the Implementation Plan (National Ocean Council, 2013).

The Implementation Plan recognizes that ecosystem-based management must work with state, tribal and local governments and should be regarded as an incremental process that builds on existing knowledge and management structures. The management structures in the Chesapeake Bay Program engage federal agencies and state and local government partners and have evolved and endured over decades and through differing perspectives on environmental management. These structures have many of the features required for ecosystem-based management, but virtually all still require incremental improvement in addressing key requirements for EMB related to integration, sustainability, precaution and adaptation.

b. Great Lakes by Dr. John Gannon, Ohio Sea Grant, ORAP member

The Great Lakes are collectively the largest concentration of fresh water in the world, comprising 90% of the United States' and 20% of the world's fresh surface water. The Great Lakes watershed is internationally shared between the United States and Canada, portions of eight Great Lakes states, and the Province of Ontario. In the United States, the Great Lakes are often referred to as the "Nation's Fourth Coast."

Ecosystem-based management, known regionally as "The Ecosystem Approach," was first articulated in a report to the International Joint Commission (IJC) in 1978 (Great Lakes Research Advisory Board, 1978). The Ecosystem Approach is defined in the report as: "the view of the Great Lakes Basin as an ecosystem in biospheric perspective; encompassing all interactions within this ecosystem, and transport of materials in and out via air as well as waters, by migrating species and by international transport." The Ecosystem Approach was a critical response to provisions in the Clean Water Act of 1972 that called for establishment of management objectives for certain chemicals in water based on most sensitive uses. The concern was that this water quality approach did not take into full account interactions within ecosystems or of stressors external to water. The report stated that water quality objectives were useful in detecting localized violations, but were of limited value in laying the foundation for effective resource management and diagnostic and prescriptive programs.

As in other coastal regions, implementation of the ecosystem approach (ecosystem-based management) in the Great Lakes has been an evolutionary process in water quality and fisheries management. The Great Lakes Water Quality Agreement (Agreement) between the United States and Canada is a case in point. The Agreement is a permanent reference under the Boundary Waters Treaty of 1909 (www.ijc.org/php/publications/pdf/ID1629.pdf). The first Agreement in 1972 was strictly water oriented to resolve the crisis of nuisance algae and dissolved oxygen depletion problems caused by eutrophication. The Agreement was revised in 1978 to include the ecosystem approach "...to restore and maintain the chemical, physical and biological integrity of the waters of the Great Lakes Basin Ecosystem." Nonetheless, the 1978 Agreement still had a water chemistry focus with the addition of toxic contaminants. The 1987 Agreement took a broader, ecosystem perspective by adding annexes on contaminants from groundwater and atmospheric deposition. It also called for Remedial Action Plans (RAPs) in an ecosystem approach context in the so-called Areas of Concern (AOCs), the most polluted river mouths, harbors, embayments, and connecting river systems in the Great Lakes. Not until the

2012 revision was ecosystem-based management fully incorporated into the Agreement, including principles of adaptive management, the precautionary approach, anticipating and preventing pollution, and sustainability. The previous emphasis on water chemistry in earlier versions of the Agreement is now balanced with new annexes in the 2012 revision on aquatic invasive species, habitat and species, and climate change impacts. In addition, Lakewide Management Plans (LAMPs) that addressed only critical pollutants in the 1987 version were broadened to include all environmental stressors that adversely affect waters of the Great Lakes using an ecosystem approach. (www.epa.gov/grtlakes/glwqa/).

Fisheries research and management in the Great Lakes has undergone a similar evolution in articulating and implementing ecosystem-based management. The Canada/U.S. Convention on Great Lakes Fisheries established the Great Lakes Fishery Commission (GLFC) in 1955 because predation by the invasive sea lamprey was devastating the commercial fishery. In addition to controlling the sea lamprey, the GLFC was given mandates to coordinate fisheries research and to facilitate cooperative fishery management among the state, provincial, tribal, and federal management agencies. Early activities mostly were focused on fish populations and fish communities. This is reflected in the 1981 Joint Strategic Plan for Management of Great Lakes Fisheries (www.glf.org/pubs/js81.pdf) that has little to say about fish and fisheries in a broader environmental context. The strategic plan was revised and superseded in 1997 to include, among other things, an ecosystem management strategy, whereby "...the parties must exercise their full authority and influence in every available arena to meet the biological, chemical, and physical needs of derived fish communities," (www.glf.org/fishmgmt/jsp97.pdf). The most recent GLFC strategic vision (2011-2020) strives for "...healthy Great Lakes ecosystems and sustainable fisheries by encouraging ...the conservation and rehabilitation of healthy Great Lakes ecosystems that sustain fisheries and benefit society." (www.glf.org/SpecialPubs/StrategicVision2012.pdf).

Cooperators in the Great Lakes have been working towards many of the priority objectives of the National Ocean Policy Implementation Plan (National Ocean Policy, 2012) since the late 1970s. Implementation of ecosystem-based management did not "begin" in the Great Lakes when it was most clearly articulated in the 2012 revision of the Great Lakes Water Quality Agreement and the 1997 revision of the Joint Strategic Plan for Management of Great Lakes Fisheries. The fact that any impact on part of the ecosystem could affect a whole lake or even the entire basin was already accepted by both the IJC and GLFC in the late 1970s-early 1980s. The cooperation between environmental and fisheries scientists and managers in an ecosystem-based context has been evolving in the Great Lakes throughout this time period with the most progress in the past decade and a half.

There is always room for more improvement in ecosystem-based management between environmental and fisheries constituencies in the Great Lakes, but the international institutional arrangements are in place to provide the context for this to happen. Moreover, most of the cooperating agencies in the United States and Canada have incorporated ecosystem-based management in their own strategic plans. Since many of the stressors affecting water quality and fisheries in the Great Lakes originate in the watershed or beyond (e.g., the airshed), future improvements in ecosystem-based management opportunities will require better

communication and cooperation between aquatic scientists and managers and land-based researchers and managers.

c. Gulf of Mexico: Barataria-Terrebonne National Estuary, by Dr. Kerry St Pe, Barataria-Terrebonne NEP, former OPAP member

Background of the National Estuary Program

The Great Lakes and Chesapeake restoration efforts have generally been viewed as successful, largely because they took advantage of the considerable resources of government agencies and incorporated, from the very beginning and at an equal level, the ideas of all those who were affected. The inclusive strategy built an organization that consisted of representatives from all of the applicable government agencies, as well as individuals representing business and industry, agricultural interests, citizens and environmental groups. This group then developed a plan, through consensus, with solutions that addressed the environmental problems in a comprehensive, holistic manner.

Because of the success of the Great Lakes and Chesapeake Bay efforts, Congress established the National Estuary Program in 1987 under Section 320 of the Clean Water Act. This section identifies nationally significant estuaries threatened by pollution, development, or overuse and requires the development of a Comprehensive Conservation and Management Plan (CCMP) to restore the system.

There are currently 28 National Estuary Programs, each added to the Clean Water Act through congressional action. Each National Estuary Program uses an approach, outlined in Section 320, which is non-regulatory and emphasizes the importance of collaboration among multiple users and stakeholders. It also endorses the value of education and research as essential components of long-term efforts to restore and manage estuaries.

The requirement for gubernatorial nomination addresses one of the central points of the estuary program process. The nomination document says, in effect, that the area is exceptionally important, that it is threatened, and that the state will assemble the groups and agencies necessary to develop and then to implement a plan to solve these problems. EPA requires that a commitment from the highest-level state official be made because the issues do not fall under one single agency or entity. The level of coordination required to address these problems goes well beyond any single agency. The nomination process acknowledges that only a governor can make such commitments on behalf of a state.

The NEP Planning Process spans a 5-year period using a variety of committees, including a Policy Committee, a Management Committee and a series of advisory committees, the Scientific-Technical Committee, the Citizens Committee, and the Local Governments Committee. An essential part of the NEP planning process is development of the restoration plan for the local region by the people who know the problems best, the agency members and scientists as well as the people living and working in the estuary. These are the people who are most aware of the socio-economic, political and ecological conditions of the system.

National Estuary Programs have proven to be a successful model. Although the NEPs are administered through EPA, they maintain an independent approach, implementing projects according to the wishes of their collective partners on the management conference and by what is contained in the management plan. Such independence is a major asset because the NEPs are able to forge a consensus-derived plan based upon the NEP collaborative partnership approach and not forgo or change an action to accommodate a single agency. On the other hand, the independent nature of the NEPs is a challenge because reaching such a consensus can be challenging in itself.

The Barataria-Terrebonne National Estuary Program

The Barataria-Terrebonne (BTNEP) was created in 1991 by an historic agreement between the State of Louisiana and the federal government. That agreement acknowledged that the Barataria and Terrebonne systems, consisting of the area between the Mississippi and Atchafalaya rivers, were both of national significance and critically threatened. The Environmental Protection Agency, on behalf of the U.S. government, pledged to elevate the status of this entire region to that of a National Estuary. The State of Louisiana fulfilled its part of this pledge by convening hundreds of representatives from business and industry, universities and other educational institutions, local governments, federal and state agencies, NGOs, farmers, agriculture, and fisheries. This group of diverse stakeholders gathered in 1991 to begin the development of a comprehensive plan to restore and preserve the newly designated Barataria-Terrebonne National Estuary (BTNEP). The BTNEP was formally approved in 1996 and has been actively implementing its restoration plan since it was approved.



The conceptual model upon which the BTNEP comprehensive plan is based (see figure 1) was developed and agreed upon by the hundreds of stakeholder representatives in several, professionally facilitated workshops in the early 1990s. The planning model is multifaceted and goes well beyond the mere restoration of coastal landmasses by recognizing that a successful restoration plan must be on a watershed level, have full community support, and consider all elements of the ecosystem.

The resultant BTNEP Comprehensive Conservation and Management Plan stresses and incorporates an approach that solves user conflicts by seeking common ground solutions and promotes sustainability through a balanced use of our resources utilizing techniques that are compatible with nature. The **management** and **natural factors** are self-explanatory and are essential when considering Ecosystem-based management concepts. The **human factor** is an often-overlooked component, but is equally important to a successful restoration effort. A restoration plan that has any reasonable chance of being implemented is not one that can be merely engineered or one that is driven *only* by science, but rather, one that also considers communities and local culture.

The BTNEP Office is the **linking factor** – the essential governance component that links all of the federal, state, and local agencies, as well as environmental groups and commercial and recreational fisherman, agricultural and industrial interests into a focused program dedicated to restoring the region. The BTNEP Office serves as the coordinating body for all agencies and groups serving on the larger collective known as the Management Conference.

d. Arctic Case Studies, by Molly McCammon, Alaska Ocean Observing System, ORAP member

Arctic Fishery Management Plan

In 2009, the North Pacific Fishery Management Council approved a new Fishery Management Plan for Fish Resources of the Arctic Management Area (Arctic FMP). The Council’s action recognized the different and changing ecological conditions of the Arctic, including warming trends in ocean temperatures, the loss of seasonal ice cover, and the potential long term effects from these changes on the Arctic marine ecosystem. More prolonged ice-free seasons coupled with warming waters and changing ranges of fish species could together create conditions that could lead to commercial fishery development in the U.S. Arctic Exclusive Economic Zone (EEZ). The emergence of unregulated, or inadequately regulated, commercial fisheries in the Arctic EEZ off Alaska could have adverse effects on the sensitive ecosystem and marine resources of this area, including fish, fish habitat, and non-fish species that inhabit or depend on marine resources of the U.S. Arctic EEZ, and the subsistence way of life of residents of Arctic communities.

The Council’s Arctic FMP was created under authority of the U.S. Magnuson-Stevens Fishery Conservation and Management Act. It closes commercial fishing, but does not regulate marine mammal and bird harvests, or subsistence or recreational fishing or any State of Alaska managed fisheries. The area is essentially closed until scientific research shows that it could be opened without doing harm.

The Council’s management policy for the U.S. Arctic EEZ is described as an ecosystem-based management policy that “proactively applies judicious and responsible fisheries management practices, based on sound scientific research and analysis, to ensure the sustainability of fishery resources, to prevent unregulated or poorly regulated commercial fishing, and to protect

associated ecosystems for the benefit of current users and future generations.” The policy recognizes the need to balance competing uses of marine resources and different social and economic goals for sustainable fishery management, including protection of the long-term health of the ecosystem and the optimization of yield from its fish resources. This policy recognizes the complex interactions among ecosystem components, and seeks to protect important species utilized by other ecosystem component species, potential target species, other organisms such as marine mammals and birds, and local residents and communities. All management measures will be based on the best scientific information available.

Adoption of the plan was relatively non-controversial since there were basically no existing commercial fisheries in the region, except for a few small fisheries (crab and chum salmon) primarily in state waters.



The Department of State has now begun discussions with other Arctic countries to consider some kind of agreement to provide for conservation of the international waters of the Arctic. The fishing accord would regulate commercial harvests in an area farther offshore – in the so-called doughnut hole of the Arctic Ocean. This is a Texas-size area of international water that includes the North Pole and is encircled by the exclusive economic zones of the coastal countries of the U.S., Russia, Norway, Greenland (Denmark) and Canada. The central Arctic was not of much concern until recently since it was primarily icebound and has been for about 100,000 years. But now, 40 percent of the central Arctic Ocean is melting each summer, and that is increasing. The agreement, like that of the U.S. Arctic, is unusual for protecting a huge

Canadian scientists have proposed that the U.S. and Canada develop a Joint EBM Pilot Initiative in the Beaufort Sea. A first step would be to produce a coordinated geospatial platform that would identify the ecological, cultural and economic data sets needed for decision-making; a process for linking the US/Canadian data sets and coordinating with other structures such as Arctic ERMA, Beaufort Sea Geospatial Platform, the Alaska Ocean Observing System Arctic Portal and the North Slope Science Initiative data portal. With Canada chairing the Arctic Council from 2013-2015 and the US chairmanship immediately following in 2015-2017, this type of project could be a case study for developing integrated management of marine ecosystem data – and potentially coordinated management efforts – that are international in nature.