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Transitioning to a New Blue Economy: Proceedings of the December 2013 Economics of the Ocean Summit

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INTRODUCTION

We need to find new ways to manage our ocean economy. Our industrial use of the ocean is on the rise, with more goods being moved by bigger ships, new oil and gas development in the deep sea, and proposals to mine minerals from the deep sea floor and high seas. Research now makes clear that healthy ocean ecosystems also contribute to the global economy (Barbier et al. 2011). Other scientific evidence documents an ocean in ecological decline (Pandolfi et al. 2003; Pauly, Watson, and Alder 2005; Worm et al. 2006).

In response to this research and to dramatic changes in ocean use and health, a movement to green the ocean economy or create a new "blue economy" has begun. The United Nations Environment Programme, along with the United Nations Department of Economic and Social Affairs, the United Nations Development Programme, the International Maritime Organization, the Food and Agriculture Organization, the International Union for Conservation of Nature, GRID-Arendal, the World Fish Center, and other organizations have begun to lay out approaches that will foster a transition to an economy that is financially, economically, and ecologically robust (UNEP et al. 2012). These approaches seek to change economic and industrial behavior to reduce impacts on the marine environment and in turn increase human welfare by carefully balancing the environmental, economic, and social capital required to support a sustainable, ecosystem-based approach to marine economic activity.

The transition to the new blue economy cannot be achieved by large international organizations alone. It will require innovation on the part of industry and government at all levels. Existing laws and regulations may need to be reconsidered to permit technological change in the way industries do business and work with one another. The transition to a new blue economy will also require governments to take risks in developing new approaches to managing marine pollution and finding ways to partner with industry to foster innovation that may not occur on its own.

A Blue Economy Is a Sustainable Economy

Investing in the long-term health of coastal and marine resources is vital to the sustainability of the global economy. The ocean provides economic wealth from minerals, fisheries, transport, and numerous other uses. But many of its habitats are deteriorating, species are threatened with extinction, and the chemical nature of oceans is changing due to pollution and ocean acidification. Moreover, much of the value of ocean and coastal ecosystems has been lost due to poor management and overuse.

Fisheries provide a particularly stark example of how the potential economic wealth of ocean ecosystems has been squandered. In 2009, more than 80 million tons of fish were harvested globally with an estimated value exceeding $100 billion dollars (FAO 2010). However, overfished stocks mean that fisheries are producing far less value than they could. A World Bank study estimated that overfishing results in a lost economic value of $50 billion each year (World Bank 2009). Better management and a more ecologically sound approach to ocean fisheries would help ensure their long-term profit and viability.

Marine Market Values of Ocean Ecosystems

The ocean and estuaries provide a suite of resources that are traded directly in markets. Ocean ecosystems contribute to tourism revenues, the value of real estate, and through goods sold on the market such as seafood, seaweed, and wood products from mangroves. The market value of these contributions is substantial. Worldwide, travel and tourism generate 9 percent of global GDP. Coastal and marine areas are a popular destination (UNEP 2011). In 2003, nearly 60 million recreational anglers spent $40 billion on their sport (Cisneros-Montemayor and Sumaila 2010). Some 10 million recreational divers and 40 million snorkelers are estimated to spend more than $5.5 billion on their sports each year (Cisneros-Montemayor and Sumaila 2010). Other sectors, such as fishing, contribute billions of dollars each year to

the global market. At the local scale, many developing countries also are heavily dependent on the sustainable productivity of ocean ecosystem services.

Non-Market Marine Values

The market does not capture many of the services provided by ocean ecosystems, including those from which people cannot be excluded and thus for which fees cannot be charged (e.g., recreation and views). Non-marketed ocean ecosystem services include natural processes that balance nutrients and provide coastal protection from storms and that support species and functions that create value rooted in cultural and indigenous practices and preferences. Many economists have attempted to capture the economic value of these non-marketed resources (Naber, Lange, and Hatziolos 2008; TEEB 2010; UNEP-WCMC 2011), and markets are being created to capture some of previously "non-marketed" goods and services through payments for ecosystem services.

Transitioning to a Blue Economy: Thoughts from Thinkers and Doers

Government's role in ocean environmental policy is often viewed as an economic cost to business rather than a boost to the economic value of the sea. But new evidence shows that the new blue economy can improve environmental quality in the ocean while generating new business opportunities. Furthermore, government has a key role to play in making, creating, and catalyzing this new blue economy. In December 2013, the Swedish government and Duke University hosted a meeting at the House of Sweden in Washington D.C. to discuss how innovative policy making and new business approaches together can improve the value and sustainability of the natural capital in our seas and estuaries. Decision makers, "big thinkers," and practitioners came together for two days to share ideas and to catalyze discussion with a focus on the experiences of the United States and Sweden, two maritime countries that are forging new ocean economies. The essays that follow capture many of the key ideas presented there.

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KEYNOTE—OCEAN SUSTAINABILITY: U.S. PERSPECTIVES

Dr. Kerri-Ann Jones, Assistant Secretary, Bureau of Oceans and International Environmental and Scientific Affairs, U.S. Department of State

Oceans are receiving increased attention in Washington these days. President Obama has placed ocean policy high on his agenda. He signed an Executive order in July 2010 that established a National Ocean Policy that defines the Administration's position on relevant ocean issues, including Coastal and Marine Spatial Planning, and established the National Ocean Council. All U.S. agencies are now following the National Ocean Policy's Implementation Plan that was issued in April of this year.

Oceans also are a major interest of Secretary of State John Kerry. The first major policy speech he gave when he arrived as Secretary was on marine protected areas, and soon thereafter he asked my bureau to plan a major oceans-related conference that would bring together key leaders and experts to discuss a series of oceans topics. We've entitled our conference, "Oceans under Threat: Charting a Sustainable Future."

The oceans and their resources are critical to the well-being of all of us. But the oceans are in trouble, and it is vital that we all recognize and face together the pressing and growing threats to the health and sustainability of the oceans. The United States, like many countries, has an intimate connection to the oceans. Our economy and our identity are firmly embedded in our ocean heritage and resources. As recognized in our National Ocean Policy, America's stewardship of the oceans is intimately linked to our national prosperity, the health and well-being of our people and of our environment, and our foreign policy.

The oceans and their resources are critical to the world community. Oceans cover almost three-quarters of our planet. They regulate our climate and our weather. Over one-third of the world's population lives in coastal areas, and more than one billion people worldwide rely on food from the ocean as their primary source of protein. Many jobs and economies around the world depend on the living marine resources in our oceans.

But the oceans are in trouble. A number of critical fish stocks have declined, some to the point of collapse. In many regions, corals are dying, leaving bare skeletons of reefs that can't support fish or protect coastlines. Run-off from land and harmful algal blooms have sapped the oxygen from water, creating marine dead zones around the world where fish and other marine life cannot thrive. Our oceans are becoming littered with debris, threatening marine life and in some places concentrating in massive "garbage patches." The oceans are absorbing carbon dioxide from the air, changing the very chemistry of the water and threatening the food webs of the oceans.

Still, there are ways to respond to many of these challenges that inspire us in the work we do every day to better manage the ocean. Through partnerships and collaboration among governments, the private sector, research institutions, and NGOs, through innovation, and with the political will and the right policies, we can address these challenges.

Examples of on-going efforts include the Port States Measures Agreement. This agreement has been signed by many nations, and once in force will help ensure that illegally harvested fish do not enter the stream of commerce. It will prevent the offloading of fish in ports around the world. Another example is the UN's initiative for a World Ocean Assessment that will provide a valuable scientific baseline to inform ocean and coastal policy and future management decisions.

A key example, and one of great interest to Secretary Kerry, is the international effort to establish marine protected areas (MPAs), following on commitments all countries made at the World Summit on

Sustainable Development Year as well as at the Rio+20 conference. The United States and New Zealand have co-sponsored a proposal to establish what would be the world's largest MPA, in Antarctica's Ross Sea. The Ross Sea is a unique ecosystem deserving of protection, in particular to allow for long-term scientific study. Our proposal is based on sound science and has been supported by Sweden and most other members of the Commission for the Conservation of Antarctic Marine Living Resources. Even after many years of sustained effort, the Commission has not agreed to establish this MPA in October, due to the opposition of a very small number of countries. We see a very positive sign for marine conservation that so many diverse countries, including those that fish in the region, are willing to establish this MPA, but unfortunately we are not there yet. The lack of success is frustrating, but it means we must redouble our efforts. We very much hope to resolve the remaining differences and to make progress on this proposal in the near term.

To address the current state of the oceans, much more needs to be done. High-level conferences, like the one we are planning, provide important opportunities to draw attention to the threats facing our oceans and to identify ways to address these challenges. We want to showcase best practices in marine conservation and encourage the participants to promote national and international action to improve the state of the oceans.

Key oceans themes—In developing the themes for the State Department's planned oceans conference, we reached out to NGOs and industry. We also worked with Members of Congress, where Senator Whitehouse co-chairs the U.S. Senate Oceans Caucus. Through these discussions and reflecting the Secretary's concerns, we are developing a focus on three broad and important issues, all of which connect to themes you will be exploring here today and tomorrow.

Sustainable fisheries—We know that the health and sustainability of marine fisheries are deteriorating. A significant percentage of key fish stocks are overfished and/or depleted. Illegal, unreported, and unregulated fishing plagues too many fisheries worldwide. Certain fishing practices also cause damage to the ocean itself, including excessive bycatch and destruction of vulnerable ecosystems and habitats. The international community has been striving to grapple with these challenges, with mixed results so far.

On a more positive note, new technologies and partnerships among governments, industries, and consumers offer prospects for improving the state of ocean ecosystems and key fisheries. We hope to showcase the best available science relating to marine fisheries and to highlight some ways to move toward a more sustainable future.

Marine pollution—The global marine environment faces threats of pollution from a variety of land, sea, and air-based sources. It is estimated that 80% of global marine pollution comes from land-based sources. Marine debris, which includes plastics, is one type of marine pollution, and is a global problem that threatens wildlife and presents health and safety concerns for humans. More than 250 different animal species—including seabirds, turtles, seals, sea lions, whales, and fish—have been documented as having ingested marine debris or suffered from entanglement in marine debris.

Nutrient pollution, caused by diverse sources including agriculture, sewage, and wastewater runoff, is a critical problem, because it over-fertilizes marine environments with high concentrations of nutrients, particularly nitrogen and phosphorous, which can produce "dead zones." It is estimated that there are nearly 500 dead zones in the world's oceans in which marine life cannot be sustained.

We intend to draw attention to these serious marine pollution issues while also highlighting best practices and innovative initiatives to combat this global concern.

Ocean acidification—Our third theme will be ocean acidification, one of the most pressing issues facing the world's marine environments. It occurs as oceans absorb increasingly greater levels of atmospheric

carbon dioxide. Ocean acidity has increased over 30% since the Industrial Revolution. Studies have shown that a more acidic environment has a dramatic effect on some calcifying species, including oysters, clams, sea urchins, shallow water corals, deep sea corals, and calcareous plankton. When these organisms are at risk, the entire food web may also be at risk.

The U.S. State Department's Oceans Conference will offer an overview of the status of ocean acidification, highlight affected industries such as shellfish farming, and address new and emerging tools for monitoring this debilitating trend affecting many critical regions of our oceans. This conference represents an important opportunity for international stakeholders to consider further research and cooperative actions to understand and address the pressing acidification issue facing the world's oceans.

It is only through innovation and collaboration that all stakeholders can address these challenges. With that in mind, I should also mention that we are exploring areas for public-private partnerships as possible ways forward related to some of these themes.

GETTING THE ECONOMICS RIGHT: QUANTIFYING THE VALUE OF MARINE AND COASTAL ECOSYSTEMS

MAKING WAVES—WEALTH ACCOUNTING AND THE VALUATION OF ECOSYSTEM SERVICES

Sofia Ahlroth, WAVES Global Partnership, The World Bank

WAVES (http://www.wavespartnership.org/) is a global partnership led by the World Bank and financed through a special trust fund. We work with partner countries to implement natural resource accounting and develop ecosystem accounts that are relevant to those countries. We have eight core partner countries, and we expect that number to grow significantly. The current partner countries are Indonesia, the Philippines, Guatemala, Costa Rica, Colombia, Botswana, Rwanda, and Madagascar.

The purpose of WAVES is to provide a tool for managing natural resources in order to promote growth and poverty reduction. We aim to build capacity within the partner countries so that they can implement natural resource accounting to keep track of their natural resources, which often are an important part of their wealth. Resource accounts provide an important base for valuing ecosystem services, which are often crucial to understanding the significance of natural areas.

Ecosystem services are usually divided into supporting, provisioning, regulating, and cultural services. Supporting services provide value through the other three types of services and are thus not often valued separately. Provisioning services, which can include timber, fish, crops, and subsoil assets, are typically covered by the standard national accounts. However, the informal part of the economy, such as household production for private use and illegal use of resources, is equally important to keep track of. Regulated services are often invisible to the economy, though they may be crucial for both production and consumption. In many of our partner countries, services like flood protection, water regulation, and soil conservation are crucial to monitor and maintain.

In natural capital accounting, we estimate the economic value of the ecosystems, that is, how much they contribute to production and consumption. That is, we estimated the loss of production if the ecosystems are depleted or degraded or by estimating the cost of damages that would occur. Cultural ecosystem services—for example, some recreational and tourism values—can be valued to some extent, but amenities such as the beauty of nature or spiritual values are better captured in other terms.

Natural capital accounting can be used to weigh trade-offs among competing uses of water and land; prioritize investments in resource management, land use, and protected areas; and plan for the future. There is a strong push for this type of work, both within the World Bank and globally.

We are very thankful for the support of our donor countries: Denmark, Norway, the Netherlands, Germany, the United Kingdom, France, and Switzerland as well as the European Commission and Japan. We also benefit from the help of other participating countries, experts, and international organizations and committees like UNCEEA, UNEP, and UNDP. In a couple of years, we believe that the number of partner countries will have more than doubled.

In a few years we hope to have helped our partner countries integrate natural resource accounts into their national accounts, such that they use these and ecosystem accounts to inform and enhance policy decisions. An important part of our work is also to help build capacity in these countries to do natural resource accounting. There have been many one-off efforts that might be useful, but what is really crucial to achieve sustainable economic and environmental development is to have consistency in gathering data and integrating them into economic analyses and policy decisions. By doing this and by involving a large

number of stakeholders, we also hope to help raise awareness about the economic importance of natural resources and the services that they provide.

LINKING ECOLOGY AND ECONOMY IN DEVELOPING MARINE STRATEGIES

Joacim Johannesson, Swedish Agency for Marine and Water Management

As part of the implementation of European Union (EU)-legislation on developing marine strategies, the Swedish Agency for Marine and Water Management (SwAM; https://www.havochvatten.se/en/swam/our-organization/about-swam.html) mapped and analyzed the linkages between marine ecology and maritime economy through ecosystem services assessments (SwAM 2012).

The European Union's marine strategies are aimed at achieving or maintaining good environmental status in EU waters by 2020 at the latest and to protect the resource base on which marine-related economic and social activities depend. The first step in developing the Swedish strategy was to assess the current environmental status (i.e., establish a baseline) and to define the objective "good environmental status."

The work included an economic analysis of the use of the sea today as well as in the future. One important part of the analysis was also to assess the potential costs of degradation in a business-as-usual scenario.

To better link ecology with the economy, SwAM applied an ecosystem services approach combined with marine water accounts. The economic analysis had two starting points: (1) the dependence of maritime activities on ecosystem services and (2) the impact of maritime activities on ecosystem services. The intention was also to establish a solid basis for the monitoring programs and program measurements, which are to be elaborated as next steps in the cycle of implementing the marine strategies. If we know how ecological and economic systems function and are interlinked, we will be better able to identify appropriate measures and to gain acceptance for those measures among stakeholders.

As for the analysis on the cost of degradation, SwAM did not come up with an estimation of the total figure in monetary terms. Rather, it made a qualitative analysis using economic values supported by valuation studies. These studies looked at the potential effects of specific types of impact or pressures, such as loss of biodiversity (in particular from fisheries), eutrophication, oil spills, and marine litter.

The mapping exercise and the analytical work resulted in a fairly good overview of the main maritime activities (i.e., drivers), pressures, and impact of those pressures. Although this exercise provided a basis for further work, additional valuations and economic evidence are needed. The cost-benefit and the cost-efficiency analysis of the program of measures will require additional economic input, because linking direct or indirect costs for positive change in the marine environment to increased human well-being is desirable.

Substantial work remains to develop usable tools for predicting how various decision alternatives would change the supply of ecosystem services. There is a need for ecological models that help identify how ecological end-points are affected by decision alternatives. These end-points are the ecological variables that are decisive for ecosystems' provision of services and therefore serve as bridges between ecological and economic systems.

One conclusion from the analysis is that the ecosystem services concept is powerful for translating environmental changes into consequences for human well-being. It helps us to demonstrate not only the risks from losing ecosystem services, but also the possibility for improving those services.

SwAM will continue efforts to integrate ecosystem services into marine management. One of the challenges ahead is the integration of ecosystem services assessments into a planned national marine spatial planning process. In that work, the lessons from the marine strategy work will be useful, but there is a need to further develop the methodologies to suit the marine planning context.

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INCORPORATING ECOSYSTEM SERVICES INTO A WHOLE SYSTEMS APPROACH TO OCEAN MANAGEMENT

Sally Yozell, Director of Policy, National Oceanic and Atmospheric Administration

As we work to support resilient coastal communities and marine ecosystems, we need to consider a new, more comprehensive approach to management, one that relies on an informed understanding of economic, ecological, social, and cultural values. The application of this integrated, or whole systems, approach to management is a paradigm shift in how we think about managing our ocean uses. It is also the corner stone of the U.S. National Ocean Policy.

Our ocean and coastal economy and communities have great value and depend on healthy ecosystems. Oceans and coasts face increasing risk from natural and man-made hazards. Such risk may be mitigated through comprehensive planning and management, but truly informed decision making will require a more complete valuation of resources and services than has traditionally been made. The value of ecosystem services must be included in our planning and management processes if we are to achieve our goals of healthy ecosystems, communities, and economies.

There is too much at risk along our coastlines not to take a comprehensive approach to management. In the United States, coastal counties comprise less than 10% of U.S. land area—yet in 2010, more than 123 million people, roughly 40% of our population, lived along U.S. coasts. These oceans and coastlines produce great value. The U.S. coastal economy is valued at $6.6 trillion, and it supports 51 million jobs and $2.8 trillion in wages (NOAA 2013).

Our coastal wetlands and the values they provide are also at risk. They provide structural protection from storms, fish habitat and nursery areas, and many recreational opportunities. From 2004 to 2009, coastal wetlands shrunk by an estimated 361,000 acres—a rate of more than 80,000 acres a year—and we continue to lose coastal wetlands at an accelerating rate (Dahl and Stedman 2013).

A whole systems approach to management focuses on ecosystems by understanding the value of the resources and services they provide. It also includes humans by fully incorporating both our impact and the benefits we receive in evaluating the tradeoffs of management actions. Translating this conceptual model into reality is a continuing project. However, NOAA and its sister federal agencies are beginning to focus on what the implementation of an ecosystem approach to management means at the operational and regulatory level—whether we are talking about water resource infrastructure development, coastal redevelopment and restoration in the wake of a storm like Sandy, or management of our trust resources such as fisheries, marine mammals, and their habitats. As we address this challenge across the government, we need to acknowledge that there are gaps in data and information and a level of modeling uncertainty. However, there is also a growing level of knowledge and best practices in this field of comprehensive management. Information and data are sufficient to demonstrate its effectiveness at the

level of pilot tests. We need to focus on demonstrating success in our local and regional efforts and then export that success to broader efforts in the Economic Exclusive Zone.

This new way of thinking is groundbreaking, and NOAA and the federal government are beginning to embrace it. It requires designing and developing an integrated science framework that uses ecosystem modeling to better understand ecosystem functions and processes and the services they provide. It also requires an understanding of the monetary and non-monetary value of those services and the full incorporation of that value into ecosystem-based management and comprehensive planning activities.

It is important that we understand what is at risk in our ocean and coastal economy and how we can mitigate that risk. We need to understand how to value ecosystem services and incorporate that value into planning and economies.

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BALTICSTERN RESEARCH ON THE COSTS AND BENEFITS OF MITIGATING EUTROPHICATION IN THE BALTIC SEA

Siv Ericsdotter, Baltic Stern Secretariat

The Baltic Sea's cold, brackish water and semi-enclosed location makes it particularly vulnerable to certain pressures. The sea is heavily eutrophied, which, combined with overfishing, has quite drastically changed the food web and led to oxygen depletion and dead sea bottoms, now covering large and increasing areas. Eutrophication, caused by nutrient loads from agriculture, wastewater, industry, and traffic, has resulted in a tenfold increase of algae blooms, including potentially harmful cyanobacteria. Hazardous substances, oil spills, litter, and invasive species are other environmental problems plaguing the sea.

The Baltic Sea Action Plan (http://helcom.fi/baltic-sea-action-plan), created to combat the sea's environmental problems, gives us cause for hope. The plan is an agreement within the Helsinki Convention by the nine countries surrounding the Baltic Sea. In this plan, countries have agreed to reduce nutrient loads by specified amounts for each country.

BalticSTERN (http://www.stockholmresilience.org /balticstern.html) is a research network with partners in all nine countries. The network decided to investigate how the Baltic Sea Action Plan would influence welfare in the Baltic region. What would it mean to the sea and to people? What would be the costs of implementing the plan and what benefits would arise? This work was also a response to a call from Nordic ministers of the environment in 2008 for analyses of the socioeconomic consequences of human impacts on Nordic seas. The acronym STERN stands for Systems Tools and Ecological-Economic Evaluation—a Research Network, but it is also inspired by the Stern Review.

In its first phase, BalticSTERN focused on eutrophication as one of the most serious problems facing the Baltic Sea, though other environmental problems were also studied (Swedish Agency for Marine and

Water Management 2013; Ericsdotter et al. 2013). Eutrophication is particularly difficult to come to grips with, because its solutions are quite costly and because sources of nutrient loads are diffuse.

Two surveys of representative samples of the populations in all nine countries were made to find out about the benefits of the Baltic Sea. In the first one, BalticSurvey (Swedish EPA 2010; Ahtiainen et al. 2013), people were asked about use and attitudes. It revealed that the Baltic Sea is important to people. About 80% of the population in all countries except Russia had been to the sea for recreation (Stockholm Resilience Center 2011).

The second survey, BalticSUN (Ahtiainen et al. 2013a), investigated how people would value an improvement of the sea's environment and ecosystem services. Ecological models were used to project the scenario in 2050 in which the nutrient targets of the Baltic Sea Action Plan were implemented, relative to a scenario in which no further actions were taken to reduce eutrophication. Respondents were then asked what they would be willing to pay each year for achieving the improvement.

Costs were calculated using two models with nine measures targeting agriculture and wastewater treatment. Costs were estimated at 1.4–2.8 billion euros annually, depending on the model used and how measures were allocated geographically. Benefits from the willingness to pay study pointed to a total value of 3.6–4 billion euros each year. The estimated welfare gain was 0.8–2,6 billion euros per year (Hyytiäinen et al. 2013).

Welfare gains may be even higher than predicted, given that benefits are probably underestimated; for example, improvements upstream in rivers and lakes were not accounted for. Furthermore, costs are probably overestimated, because modeling at such a large scale could include relatively few measures, some of them less costly than the most costly ones included.

Not all countries would receive a net gain from Baltic Sea improvement, so there may be need for policy instruments that could handle distributional effects.

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MARINE ECOSYSTEM SERVICES BENEFIT US IN SURPRISING WAYS

Dr. Tundi Agardy, SoundSeas

Focusing on marine and coastal ecosystem services has great potential for improving the way we approach marine management, steering our use of the sea’s resources and space toward sustainability. Why? Simply put, we humans are willing to invest in the protection of nature only when we see it benefits us. New research that identifies and assesses ecosystem services, and estimates their economic value, can focus attention on safeguarding the ecosystems that support, sustain, and enrich us all. Marine ecosystem services provide direct benefits, many of which are only now being recognized. Properly considering the role that marine ecosystem services play in human well-being provides us with an approach to management that could lead to vastly improved outcomes.

The loss of ecosystem services is not an esoteric concern shared only by academics and environmentalists. It threatens us all, whether we live on the coasts or inland, whether we are engaged in business or employed by government. Risks are heightened when services are lost: it’s not just fisheries collapse, shoreline destabilization, and exposure to natural hazards, but also risks to traditional livelihoods, to physical health, and to emotional well-being. And given the role of oceans in maintaining planetary balances and in weather, climate, and nutrient cycling, we risk disrupting our entire life support system when we carelessly degrade our oceans.

An ecosystem services approach assists us in scoping the problems facing our oceans and developing strategies to address them (planning), and in policy development, legislation enactment, and implementation of rules and regulations (management). One of the most important facets of this approach is that it is holistic: one cannot identify ecosystem services of value without describing the linkages that connect various elements of nature (species within ecosystems, one ecosystem to the next) and the linkages between natural systems and human well-being. Understanding these linkages is the foundation for ecosystem-based management, improving efficiency, and reducing vulnerabilities to surprises and unintended consequences.

The focus on ecosystem functions of value to humans can also generate the flow of new funds for conservation and management, which are badly needed. Conducting targeted research to support planning, convening parties to negotiate international agreements, monitoring marine areas, enforcing laws, and conducting day-to-day management of marine areas all require significant human and financial resources. Those who directly benefit from effective management—and continued ecosystem services delivery—should view protection of ecosystems as worthwhile business investments, with high rates of return. Demonstrations of new revenue streams generated by private sector investment are cropping up worldwide, but we urgently need to replicate them and bring them to scale.

Paradoxically, recent interest in quantifying ecosystem services can lead us away from making investments that will improve planning and management for these benefits. Rather than generating useful information for rapid uptake by planners and decision makers, some in the scientific community push for a full understanding of ecosystems, ecological processes, social and ecological resilience, and economic valuation of services. This is complicated stuff, sometimes controversial, and always time-consuming.

We simply don't have the luxury of time to generate full understanding before we act. Yet we know enough about most of these systems to quickly identify what ecosystem services they provide and how. We know which human activities cause negative impacts that need to be reduced. And we know enough to practice triage, that is, rapidly identify which coastal and marine (and inland) areas need immediate protection in order to safeguard ecosystems and the delivery of services.

All of this information can be synthesized, and much of it can be mapped to become the basis for spatial planning and for zoning plans that accommodate use but also protect what needs protecting. An ocean zoning plan that is built from solid scientific understanding of how ecosystems function and contribute to the well-being of people and that shows how we can alleviate the pressures that threaten that well-being is the best hope we have for protecting our oceans and our planet.

Photo courtesy of Dr. Tundi Agardy

SECTION HIGHLIGHTS

- WAVES, a project of the World Bank, is a natural capital accounting tool that can be used to weigh trade-offs among competing uses of water and land; prioritize investments in resource management, land use, and protected areas; and plan for the future. **(Sofia Ahlroth)**
- The Swedish Agency for Marine and Water Management (SwAM) mapped and analyzed the linkages between marine ecology and maritime economy through ecosystem services assessments. **(Joacim Johannesson)**
- NOAA and its sister federal agencies are beginning to focus on what the implementation of an ecosystem approach to management means at the operational and regulatory level. Information and data are sufficient to demonstrate its effectiveness at the pilot test level. **(Sally Yozell)**
- The Baltic Sea Action Plan is an agreement within the Helsinki Convention by the nine countries surrounding the Baltic Sea. Each of these countries have agreed to reduce nutrient loads by a specified amount. **(Siv Ericsdotter**)
- We know enough to practice triage, that is, rapidly identify which coastal and marine (and inland) areas need immediate protection in order to safeguard ecosystems and the delivery of services. **(Tundi Agardy)**

KEYNOTE: A VIEW FROM THE U.S. NAVY'S CHIEF OCEANOGRAPHER

RADM Jonathan White, U.S. Navy

The U.S. Navy relies on superior knowledge of the oceans and atmosphere around the world to maintain a war-fighting advantage against any potential adversary in any maritime environment. This knowledge, including the ability to accurately predict dynamic changes on short- and long-term timescales, enables us to operate safely and plan effectively. The long-term physical alterations to the world's oceans due to climate change represent significant risk to coastal infrastructure and oceanic ecosystems, and they will undoubtedly influence local, regional, and global economies.

This risk will drive our future Navy's infrastructure planning and will likely induce security concerns in oceanic nations, including ones that are already considered as "high-risk for conflict" due to existent geo-political and economic instability. The ability to accurately plan for the impacts of changing oceanographic conditions, to include sea-level and chemical composition, will enable the U.S. military (and our allies) to better prepare and respond to future threats and crises.

Our changing climate and global ocean can legitimately be characterized as a "Revolution in Human Affairs." Such revolutions are not new, but are usually recognized only in retrospect. From Noah's Ark to the Industrial Revolution to the Information Age, the human race has experienced numerous events or innovations that have revolutionized the course of history. Ongoing climate change portends just such a revolution, as the world that we know today will be quite different by the end of this century. The economic impacts of this change will be numerous:

- An Arctic Ocean that is open for extensive summer and fall periods for transit; resource exploitation, fishery expansion, tourism, etc.
- Coastline reconfiguration and resulting loss of infrastructure, displaced populations, changes to fish habitats (as well as other oceanic food sources)
- Increased catastrophic weather events, including more frequent and more dispersed droughts and floods.
- Damages to oceanic and estuary ecosystems by ocean acidification (caused largely by absorption of anthropogenic carbon) – representing extensive modifications to food sources.

The developed nations of our world have the opportunity to prepare for these changes, and to prevent or minimize the extent of geo-political and economic upheaval. We must realize that even with dramatic changes to industrial activity to mitigate the ongoing climate changes, the changes that will occur over the next century are largely unstoppable as the momentum of processes in place is too great to reverse for many decades. Thus we must adapt and evolve as a global society. As Charles Darwin is often paraphrased: "It is not the strongest of the species that survives, nor the most intelligent, it is the one that is the most adaptable to change."

The road to success can be characterized by five "Ps"—Partnership, Prediction, Publicity, Preparedness, and Prevention.

Partnership: Whether along traditional organizations such as the United Nations, G8, G20, etc., or through the establishment of global and regional "coalitions of the willing," individuals must commit to work together across international, intergovernmental, and public-private boundaries in all facets of this matter. Outside of wartime, this has never been done effectively. Leadership is the most important, and likely the most difficult part of these partnerships to determine.

Prediction: The partners must generate the most accurate and highest resolution (spatially and temporally) predictions on specifically what changes to our oceans are anticipated and where, and all must agree to use these predictions for planning.

Publicity: Effective marketing is key to bringing the world together; publicity is the only means by which effective partnerships will be generated in advance of crises.

Preparedness: Partners must cooperatively invest scarce resources to ensure the highest risk nations and regions are prepared for anticipated changes to the greatest extent feasible. This should include the establishment of legitimate metrics for humanitarian assistance efforts toward this end.

Prevention: The above steps, which are incredibly complex and difficult, can enable us to move from a disaster response mindset to a disaster prevention mindset – the key measure of success in the long run, and perhaps survival.

The U.S. Navy, as a partner and leader in the global ocean community, should be considered as a major partner in these efforts. Our considerable investment in research and operational prediction of ocean conditions is unparalleled. As a Global Force for Good, we stand ready and willing to participate.

Reference

L. Megginson. "Lessons from Europe for American Business," *Southwestern Social Science Quarterly* (1963) 44(1): 3–13, at p. 4, noted by Nick Matzke.

INTEGRATING ECOSYSTEM SERVICES INTO DEVELOPMENT AND PLANNING

THE SARGASSO SEA ALLIANCE: A NEW PARADIGM FOR CONSERVATION OF AREAS BEYOND NATIONAL JURISDICTION?

Dr. David Freestone, Executive Director, Sargasso Sea Alliance

The Sargasso Sea is a unique ecosystem, of some 2 million square miles, in the North Atlantic. The sea is named after two species of holopelagic algae (*Sargassum natans* and *S. fluitans*), which reproduce solely by fragmentation without contact with land. The algae accumulate in the North Atlantic Subtropical Gyre, where they form into large mats or windrows. Bounded on all sides by the clockwise flow of major ocean currents, the Sargasso Sea is the world's only sea without coasts; only the tiny islands of Bermuda have direct coastal frontage. Just as the currents vary, the boundaries of the Sargasso Sea also vary.

The *Sargassum* is home to a range of endemic species, and the Sargasso Sea is a major feeding and migration route for a number of threatened and endangered species, including sea turtles, Humpback and Sperm whales, as well as for commercially important tunas and billfish. It is the only place in the world where the catadromous, endangered European eel (*Anguilla anguilla*), and the American eel (*A. rostrata*) spawn.

Bermuda, at the center of the Sargasso Sea, is an overseas territory of the United Kingdom. It claims a 200-nautical-mile Economic Exclusive Zone (EEZ). Beyond the Bermudian EEZ, however, the remainder of the Sargasso Sea is largely an area beyond national jurisdiction (ABNJ). Despite the fact that the area sits between the United States and Europe, neither a regional marine environmental treaty framework nor a regional fisheries agreement is in place for this part of the Atlantic.

The Sargasso Sea Alliance (SSA) was formed in 2010 under the leadership of the government of Bermuda. Its small secretariat, headed by an executive director, is based in the International Union for the Conservation of Nature (IUCN) office in Washington, D.C. Within the Bermuda government, the Bermuda Ministry of Health and Environment leads the project.

SSA has three key objectives: (1) to build an international partnership that will secure recognition of the ecological significance of the Sargasso Sea and the threats that it faces; (2) to use existing regional, sectoral, and international organizations to secure a range of protective measures for all or parts of the Sargasso Sea to address key threats; and (3) to use the process as an example of what can and cannot be delivered through existing institutions in areas beyond national jurisdiction.

SSA's general strategy is to identify the most important threats to the Sargasso Sea ecosystem and to address them by seeking appropriate protection measures within the relevant international or regional sectoral organizations. Possible threats from shipping or vessel-source pollution would be addressed through the International Maritime Organization (IMO); threats from fishing, through the International Commission for the Conservation of Atlantic Tunas (ICCAT) and (for the small area of the Sargasso Sea above 35°N) the Northwest Atlantic Fisheries Organization (NAFO). Seabed mining issues would be addressed through the International Seabed Authority (ISA). No one appears to have attempted to put a range of sectoral measures in place before for an important area beyond national jurisdiction. Hence, the project has attracted a lot of international attention and support.

As the basis for supporting this work, the Bermudian and the UK authorities asked for a scientific justification for seeking protection measures for the Sargasso Sea. The resulting study, *The Protection*

and Management of the Sargasso Sea: The Golden Floating Rainforest of the Atlantic Ocean, Summary Science and Supporting Evidence Case, was published in 2011. Edited by professors Dan Laffoley and Howard Roe, this report involved 74 collaborators from 11 marine scientific institutions in 10 countries. The report drew on the extensive research literature on the Sargasso Sea plus a number of commissioned papers (now published on http://www.sargassoalliance.org), among them *Values from the Resources of the Sargasso Sea* (Sumaila, et al.). This preliminary study suggested that the indirect use value from the Sargasso Sea is more than $2.7 billion per year. Professor Linwood Pendleton is directing a European research team to look even more closely at the economic benefits that derive from this unique ecosystem.

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VALUE, MEASURE, AND DESIGN: THREE KEY CONSIDERATIONS FOR INTEGRATING ECOSYSTEM SERVICES INTO DEVELOPMENT AND PLANNING

Sebastian Troeng,* Senior *Vice President, The Betty and Gordon Moore Center for Science and Oceans, Conservation International

In a sense, integrating ecosystem services into development and planning is like navigating a large ocean-going vessel to a safe destination in the time before GPS. To do so, we need to undertake three tasks:

First, we need to fix the broken economic compass (Sukhdev 2010) and properly value the benefits ocean ecosystems provide to economic sectors, to communities, and to societies. Most economic decisions are made without adequately taking into account ocean ecosystem goods and services. For these goods and services to be part of decision making, their economic values must be quantified and the beneficiaries of these values must be identified.

Second, we need to know where we are starting our journey. That is, we need a way to measure the status and likely future trend of ocean health and the capacity of the ocean to provide benefits to people.

A couple of years ago, my colleagues and I were asked by a successful business leader if there was any consistent way to measure ocean health. After all, how can we manage ocean health if we cannot measure it? After careful review of the literature and a detailed feasibility study, we realized there were no such measures but that it would be possible to develop one. So we partnered with several organizations, in particular the National Center for Ecological Analysis and Synthesis, the National Geographic Society, the New England Aquarium, the Sea Around Us project at the University of British Columbia, and dozens of researchers worldwide to develop the global Ocean Health Index (Halpern et al. 2012). Our goal was to measure the ocean's capacity to sustainably provide food, coastal protection, coastal livelihoods and economies, carbon storage, natural products, biodiversity, clean water, and three other benefits to people both now and in the future. The index provides a global score for ocean health as well as global scores for each of the 10 benefits and for each of 221 countries and territories around the world. The original scores were published in the journal *Nature* (Halpern et al. 2012); the most recent scores were released in October 2013 (http://www.oceanhealthindex.org). Globally, ocean health scores 65 out of 100, indicating that we have a long way to go to optimally use and adequately manage our oceans. The United States came in 75th place, with a score of 67; Sweden was 85th, with a score of 66. Quantifying the value of ocean ecosystem goods and services and measuring ocean health with an index provide us with a compass and a known starting point for our journey.

Third, we need to get the whole crew to work together with a common purpose. Effectively integrating ecosystem services into development and planning will require breaking down the traditional silos of ocean management whereby one government agency manages one ocean use or sector, often at cross-purposes with other sectors, companies, or organizations.

I am optimistic that there is increased recognition around the world that business as usual is not an effective way to manage oceans and ocean resources. Last week, I got back from the Eastern Tropical Pacific, a region where there is progress in breaking down management barriers among institutions. One example is that both the fisheries agency and the environment agency collaboratively inspected the permits on the boat I was on in Panama. In nearby Costa Rica, Colombia, and Peru, inter-institutional ocean commissions have been created to bring together all the relevant agencies with mandates for oceans for more effective management. Similarly, both Costa Rica and Ecuador have created vice ministries for oceans with a mandate to coordinate activities to ensure more holistic ocean management of all the benefits the oceans provide.

So value, measure, and design are the three considerations that are required to effectively integrate ecosystem services into development and planning and to bring both ecosystems and people to a safe harbor.

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MARINE SPATIAL PLANNING IN SWEDEN

Tomas Andersson, Swedish Agency for Marine and Water Management

Marine spatial planning (MSP) is one important tool to help us face the increasing pressures put on the seas and to prevent them from becoming a future battlefield for different development interests and the ecosystem. Globally, more and more countries are either doing some kind of marine spatial planning (e.g., China, Australia, England, Norway) or are preparing to introduce it (e.g., Sweden, Poland) as a way of meeting increased pressures.

It's important to be clear about what kind of planning we are talking about. There are differences among a management plan, a strategic plan, and a spatial plan as well as between a legally binding plan or an indicative plan, just to mention some examples. It's also important to explain what planning can achieve and what issues it cannot address.

In Sweden, we understand spatial planning as a future-oriented and democratic process. It's used for analyzing and balancing land and sea uses, while allocating space with the aim of achieving ecological, economic, and social (politically decided) objectives. Spatial planning is about balancing uses, including development and preservation, for the good of society and nature. Planning should be adaptive and could be seen as a never-ending learning process. I would argue that there are no differences between spatial planning as a concept and marine spatial planning, even though there are differences in the pre-conditions

of various planning activities. For example, in Sweden there is hardly any private ownership in the Baltic Sea. The stakeholders are more difficult to identify, and the marine ecosystem is less well known than terrestrial ecosystems, and thus harder to study.

Maritime spatial planning has been defined as "a public process of analyzing and allocating the spatial and temporal distribution of human activities to achieve ecological, economic, and social objectives that are usually specified through a political process" (Ehler and Douvere 2007).

An MSP process should be:

- Integrated and multi-objective, including all important sectors, ecological, economic and social;
- Strategic and future oriented, considering alternative solutions to achieve a vision;
- Continuous and adaptive, with emphasis on monitoring and evaluation;
- Participatory, with a broad base of stakeholders; and
- Ecosystem based, with a focus on maintaining ecosystem services over time.

A well-conducted MSP process includes access to good knowledge of the ecosystem and the value of marine habitats, and it has the potential to be an important platform for dialog on responsible development. It can also act as a link between the ecosystem approach and nature conservation on one side and blue growth development on the other side. However, this capacity requires additional knowledge about the function of the marine ecosystem and its habitats and how to value them. This knowledge, including evidence in spatial terms, needs to be translated into planning so it can be assessed and described.

Marine spatial planning is still a relatively new concept for most actors, and there is a general need for nations and sectors to share experiences and learning from one another. Given the sea's lack of administrative borders, there is a great need for administrative entities to develop and establish a common understanding and common approaches to marine spatial planning. Discussions on this issue should touch on how to describe the ecosystem, what planning principles should be used, what are common planning requirements, and the minimum standard criteria for planning in a cross border context. The issues yet to be agreed on will enable a common understanding when holding discussions in international fora and planning activities.

Marine spatial planning is a constant learning process, involving give and take among those involved. A planning process is about creating understanding and acceptance of different needs from different sectors. A good planning process will consider the priorities of political goals and the ecosystem to create an enabling environment for implementation of the plan. Most people, even professionals, are not used to cross-sectorial thinking and do not in general have a very good knowledge of other sectors' requirements for their activities. Therefore, professionals do not always understand sectors' needs and interests in relation to their own sector's needs and interests. Dialog among stakeholders is as important as that between the planning agency and the stakeholders.

Finally, a marine spatial plan should perhaps not be understood as just a plan. I would argue that the planning process is more important than the actual plan itself, because planning is an ongoing activity based on improved knowledge, changing conditions, and political targets. Plans will be evaluated, revised, and adjusted over time, and there will follow a second plan after the first plan, and so on.

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DEVELOPMENT OF A MARINE PROTECTED AREAS NETWORK: TOWARD A BLUE ECONOMY IN THE ASEAN REGION

Assc. Prof. Nguyen Chu Hoi, University of Science, Vietnam National University, and Chairman of National ASEAN Working Group on Coastal and Marine Environment

The Association of Southeast Asian Nations (ASEAN) includes nine maritime countries: Brunei Darusalam, Cambodia, Indonesia, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam. With the exception of Laos PDR, all of ASEAN's members have a marine border. The ASEAN coastline totals some 173,000 kilometers. ASEAN countries also have extensive river deltas and diverse coastal and marine habitats that support the richest concentrations of marine biodiversity in the world and encompass globally significant marine biodiversity areas. These habitats contain 30% of the world's coral reefs, 35% of its mangroves, and at least 18% of its seagrass meadows (ASEAN 2011).

An estimated 600 million people, many of them poor, live in ASEAN countries. Approximately 69% of the population live within 50 kilometers of the coast (http://www.wri.org/resources/maps/reefs-risk-southeast-asia) and are directly dependent on coastal, marine, and ocean resources for food and to generate at least a portion of their livelihoods. The area's marine ecosystems are a resource base for key regional industries, including fisheries, tourism, and shipping. Coastal and marine ecosystems can act as the first line of defense in mitigating natural disasters, such as cyclones, hurricanes, storm surges, and tsunamis. They can also defend against the effects of climate change and sea level rise, which have a serious impact on the coastal and marine economy, community life, and health in the region. The blue benefits provided by the sea are only possible by maintaining healthy coastal and marine ecosystems. These environments are critical to sustaining social and economic development in the ASEAN region as well as to protecting globally significant ecological service values and resources for the world community.

ASEAN member countries have established marine protected areas (MPAs) in a variety of forms and scales, from village community-managed areas to large-scale nationally designated marine parks. The MPA network is recognized as a marine environment management macro tool as well as a policy development reference to protect coastal and marine assets for blue economics. Effective management of MPAs should first restore the designated area and then lead to spillover effects. The ASEAN *State of the Environment* report (2009) stated that the total number of MPAs in ASEAN is 1,452. Most MPAs are in the Philippines (80.5%), followed by Malaysia (8.9%), Indonesia (5.2%), Vietnam (2.1%), Thailand (1.8%), Cambodia (0.5%), Myanmar (0.4%), Brunei (0.4%), and Singapore (0.1%). However, in the past few years only a few (some 20–30%) of the established MPAs are effectively managed, and the remaining MPAs are inadequate, a situation examined in 2002 and again in 2008–09 by the ASEAN Center for Biodiversity (http://www.aseanbiodiversity.org/). This situation calls for establishment of an ASEAN regional network of MPAs. Effective MPAs are locally managed, and MPA networks in ASEAN member countries (to different degrees) play an important role in sharing timely lessons from management of individual MPAs among member countries. Best practices for developing MPA networks will be reviewed to help maintain ecosystem services values for sustainable development and blue growth in the ASEAN region.

Throughout the region, coastal and marine ecosystems and the natural resources that they support face a number of threats, including land-based pollution and sedimentation, excessive harvesting, and climate change and its associated consequences. According to the ASEAN Center for Biodiversity (ASEAN 2010), these threats decrease coastal and marine biodiversity resources and may reduce their capacity to continuously provide for the livelihoods, health, and food security of people in the ASEAN region. Funding and mobilization of various local and national conservation initiatives there have improved local human and institutional capacities for MPA management, governance, and enforcement. According to ACB (2010), the successes of such initiatives are due to (1) *strong scientific references* that identify critical habitats through resource assessments and surveys, perception mapping, and the use of

connectivity information (current patterns and larval dispersal); (2) *local stakeholder participation* in integrated spatial planning, policy design, preparation, and implementation, (3) *political commitment, action, and institutional support* at least from the local government but not excluding the national government, and (4) *adequate funding support*.

ASEAN member countries agree that increasing the number of MPAs by 2020 is essential. Although MPAs have received international support, mostly from the European Union, international assistance to improve the ASEAN network of MPAs in the near future remains necessary.

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WINNING THE RACE TO FISH

Fred Boltz, Ph.D, Managing Director for Ecosystems, The Rockefeller Foundation

Throughout history, the ocean has served as humanity's great global commons. The ocean's free resources fueled human development. The ocean's seemingly endless bounty propelled economic growth globally for centuries, and in part inspired Europe's age of exploration. The ocean remains an essential economic driver today, providing resources for food, fuel, minerals, cosmetics, and medicines. Principal among these resources: fish. Marine fisheries alone supply the main animal protein for more than one billion people and support the livelihoods of hundreds of millions. Meanwhile, entire industries in energy, transport, recreation, and tourism depend on the ocean. And though harder to monetize, the ocean provides the essential services of regulating Earth's climate and generating roughly half of primary production of organic matter.

Despite the limitless value the ocean provides, its economic history is a tragedy of human mismanagement. Undervalued marine ecosystems are plundered in fishing, mining, and coastal development. Fisheries—free goods from the natural wealth of the ocean—are commonly harvested to the point of collapse. Roughly 87% of global marine fisheries (that's nearly all of the saltwater fisheries!) are overexploited or fully exploited per the Food & Agriculture Organization's 2012 assessment. Once abundant, marine biodiversity has declined to dramatically low baseline levels, uncharacteristic of the natural state of the ocean. Indeed today, Europe's seas are estimated to hold less than 5% of the total mass of fish that once swam in those waters (Roberts 2007).

The historic and prevailing economics of the ocean commons is the well-known tragedy. Humanity, sharing this global natural asset, has favored self-interest over the collective good. The ocean is managed to maximize private, financial, and material gain, while social worth is neglected. The depreciation of our common ocean asset is unaccounted for in standard measures of wealth. As a consequence, the current institutions for the collective management of fisheries have proven unable to advance sustainable catch levels, instead favoring short-term gain. Public subsidies mask the costs of private industry, sustaining destructive use and overconsumption. At the same time, overfishing continues to prop up underperforming economies; fisheries serve as the economic safety net for the poor worldwide or a livelihood of last resort.

Getting the economics wrong has sustained humanity's impulse to "race to fish"—to harvest the wealth of the oceans before and at a greater scale than others. This phenomenon is ascribed to individual fisheries, in which catch limits create the perverse incentive for each fisher to rush to capture the largest possible share, but the same mentality characterizes the economic history of the ocean. Each generation, whether driven by the market for fish or by demand for oil, coastal development, or vanity products, has raced to extract as much profit from the ocean as possible. While the financial boons to local and national economies have been significant, and private benefits have been great, too, current practices simply can't continue—the ocean can't support them.

Indeed, by winning the race to fish, we risk losing everything. Winning will mean the collapse of fisheries, the loss of marine ecosystems, and the impoverishment of the oceans. Increasingly, we face a race to avert the collapse of our great ocean commons as we know it. Remarkably, solutions to this grave problem are largely known. Reducing catch, protecting critical ecosystems, halting destructive harvesting, and transforming the marine environment are straightforward and robust solutions. What's more, the oceans are amazingly resilient. Fish populations have an extraordinary recovery capacity, though not all will be easily restored. Even the prized bluefin tuna, which is predicted to collapse this decade at current catch levels, could also be fully restored simply by reducing harvest and halting illegal fishing. The ocean's resilience offers an exceptional license to correct our course—to replenish stocks, restore habitats, and conserve critical marine ecosystems and services.

So what will it take? A full accounting of the social worth of our oceans is a key starting point. By reflecting the full public and private value of the resources the oceans hold, the industries and economies that are built on them stand a chance of long-term productivity and profit. The necessary changes will be politically challenging—short-term profits may decline, and there will be private losers for the sake of the public good. However, these short-term costs can restore the wealth of the oceans for the benefit of generations to come.

We must correct our misguided economy of the oceans or there will be no economy left to correct. The solutions are known. Let us race to achieve them.

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SECTION HIGHLIGHTS

- The Sargasso Sea Alliance is identifying the most important threats and protection measures for the Sargasso Sea. It recently published a report suggesting the sea's indirect use value is more than $2.7 billion per year. (**David Freestone)**
- The Global Health Index provides a global score for ocean health as well as global scores for each of 10 benefits and for each of 221 countries and territories around the world. Globally, ocean health scores 65 out of 100, indicating that we have a long way to go to optimally use and adequately manage our oceans. **(Sebastian Troeng)**
- A well-conducted marine spatial planning process includes access to good knowledge of the ecosystem and the value of marine habitats, and it has the potential to be an important platform for dialog on responsible development. (**Tomas Andersson*)***
- Only a few (some 20–30%) of established ASEAN marine planning areas are effectively managed, and the remaining MPAs are inadequate. This situation calls for establishment of an ASEAN regional network of MPAs. **(Nguyen Chu Hoi)**
- The current institutions for the collective management of fisheries have proven unable to advance sustainable catch levels, instead favoring short-term gain. By reflecting the full public and private value of the resources the oceans hold, the industries and economies that are built on them stand a chance of long-term productivity and profit. **(Fred Boltz)**

KEYNOTE: INNOVATION FOR SUSTAINABLE SHIPPING

Claes Berglund, Director of Public Affairs and Sustainability, Stena AB

All through history and the development of mankind, shipping has played a central role. It is one of the oldest businesses in the world. Meanwhile, the oceans unite people and enable trade—it is a fantastic resource.

Shipping is an important enabler of world trade and thereby the increased distribution of wealth. Shipping has employees from all over the world and is truly a global business that most of us are proud to be a part of. It is also the safest and the most environmentally friendly mode of transport.

Stena is a diversified family-owned business based in Sweden. Today, Stena is involved in offshore drilling, property, finance, technical and environmental services, and shipping. Innovation, care, and performance are our key values and are part of our success.

The shipping industry operates some 80,000 ships. The International Maritime Organization (IMO) is the governing body over this industry. States and the industry itself work side by side to improve shipping as a whole, especially when it comes to safety and environment. The soon-to-arrive Ballast Water Convention, which identified a problem with invasive species and was addressed by the IMO, is a good example of this drive. It is also worth noting that the shipping industry is the only industry with a global regulation for carbon dioxide emissions. It regulates what type of ships we are allowed to build and requires that all ships have an energy efficiency plan.

The rise in oil prices has made investments in energy efficiency a paramount activity. Fuel saving is thus on the top of the agenda of every shipping company today. The focus here is on technical improvements such as hull shape, propeller blades, and on operational changes including slow steaming and improved information on fuel consumption on the bridge. The result of these efforts is substantial. Our studies show that the carbon dioxide emissions from shipping in the North Sea have been reduced by approximately 25% since 2008. This has been accomplished solely through competition within the shipping sector and by industry response to customer needs.

As an industry, we face a new energy challenge. It´s time to look for a new fuel again. Today most ships run on heavy fuel oil—a residual substance at refineries as compared to the different fine distillates that supply cars and aircrafts. Tighter regulations for cars and lorries have resulted in even dirtier fuel for ships. Although being the most environmentally friendly mode of transport, maritime shipping cannot and should not be excluded when it comes to environmental improvements.

Natural gas is a comparably clean fuel. It is also quite cheap. The problem is that it is very hard to transport, unless you are close to a pipeline. This problem can be solved in two ways. First, by lowering the temperature to -163 degrees, which makes the gas a liquid and 600 times smaller in volume. It's called LNG (liquid natural gas) and is often used to transport natural gas where it can later be turned into gasified natural gas. Natural gas from LNG is increasingly used as a fuel for ships.

The second alternative is to convert natural gas to methanol at the source. Then it becomes a normal flammable liquid. It is possible to produce methanol from many different sources, for example, forest products or waste. It is even possible to make methanol from carbon dioxide and water.

We are looking very closely at these different options, but it's still too early to say whether LNG or methanol will be the choice for shipping.

Shipping is developing with society—and it will continue to contribute to a sustainable world.

OCEAN INNOVATION AND BLUE GROWTH

ENVIRONMENTAL CHALLENGES IN OCEANS AND WATERS DEMAND INNOVATIONS

Catarina Hedar, Swedish Agency for Marine and Water Management

Coastal regions are tremendously important for Europe's economy—and for Sweden's economy. Approximately 40% of the European Union's population lives within 50 kilometers of the sea. Almost 40% of EU gross domestic product is generated in these maritime regions, and a staggering 75% of the volume of the EU's foreign trade is conducted by sea. However, this important role played by our coasts has come at a cost to the environment, as a European Environmental Agency report, *Balancing the Future of Europe's Coasts,* makes clear.

We all know that the ecological health of the Baltic Sea is in a critical state due to eutrophication, hazardous substances, and overfishing, but the region is well positioned to find solutions.

The objective of the Swedish Agency for Marine and Water Management, SwAM, is to turn problems into opportunities, and to look at the sea as a sustainable resource. To achieve results and reach goals in our environmental efforts, it is essential that innovation and collaboration across borders occur. The agency´s mandate is broad and diverse. One of its core tasks is to regulate fishing and develop guidelines for how marine environments and streams may be used, for example in the case of wind and water power. We also play an important role in the continuous development of blue growth, and within the field of social and environmental economics, concentrating on the sea, waters, and coast.

One possibility for obtaining a balance between human impact and maintaining or improving marine and aquatic environments is for environmental technology solutions to be developed and applied to specific uses.

One of our reports—*Create a Better Water Environment while Making Money: Is That Possible?*—asks if creating a better water environment is both profitable and possible. For the report, SwAM conducted a series of interviews in which that question was posed. And the answer is: yes, it's profitable and possible. More than half of the companies interviewed for the report said that they would be more profitable if we, the governmental agencies, demanded higher environmental standards and stronger regulations. By doing so, we could possibly help open a market for sustainability.

Two companies that represent the shift toward profitable environmentalism include Waves4Power and Tech Market. Waves4Power creates energy from the waves. Tech Market focuses on phosphorus recovery and the removal of hazardous substances from bottom sediments.

There are also other interesting concepts, for example, oxygenation of the dead seabed. There is a large area in the Baltic Sea, the size of Denmark, which is dead. Boxwin is a project constructing a prototype to deal with this problem. The concept involves a floating wind turbine that drives a pump that brings oxygen-rich surface water to the lower layers of water to hopefully bring new life into the seabed again.

Another problem that has yet to be solved is the overfishing in the Baltic Sea. Solutions for this include selective fishing gear that distinguishes species and size of fish.

Harvesting algae for biofuel or even as food is a concept encouraged by SwAM. Tests for algae production are taking place in the south of Sweden.

We also need alternative solutions to current anti-fouling paints. Imagine a solution where you can get an alert via text message when the barnacles begin to accumulate on a vessel's hull, making it time to scrub

the boat. You could take care of your boat in an environmentally friendly manner and reduce the use of antifouling paints.

Another interesting concept supported by SwAM is the Clean Shipping Index (CSI), a business-to-business tool for cargo owners to select clean ships and quality ship operators. Transport buyers use it to calculate and minimize their environmental footprint. Ship owners present the environmental profile of their fleets to a network of large customers who then consider the profiles in procurement situations. The aim is a market demand for clean ships. CSI is driven by a non-profit organization.

Pilot studies are important to innovation. We have to get new systems in place and have them tested on-site. There is good research out there that's yet to be tested, and we need to create the appropriate prerequisites to see it through.

The role of an agency like SwAM is to help the invisible hand move the market in the right direction. SwAM supports innovation to accelerate the transition to a sustainable society.

Although the environment in the Baltic Sea is under intense pressure, the conditions to tackle the challenges are better here than in many other places.

INNOVATION AND WATER QUALITY

Sandra K. Ralston, President, Water Environment Federation

Since 1928, the Water Environment Federation (WEF) has pursued its mission to preserve and protect the water environment through education and training, knowledge creation and dissemination, and advocacy on behalf of its 36,000 individual members and 75 affiliated member associations worldwide. As WEF and others in the industry marked the 40th anniversary of the Clean Water Act (CWA) last year, they observed that without some transformational event or policy, the water quality gains of the past 40 years could erode during the next 40 years. In the absence of greater innovation, water quality will be stressed by population growth (the U.S. Census Bureau projects U.S. population growth up to 400 million by 2044) and its commensurate waste loads, the increasing population density of urban areas, and the intensity of precipitation and other consequences of climate change.

The decline in industry innovation in the United States caused concern among WEF's leadership—to the extent that when WEF released its new strategic plan in 2011, the first of its three critical objectives was to drive innovation in the water sector (www.wef.org/strategic-plan). WEF is accomplishing this as a facilitator among sector partners (manufacturers, utilities, financiers, and regulators), a platform for introducing innovative technologies and practices, and a resource bank of member expertise and experience.

WEF's embrace of innovation is based on the view that great technologies are being developed but not adopted by utilities and other treatment systems at the optimum rate due to a low risk tolerance built into regulation, which in turn affects manufacturing, financing, and distribution. WEF is driving innovation through several programs that address the barriers and that are having an impact on the Chesapeake Bay, among other watersheds.

LIFT (Leaders Innovation Forum for Technology)

The Leaders Innovation Forum for Technology (LIFT) is a multi-pronged initiative undertaken by WEF and the Water Environment Research Foundation to help bring new water technology to the field quickly and efficiently.

More than 200 utilities are now members of LIFT. One of its components is identification and evaluation of innovative technologies for readiness plus technical review of inventor's claims. Audiences for LIFT technology scans include municipal and industrial facility owners, consulting firms, and venture capitalists. Another LIFT component is informing local, state, and federal policies and regulations by identifying barriers to innovation and developing actions to overcome them. A third LIFT component is benchmarking, or gathering information on how individual utilities accomplish research and development and identifying elements of effective R&D. LIFT's fourth component is an informal forum for R&D: managers and individuals responsible for technology identification and deployment share experiences, activities, and interests.

WEFTEC Innovation Pavilion

WEF runs WEFTEC (www.weftec.org), the world's largest annual water quality conference and exhibition. The exhibit includes an innovation pavilion and theater where award-winning start-up companies and inventors interact with some of the 22,000 WEFTEC attendees. Sponsored by WEF, Imagine H2O, the Johnson Foundation, and BlueTech Research and supported by the Johnson Foundation at Wingspread and the Bill and Melinda Gates Foundation, the pavilion attracts venture capitalists and entrepreneurs who assist in bringing promising innovations to the market. In 2013, companies included NGen, which removes nutrients from wastewater and produces energy from ammonia; PaveDrain, a stormwater runoff storage system; and others featuring green roofs, membranes, and algae technologies.

Stormwater Initiative

Stormwater, nonpoint source runoff is a significant contributor to the Chesapeake Bay nutrient load. Stormwater management cannot be limited to large-scale, high-tech solutions at centralized water resource recovery plants; it must include green infrastructure, such as retention basins, infiltration facilities, and green roofs. And, it depends on local ordinances related to low-impact design as well as to federal regulations.

The Stormwater Congress, hosted by WEF as part of WEFTEC 2013, found a growing need in the market for new approaches and also for acceptance of stormwater management solutions. As with the adoption of new advanced technologies, stormwater practices are not being fully embraced by some, who associate lower risk with conventional "grey" solutions.

Conclusions

WEF's experience regarding innovation and water quality leads to three conclusions. First, we have to change our risk paradigm when evaluating innovative technologies to address water quality challenges in the Chesapeake and other watersheds. We need a process that accepts greater risk over time and an understanding of how to manage that risk. Second, we need to accept that all technologies are not equal: both in water quality impact and in capability to enter the marketplace. Third, some technologies provide multiple benefits—a triple bottom line—and should be evaluated accordingly. For example, green infrastructure may be less effective than conventional infrastructure at reducing consequences of intense rain events, but in terms of life-cycle costs, land amenities, and urban renewal associated with the greening of our cities and our watersheds, it may be the better solution in some cases.

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LIGHTHOUSE AND THE ZERO VISION TOOL: MARINE INNOVATION PLATFORMS

Bengt-Olof Petersen, Director, Lighthouse

Global trade is important for reducing poverty, improving living conditions, and generating growth. Shipping is one of the most important enabling mechanisms for global trade—more than 90% of world trade is transported over the sea (http://www.imo.org/KnowledgeCentre/ShipsAndShippingFacts AndFigures/TheRoleandImportanceofInternationalShipping/Documents/International%20Shipping%20-%20Facts%20and%20Figures.pdf). Shipping is also typically very energy efficient in comparison with other transport modes. But shipping emissions are increasing due to growing global trade. Current international regulations negotiated at the International Maritime Organization (http://www.imo.org/OurWork/Environment/PollutionPrevention/AirPollution/Pages/GHG-Emissions.aspx) will only marginally improve the situation, and emissions will continue to rise for a long time due to slow implementation of measures.

The IMO estimates that the energy use of the world fleet could be reduced 25–75% by deploying known technologies. As in other industries, such cost-effective investments are often not made due to barriers in markets, institutions, and organizations. There are few market incentives for potential providers of more environmentally friendly ships, because cargo owners are rarely willing to pay a premium. Also, there are few tools to really assess if a ship is environmentally friendly. Few shipyards engage in product development. Finally, most shipyards take no life-cycle responsibility, prefer production of mature designs, and compete only on price and delivery time.

The Swedish Shipowners' Association decided in 2009 to support the EU Commission's vision of a maritime industry without negative impacts on air and water. This action has led to the Zero Vision policy, which foresees providing competitive sea transport solutions and maritime operations with minimum impact on the natural environment and health, while avoiding accidents as well as unnecessary resource use.

To reach the Zero Vision goals, the ship—itself a system with many technical and operational subsystems with long life cycles—must be viewed as part of an intermodal transport system. Moreover, a wide range of research and innovation disciplines must be employed. They include policy formulation, public cost benefit and logistic analysis to hydrodynamics, energy systems optimization, navigational skills, and environmental performance assessment. Multi-disciplinary research and collaboration is therefore required to address policy issues, improve deployment of already established knowledge, and develop new technologies and competence.

Lighthouse (http://www.lighthouse.nu/), which was founded in 2006, is a competence center hosted by the Chalmers University of Technology in Gothenburg in Sweden. Its mission is to organize collaborations on strategically focused multi-disciplinary research and innovation to provide solutions with a high technology relevance level, with the ultimate goal of reaching the Zero Vision. Lighthouse uses a triple helix collaboration whereby partners from industry, society, and academia work together on theme areas.

In 2011, the Swedish Shipowners' Association, in cooperation with SSPA, a marine laboratory and consultant firm, established the Zero Vision Tool (ZVT; http://www.sspa.se/zero-vision-tool). ZVT is a collaborative method and environmental technology test platform. More than 100 organizations from industry, society, and academia work together on joint industry projects, each focusing on piloting particular new technologies, such as those relevant to new ship fuels or emissions abatement. A unique feature is the reference group, ZVT REF, within which governmental agencies meet with project managers to discuss and address regulatory or infrastructure barriers to deployment of new innovative technologies.

BALTIC SEA REGION: A TESTBED FOR INNOVATION AND NEW PLAYERS

Kerstin Hindrum, Project Manager, BSR Stardust and OffshoreWest

The Baltic Sea area provides unique opportunities for collaborative efforts focused on marine and maritime issues. The Baltic Sea is of paramount importance for the countries around it. The challenge it faces require both innovative thinking and cross-border collaborations. These collaborations must create partnerships not only among countries, but also between various industries and different sectors of society.

The BSR Stardust (http://www.bsrstars.se/stardust), an EU project that includes a focus on future maritime transportation, has been in place for three years. Eleven partners from around the Baltic Sea have studied proposals for new energy-efficient small passenger ferries that are made of lightweight materials and that use electric propulsion. These ferries will use new fuels to reduce harmful emissions and create transport solutions with ports as hubs.

The Baltic Sea and the North Sea have an expanding offshore industry, and not just in oil and gas in the North Sea. Rather, we are also seeing increased interest in renewable energy extraction. Operating in difficult conditions offshore poses considerable challenges for both people and equipment. There is, therefore, great potential for innovation, for example, within service and maintenance. In Sweden, we have not been so active within the offshore sector. However, we have strong environmental technologies, automotive, pulp and paper, and other process industries. One year ago, the OffshoreWest initiative, which involves a consortium of 50 organizations, was begun to use traditional Swedish industry strength to contribute to the development of the offshore sector including renewable energy industry. The contacts established in the BSR Stardust project are also used to develop new collaborations in this area.

We need to find innovative technological solutions, but we also need to consider new business models. Investment decisions must increasingly take into account life-cycle cost.

The Baltic Sea area offers fantastic opportunities to develop sustainable solutions. Local inhabitants are willing to engage in blue growth and have an interest in new solutions and innovative thinking. We therefore welcome increased cooperation between the Baltic Sea region and the United States on marine and maritime issues.

THE SUBMARINER PROJECT AND NETWORK

Joanna Przedrzymirska, The Maritime Institute in Gdańsk, Poland

The SUBMARINER Project (http://www.submariner-project.eu) and its successor the SUBMARINER Network project (www.submariner-network.eu) work toward sustainable and innovative uses of Baltic marine resources, namely, macroalgae harvesting and cultivation, mussel cultivation, sustainable fish aquaculture, reed harvesting, large-scale microalgae cultivation, blue biotechnology, wave energy, and offshore multi-use wind parks. The project was co-financed with EU funds within the framework of a transnational cooperation program covering the Baltic Sea region; the network is financed from the member's fees.

Over the course of the SUBMARINER Project we have experienced an ever-growing interest in the opportunities offered by innovative and sustainable uses of marine resources, not only across the Baltic Sea region, but also throughout the whole of Europe.

A multitude of stakeholders have directly participated in the events organized by SUBMARINER. They have also followed presentations given by SUBMARINER during numerous conferences and round

tables both within and outside the region. Topics discussed within SUBMARINER have also gained prominence in many other events and in policy papers outside the project's immediate range.

Since its release in December 2012, the SUBMARINER Compendium—the first-ever comprehensive assessment of a broad selection of innovative and sustainable uses around the Baltic Sea—has received a very positive response from stakeholders. We have presented the results of a multidimensional analysis for each of the above-mentioned uses: an inventory on state-of-the-art concepts (including availability of resources, current technology development, legal frameworks, competence center), environmental impacts, socio-economic framework, and market potential. The compendium provides plenty of evidence that the economic use of Baltic resources and protection of its environment can be smartly combined. At the same time, it has also shown that much remains to be done.

The importance of this work was recognized in February 2013, when the SUBMARINER Network was granted flagship status under the priority area "innovation" of the revised EUSBSR Action Plan (http://www.balticsea-region-strategy.eu/item/405532). The Ministry of Economic Affairs, Employment, Transport and Technology Schleswig-Holstein is the flagship leader, and the Swedish Agency for Marine and Water Management and the Maritime Institute in Gdańsk are co-leaders. The network aims to bring the various actors together to foster knowledge exchange within a structured process. It is based on the belief that strong collaborations among the areas of environmental sustainability, the economy, and research and development are best suited to tackle the demands of the future.

The SUBMARINER Roadmap (http://www.submarinerproject.eu/index.php?option=com_content&view=article&id=87&Itemid=224) is a reference document for the initiatives that network members aim to support and undertake in the field of sustainable and innovative uses of Baltic marine resources. The roadmap focuses on the key issues that require joint efforts to enhance blue-green growth in the Baltic Sea region, while also sustaining and improving its natural capital and, in particular, the Baltic Sea itself. The roadmap directly feeds into the European Commission's Blue Growth initiative, the EU strategy for a sustainable bio-economy as well as offers support for implementation of the HELCOM Baltic Sea Action Plan.

The SUBMARINER Network Action Plan (part of the roadmap) reflects the understanding that success hinges on appropriate scale of efforts and reliable evaluation of their potential impacts and benefits. Thus, the network calls for a joint coalition for interdisciplinary research and applied tests.

Photo courtesy of The Maritime Institute in Gdańsk, Poland

THE GALWAY STATEMENT ON THE ESTABLISHMENT OF A TRANS-ATLANTIC OCEAN RESEARCH ALLIANCE

Dr. Peter Heffernan MRIA, Chief Executive, Marine Institute Ireland

The Irish Presidency of the European Union (January–June 2013) placed a high priority on supporting the emergence of the EU Action Plan for the Atlantic (European Commission 2013), Horizon 2020, and an agreement on the Trans-Atlantic Ocean Research Alliance. I was honored to act as an ambassador for the alliance in association with our diplomatic missions in Brussels and Washington.

The signing of the Galway Statement on the Trans-Atlantic Ocean Research Alliance (Marine Institute Ireland 2013) by Canada, the European Union, and the United States in May 2013 signaled the following shared goals:

- Achieving a better understanding of the North Atlantic and Arctic ecosystems to study the interplay between them, particularly relating to climate change, and to promote sustainable management of their resources;
- Cooperating to help achieve mutually beneficial scientific advances, including better ecosystem assessments and forecasts, and a deeper understanding of vulnerabilities and risks, and
- Fostering public understanding of how ocean science and marine observations address pressing issues for citizens, the environment, and the world and of the importance of the Atlantic Ocean.

The parties to the Galway Statement have established an implementation mechanism through their existing bi-lateral mechanisms. This implementation mechanism is based on a three-stage process: (1) taking stock of and using existing bilateral science and technology cooperation (e.g., the U.S.-European Union Science and Technology Joint Consultative Group and the Canada-European Union Science and Technology Joint Coordinating Committee) and multilateral cooperation frameworks, including those related to ocean observation and ocean literacy initiatives; (2) recommending priorities for future cooperation; and (3) where possible, coordinating the planning and programming of relevant activities in these areas, including promoting researcher mobility.

Strong support for the implementation of the Galway Statement is evident in the EU's Horizon 2020 program, which has outlined calls for proposals for 2014 and 2015. These calls are part of the largest-ever funding support package for marine sciences in EU research, and they reflect the priority being afforded the blue growth agenda in Europe.

Horizon 2020 Support for Implementation of the Galway Statement

	Call	Action	Funding
BG8-2014	Atlantic Ocean observations	Research & innovation	€20m / $27m
BG14-2014	Atlantic Ocean cooperation research alliance	Coordination & support	€3.5m / $4.7m
BG15-2014	European polar research cooperation	Coordination & support	€2m / $2.7m
BG13-2014	Ocean literacy: oceans & human health	Coordination & support	€3.5m / $4.7m
BG1-2015	Atlantic marine ecosystems	Research & innovation	€20m / $27m
BG7-2015	Response capacities to oil spills & maritime pollution	Research & innovation	€8m / $10.8m

Furthering the aims of a trans-Atlantic ocean research alliance augurs well for our collective challenge to develop wise policies to guide mankind's stewardship of our ocean resources.

Signatories to the Galway Statement at the Marine Institute Galway, May 24, 2013:
(front) Senator David Wells (on behalf of Edward Fast, Minister for International Trade and Minister for Asia-Pacific Gateway, Canada), commissioners Maria Damanaki and Máire Geoghegan-Quinn for the European Union, and Assistant Secretary Kerri-Anne Jones for the United States.
Witnesses: (back) Irish Prime Minister Taoiseach Enda Kenny and Minister Simon Coveney.
Photo courtesy of Dr. Peter Heffernan

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THE IMPORTANCE OF GOVERNANCE IN DEVELOPING BLUE ECONOMIES

Leah Karrer, Senior Environmental Specialist, Global Environment Fund

Oceans have tremendous economic, social, and ecological value, and their integrity is vital to build blue economies. Oceans provide more than $1 trillion annually to the world economy in market goods and services (food security, tourism services, storm protection, and so on) and many times that in non-market amenities (Costanza 1997). But they are under threat from unsustainable practices, including over-fishing, land-based pollution, habitat destruction, and climate change.

An underlying cause of degradation is the failure to integrate ocean values into public and private sector policies and accounting, leading to widespread market and policy failures that are major drivers of ocean degradation. As a result, both the public and private sectors have tended to under-invest in marine-sustaining activities, such as wastewater treatment and coastal habitat protection, and to over-invest in detrimental activities, such as over-exploitation of fish stocks and chemically intensive types of aquaculture.

The Global Environment Fund recognizes the importance of ocean governance and has provided tremendous support to ocean conservation. In fact, the GEF is the largest investor in transboundary water

cooperation with $1.4 billion in grants in more than 170 states. It works across nations to protect 21 large marine ecosystems by promoting ecosystem-based approaches to fisheries and other marine and coastal resources, protecting coastal habitat from land based sources of pollution, and catalyzing the formation of country-driven, country-owned, and—ultimately—country-financed regional institutional frameworks. For example, GEF support helped to establish the Benguela Current Commission in Southern Africa, which brought together the nations of Angola, Namibia, and South Africa to work toward sustainable ocean governance. And the GEF supported the Partnerships in Environmental Management for the Seas of East Asia, which pioneered best practices in integrated coastal management across 12 East Asian countries. Likewise, the GEF is providing support to the sustainable management of shared marine resources of the Caribbean Large Marine Ecosystem, bringing together 25 small island developing states (SIDS) to build an integrated management approach for large marine ecosystems.

GEF ocean projects work from ridge to reef and from village chief to cabinet minister. In doing so, these projects are incorporating the market value of marine resources into national economies, resulting in economic and social benefits. GEF support to improve the governance and management of Pacific island state fisheries, which represent 40 percent of global tuna catch, helped those states triple the value of their fish landings and revenue. Other GEF projects have sparked new global legislation and industries, such as a new ship ballast water treatment and management industry (now valued in the tens of billions of dollars) to eliminate invasive species in ballast water. Yet other GEF projects have increased farm production and incomes—for example, in the Hai River Basin, where new sustainable agriculture practices benefited the watersheds by reducing nutrient loads into Bohai Sea and improved community livelihoods.

These GEF integrated projects demonstrate the positive contribution ocean management can make to national economies and local societies. They also demonstrate that the future of successful ocean governance depends on catalyzing strong partnerships that bring together governments, the private sector, NGOs, and multilateral institutions.

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SECTION HIGHLIGHTS

- The role of an agency like SwAM is to help the invisible hand move the market in the right direction. SwAM supports innovation to accelerate the transition to a sustainable society. **(Catarina Hedar)**
- The Water Environment Federation's embrace of innovation is based on the view that great technologies are being developed but not adopted by utilities and other treatment systems at the optimum rate. **(Sandra K. Ralston**)
- The Swedish Shipowners' Association decided in 2009 to support the EU Commission's vision of a maritime industry without negative impacts on air and water. This action led to the Zero Vision policy, which foresees providing competitive sea transport solutions and maritime operations with minimum impact on the natural environment and health. (**Bengt-Olof Petersen)**
- BSR Stardust, and its eleven partners from around the Baltic Sea, has studied proposals for new energy-efficient small passenger ferries that are made of lightweight materials and that use electric propulsion. These ferries will use new fuels to reduce harmful emissions and create transport solutions with ports as hubs. (**Kerstin Hindrum)**
- The SUBMARINER compendium provides plenty of evidence that the economic use of Baltic Sea resources and protection of its environment can be smartly combined. At the same time, it has also shown that much remains to be done. **(Joanna Przedrzymirska)**
- The Irish Presidency of the European Union (January–June 2013) placed a high priority on supporting the emergence of the EU Action Plan for the Atlantic, Horizon 2020, and an agreement on the Trans-Atlantic Ocean Research Alliance. **(Peter Heffernan)**
- An underlying cause of degradation is the failure to integrate ocean values into public and private sector policies and accounting, leading to widespread market and policy failures that are major drivers of ocean degradation. **(Leah Karrer)**

KEYNOTE: THE POWER OF PARTNERSHIP TO IMPROVE OCEAN HEALTH

Dr. Pawan G. Patil, Senior Economist, World Bank Group

Nowhere is the link between poverty and the environment more obvious than in the ocean. The ocean plays a vital role as the planet's life support system. It holds about 97% of our water, it absorbs heat and carbon dioxide, it generates oxygen, and it shapes our weather patterns.

However, the ocean is not a life-support system in the abstract sense. It feeds more than a billion people and supports hundreds of millions with jobs and livelihoods. Many of these people are located in some of the poorest coastal and island nations. More than half of the world's economy is produced within 100 kilometers of the ocean.

This is exactly why the World Bank has engaged in the ocean agenda for many years now. If we care about ending extreme poverty by 2030, we cannot ignore the ocean. The ocean is fundamental to the economic well-being and future food security of a huge number of our client countries.

The work we do on natural capital accounting shows the value of a healthy ocean to a country's economic prosperity. Countries tell us they want our help to put in place the laws and institutions needed to better manage their ocean resources for sustainable economic growth. In a changing climate that is already displacing thousands, endangering millions, and threatening the development gains that have been so hard won, this help is increasingly important.

To give the ocean a fighting chance of withstanding climate change, we have to tackle the other issues threatening its health in the meantime—and that means overfishing, destructive and illegal fishing, marine pollution, and destruction of marine habitats like coral reefs, sea grasses, mangroves, and salt marshes. The good news is that solutions exist for all these problems. We can rebuild fish stocks, protect critical natural habitats, and reduce pollution levels. In fact, an integrated approach to all these threats is the best thing we can do for the health of the ocean while we transition away from carbon-based economies.

At the World Bank Group, our portfolio of support to fisheries and ocean habitat conservation now runs to more than $1 billion, and we are providing another $5 billion to support pollution reduction and water resource management in coastal areas. We have heard, however, that while a good start, this is not enough.

Through this work, however, we learned that change can happen and when it does, people benefit. There are many examples. We know that our work alone isn't enough. No one organization or country can do what's needed to turn around ocean health. That's why we see partnership as so important. When the global community comes together to focus on real solutions, the opportunities that emerge are tremendous.

The Global Partnership for Oceans (GPO) is a new way for us to focus on the action needed. The Global Partnership for Oceans, which the World Bank has been stewarding for the past 18 months, is an important platform for the global community to focus on ocean action. The Bank is grateful to more than 140 public, private, and civil society partners for their enthusiasm, passion, and expertise, which have been vital to the GPO's evolution.

The partnership seeks to bring public, private, and civil society financial flows together in a way that creates the triple win that we all seek: poverty reduction plus profitable investments in the ocean space for sustainable growth plus conservation for protection of ecosystem services. Rather than simply having all the players "at the table"—we're starting to see a different sort of dynamic emerging through the GPO—one in which the partners own and drive the agenda. Countries needing expertise and financing to achieve

declared targets—like Aichi Target 11, poverty alleviation, and inclusive green growth—are in the driver's seat of this process.

But no one size fits all: actions and solutions have to be tailored to the local context and adapted on the basis of careful monitoring and lessons. We know this will be hard—any partnership focusing on such a large part of the planet and involving so many countries and groups will be. But after one year of working with many stakeholders, we're really excited about the GPO moving forward.

Together, we can build the momentum and results to solve the global challenge of the oceans and seize the opportunity for countries and the global economy. In partnership, we can unleash the wealth of the ocean in pursuit of a world without poverty, a world underpinned by healthy oceans and the goods and services they provide. We are proud to work as one of many in partnership and believe this is the only way we can turn the tide on ocean health.

NEW GREEN TECHNOLOGIES FOR A HEALTHY SEA

WAVES4POWER

Mattias Larsson, Waves4Power

Oceans cover 70% of the earth. The energy content above and below the ocean surface exceeds global energy needs several times over. Ocean power is the world's largest untapped green energy source.

No commercially available systems to harvest ocean energy exist today. Therefore almost not a single kilowatt-hour (kWh) of this vast ocean resource is being commercially captured and delivered to local or national power grids.

Conditions are changing, however. In recent years, regulatory and political changes—locally and internationally—are opening the playing field for new ideas and giving incentives, never seen before, for innovative ventures from energy companies and innovative startups.

In this new environment, the company Waves4Power has the opportunity to prove to investors the functionality of its wave energy converter, which generates electricity from ocean waves at a cost of 15–20 cents/kWh.

The idea for the W4P device initially originated in the oil crises of the 1970s. Since then, the company's founders have developed and refined the buoy—or Wave Energy Converter—that represents the heart of the wave power system that we offer today. After two successful ocean trials off the Swedish coast, we are ready for prime time and are preparing ourselves to launch a pilot wave power park off the coast of Cornwall in the United Kingdom.

We have received a letter of interest from an energy company ready to build the world's first commercial wave power park with our system, once we have showed them survivability in Cornwall for a year or two. This is where we are today!

So what is W4P? Our business idea is to develop and sell turnkey wave power parks, based on a floating buoy system, to utilities and power companies around the world.

Two things are important to succeed in ocean power: technical longevity and low costs for profitability.

Our company has its origins in the marine industry, and our founders have industrial backgrounds, so longevity and cost efficiency in manufacturing are historically ingrained in our guiding principles. Navigational buoys are the longest surviving manmade device in the ocean. Our WEC is shaped and sized like a large navigational buoy, and so its design gives it an inherent longevity.

Two successful full-scale ocean tests—the latest in 2010 in cooperation with a Swedish energy company—has showed the system's high power output. This is additional evidence that our system is coherent with our guiding principles of longevity and profitability.

Initially our core business will be to deliver turnkey wave power systems, but as more and more units are installed, our business model will include additional services such as operations, maintenance, and monitoring. All of these services will have repetitive revenue streams for the rest of the device's life.

W4P's founders and technology team have a combined marine and wave energy experience of more than 150 years. All have high academic backgrounds and technical skills as well as hands-on

experience. It may very well be that this seven-person W4P team has the most combined wave energy expertise on the globe.

My own background in investment banking strengthens the company's investor relations and fundraising efforts.

So what is needed today for this industry to kick off and reach parity with, say, wind power?

Government ocean energy initiatives are increasing. The United Kingdom is at the forefront of understanding and supporting the needs of ocean energy developers and investors. It has undertaken electricity market reform. Prioritization of such reform, along with other initiatives to support companies within the marine technology and ocean power industry, will be needed if we are to reach global environmental goals. In particular, the industry needs (1) simple and rapid application processes for permits and grants, (2) credible subsidy schemes such as feed-in tariffs with well-defined levels in the short and long term, and (3) designated test sites and future development sites.

When such initiatives are implemented, W4P will be a big part of the overall global solution to reduce carbon emissions. Our responsibility to future generations is staggeringly large. We are prepared to take our part of this responsibility and look forward to it!

DEVELOPMENT OF MARINE HYDROKINETIC ENERGY IN THE UNITED STATES

Damian Kunko, Strategic Marketing Innovations and Co-founder of Ocean Renewable Energy Coalition

Marine and hydrokinetic (MHK) energy (or ocean energy) is potentially the only form of renewable energy that could offer reliable "baseload" power—the amount of power a utility needs to meet minimum energy demands. Ocean waves are predictable up to three days in advance, and tidal flows, which are caused by the moon's orbit and gravitation, can be determined up to 100 years in advance. Unlike solar and wind, which are intermittent, MHK can provide a constant source of energy generation. Approximately 100 wave energy devices and 60 tidal devices are under development worldwide.

The United States first recognized MHK systems as a qualified, renewable energy source on par with wind, solar, geothermal, and biomass energy in 2005. Since the Energy Policy Act of 2005 was signed into law, the U.S. MHK industry has made steady progress, including the successful grid-connection of wave and tidal energy devices. However, it has fallen behind the MHK industry in Europe, Canada, and Asia, which have active test centers, market pull incentives, significant R&D funding support, and national energy policies that include specific commitments to MHK energy.

The first U.S. MHK Technical Roadmap was released in 2011 and was led by the U.S. MHK trade association, the Ocean Renewable Energy Coalition (OREC). The roadmap established a goal of installing at least 15GW of MHK energy in U.S. waters by 2030. Resource assessment studies in these geographically varied regions have proven that the United States has the potential to well exceed 15GW of MHK power. Unfortunately, the ability to harness this energy and quicken the pace of commercialization is dependent on a number of political and regulatory factors. The U.S. regulatory landscape is complicated, especially for small businesses. As such, the immediate needs of the industry are research and development funding, testing infrastructure that can get devices cost effectively into the water, and a permitting process that promotes the efficient testing and commercialization of MHK devices.

There is some level of U.S. congressional support for MHK technology. Current initiatives in Congress include the introduction of the Marine Renewable Energy Promotion Act, which OREC is lobbying Congress to pass, and an increase in funding to the Department of Energy's Water Power R&D Program and U.S. Navy Energy Program. In fiscal years 2012 and 2013, Congress funded the Water Power Program at $59 million—a three-fold increase over 2011 funding. The U.S. Navy was funded in 2013 to provide $25 million for MHK technology development. These actions have resulted in renewed interest from domestic and international developers and bode well for the continuation of MHK progress in the United States.

This progress is evidenced by the decision made this year to have the U.S. Navy build a grid-connected wave energy test site at the Kaneohe Bay, Hawaii, Marine Corps Base, where up to three full-scale wave energy devices can be demonstrated. This facility, the first of its kind in the United States, will be opened to technology developers at the end of 2014.

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BIO-EXTRACTIVE AQUACULTURE TO RESTORE WATERWAYS

Alyson Myers, CEO, Kegotank Bio

Nutrient pollution from land—the primary cause of coastal waterway impairment—creates large algal blooms that lead to low-oxygen and dead zones inhospitable to aquatic life. Despite efforts through the Baltic Sea Action Plan, the U.S. Environmental Protection Agency and other entities, waterways remain polluted. Efforts focus correctly on regulating land-based polluters, yet these efforts do not address nutrients resident in the aquatic system. Solutions do exist "in" the waterway through bioextractive aquaculture.

Certain kinds of aquaculture have the potential to mitigate nutrient pollution and maximize oxygen production while providing economic growth and useful raw materials. Given that nearly 97% of Earth's water is in the oceans and less than 1% is available as fresh water, farming of the sea provides a sustainable option for the production of food, feed, and raw materials.

Certain kinds of aquaculture—shellfish—filter excess nutrients, whereas others—macroalgae (seaweed)—use nutrients to grow biomass. This second means of extraction is the focus of our work. Seaweed farming can produce economic goods like fuel, feed, fiber, soil amendments, and raw materials for industry. It also oxygenates waterways, provides habitat for aquatic organisms, and can potentially reduce ocean acidification locally. Harvest of naturally occurring seaweed avoids deoxygenation, which would occur if the plants were left to eventually die and decompose.

Aquaculture fulfills several goals. One is using seawater meeting increasing demands on fresh water and agriculture due to population growth, which is expected to reach or exceed 9 billion by 2050 (United Nations Population Division 2009) (http://ga.water.usgs.gov/edu/earthhowmuch.html). However, to feed and provide goods for a growing population, aquatic ecosystems must be healthy. Kegotank Bio (http://www.kegotankoysters.com/) looks to this abundant resource as the nexus for several solutions.

Cost-effective solutions to enhance ecosystem function require innovation and cross-disciplinary work teams. Collaboration between universities and the private sector, with non-profits or governments as catalysts, could expedite the process. The private sector's incentive is profit; its skill is problem solving. The core of Kegotank's plan is to establish a revenue stream for the private sector to accomplish the goal of waterway restoration. Meanwhile, the private sector can capture additional value and a market advantage through production of "green" products. A separate revenue stream may be available through nutrient trading. (For an overview of nutrient trading, see *Nutrient Credit Trading for the Chesapeake Bay: An Economic Study* (Chesapeake Bay Commission 2012).

Kegotank's plan for bio-extractive aquaculture is one industry-based solution. This form of aquaculture requires development and funding to optimize nutrient absorption, propose harvest protocols to maximize oxygen levels and biomaterials analysis. The benefit of cleaning up our waterways is significant for the economy and for the function of our aquatic ecosystems. For innovative solutions, we should pursue cross-disciplinary dialogue among scientists, entrepreneurs, and social impact and other investors.

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SEAWEEDS FOR A BIO BASED SOCIETY: FARMING, BIO REFINING, AND ENERGY PRODUCTION

Fredrik Gröndahl, Department of Sustainable Development, Environmental Science and Engineering

Meeting human development needs and at the same time protecting the earth's life support systems will require a global economy less dependent on fossil resources than today. Biomass is the only sustainable raw material that can simultaneously provide sufficient transportation fuels and renewable materials. Hence, a transition to a bio-based economy in which raw materials are produced through the sustainable use of ecosystem services from land and water offers an avenue toward energy independence and a more "green" economy. In addition, new industrial uses of biomass mitigate greenhouse gas emissions and the effects of global climate change, boost innovation, contribute to rural development, and improve air quality.

Many models for biomass production are based on land agriculture. Large-scale cultivation of biomass on land has, however, frequently been associated with environmental problems due to extensive use of land (preceded by deforestation), use of fertilizers and pesticides, and consumption of fresh water. One alternative to terrestrial crops for biomass production is to culture benthic marine algae (seaweeds) in the sea. Seaweeds grow faster than any land plant and are effective at capturing carbon dioxide. Furthermore, the oceans, with their extensive coastal regions, provide a vast area offering limited conflict with food

supply. Seaweeds also function as ocean biofilters, which can be used for nutrient stripping of eutrophicated coastal waters.

Seaweeds contain a variety of biomolecules and thus form an attractive biomass base for a biorefinery producing food, feed, biomaterials, and biochemicals. Seaweeds, such as kelp, contain up to 50% carbohydrates (dry weight basis) with a unique compositional profile that can be used both for conversion into materials and biochemicals. Seaweeds also contain lipids rich in omega-3 fatty acids (PUFA), proteins rich in essential amino acids, glutamate, polyphenols (phlorotannins) with both antioxidative and antimicrobial properties, vitamins, and essential minerals (Holdt and Kroon 2011).

Seaweeds also form a vast biomass base for energy production. They can be fermented to produce alcohols or be anaerobically digested to produce methane. The low lignocellulose content of seaweed biomass, as compared to land plants, makes it a more suitable substrate for biological processes, such as methane and ethanol production. The constructing of a biorefinery that combines the isolation of high value compounds with biofuel production will make the use of seaweeds as a biomass source more cost effective.

To avoid risks associated with the implementation of an innovative system like the one described in the SEAFARM project (http://www.seafarm.se), sustainability assessments (SA) are essential. Today, many SA methods are available, but a majority focus on one defined product or process. For multiple process and product systems, the handling of sustainability issues has not been well described. Examination of different existing SA tools is required to propose applicable SA methods for multiple process/product systems in coastal zones.

In conclusion, there is great potential in using cultured seaweeds as a sustainable biomass, but a number of research challenges need to be addressed. These include (1) development of seaweed cultures under Sweden-specific conditions (species, culture techniques, environmental impacts), (2) integration of sequential process/fractionation events into a biorefinery so as not to destroy residual elements when targeting a specific high-value compound, (3) evaluation and optimization of biogas processes using residues obtained in a seaweed biorefinery, and (4) development of methods for handling sustainability issues in multiple process and product systems such as the one proposed in the SEAFARM project.

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DENSITY SORTING DREDGING: FROM BURDEN TO BENEFIT

Bengt Simonsson, Techmarket

All over Sweden, aquatic environments are suffering from levels of nutrient loading that cause eutrophication and expand anoxic seabeds. After decades of discharge and run-off into the Baltic Sea, internal leakage from pipes and fuel pumps is now many times larger than the current leakage from societal systems. We need sustainable solutions that reduce total loading. First, we need to reduce nutrient leakage from societal systems, and second, we need to reduce the internal nutrient leakage from anoxic areas of our seabeds.

The solution needs to be both technically and financially viable. Ideally, we need to make restoring eco-systems profitable. That way, we can attract solid capital investment and encourage job creation.

Enabling Technology
We need to see beyond contemporary perceptions. Where some see mud, others see a potential gold mine of resources, including sources for biogas, fertilizers, land cover materials, and valuable trace metals and minerals. Density sorting dredging offers the possibility that different fractions of specific elements can be extracted from retrieved seabed sediments. The fractions can be refined in such a way as to make them usable for other parties. For example, the density sorting process can extract clean and recent sediments only, thanks to differences in density.

Seeing Revenue Streams
Density sorting dredging creates many revenue stream possibilities for the restoration of aquatic environments. Indeed, the money paid by past generations to dispose of nutrients has created a potential income from refining. The destruction of natural capital from nutrient loading creates a potential income from extraction.

We are moving in a direction in which each cost chain is being reversed to generate a value chain. Still keeping in mind and respecting the prime driver—to restore ecosystems—integrated revenue streams will be a core prerequisite of the system design.

Flexible Pollutant Fees
By holding onto our primary objective—to restore ecology—we catch the public's interest, and it is in the public's interest to find a socio-economic allocation of costs. It is reasonable that emitting anything into an ecosystem should not be free. In principle, any pipe that connects to the municipal waste water system or any pipe that emits directly into a watercourse can be subject to a fee. The price could be set at the same level as the cost to restore the ecosystem. If ecosystem damage is irreversible, the cost to emit should be slightly higher than the price of not emitting. The economic incentive would be to choose the slightly cheaper, less polluting option. The price can be discovered through the Flexible Emission Fee Mechanism (The Nordic Council 2012). A fee is levied on emissions and raised at regular intervals until the market develops alternative, non-polluting solutions. The revenue from the fee, minus dredging and other costs, is returned to taxpayers to further stimulate the economy so that it will distribute costs in a fair and democratic way.

Initial estimates indicate that areas with lower urbanization levels will find it more cost-efficient to handle larger accumulations of nutrients than to deal with single household sewage systems. In a country like Sweden, with large areas of low population density, the cost of connecting sewage systems to municipal systems will be 3,000 times higher than removing the same amount of nutrients from seafloor (UAC).

Turning mud into fertilizers is just one opportunity. Another example comes from Boliden Aitik, a copper mine situated outside the town of Gällivare in the very north of Sweden. Cover material for the mine's sealing layer, cover layer, and vegetation layer could be recovered from the Baltic Sea. Fractions of the vegetation layer will consist of recent sediments that also will be used for biogas production. Sealing layers could consist of mineral sediments mixed with pozzolan materials, like cement. Cover layers could consist of a mixture of mineral sediments and organic sediments.

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SECTION HIGHLIGHTS

- The company Waves4Power has the opportunity to prove to investors the functionality of its wave energy converter, which generates electricity from ocean waves at a cost of 15–20 cents/kWh. **(Mattias Larsson**)
- Marine and hydrokinetic (MHK) energy (or ocean energy) is potentially the only form of renewable energy that could offer reliable "baseload" power—the amount of power a utility needs to meet minimum energy demands. **(Damian Kunko**)
- Aquaculture has the potential to restore waterways, provide economic growth through jobs, and produce useful products. The core of Kegotank's plan is to establish a revenue stream for the private sector to accomplish the goal of waterway restoration. **(Alyson Myers**)
- There is great potential in using cultured seaweeds as a sustainable biomass, but a number of research challenges need to be addressed. **(Fredrik Gröndahl**)
- Density sorting dredging offers the possibility that different fractions of specific elements can be extracted from retrieved seabed sediments. The fractions can be refined in such a way as to make them usable for other parties. **(Bengt Simonsson)**

KEYNOTE: SUSTAINABLE MARINE GOVERNANCE: LESSONS FROM THE BALTIC SEA REGION

Dr. Mikael Karlsson, President of the Swedish Society for Nature Conservation (SSNC) and the European Environment Bureau (EEB)

Some decades ago in Estonia, I witnessed enormous mining landscapes and huge open waste ponds with tons of radioactive sediments close to the Baltic Sea. Not far away though, national parks and wooden meadows showed a flourishing biodiversity. There was hope amid havoc.

This situation was not unique for post–Soviet states. In between beautiful coastal areas, industries all around the Baltic Sea emitted enormous volumes of pollutants. Together with high nutrient loads from agriculture and municipalities, this has made the Baltic Sea probably the most polluted marine area in the world. Adding overfishing, continuous oil spills, high ecosystem sensitivity, limited water exchange with the North Sea, and steadily changing politics illustrates the challenges at hand.

Nevertheless, preventive measures were taken quite early, in some nation states and under the 1974 Helsinki Convention for the protection of the Baltic Sea. By then, only Denmark and West Germany were EC members, and the Soviet Union dominated the eastern shores. In spite of the cold war though, HELCOM adopted hundreds of recommendations, including those on several hazardous substances. The effect has been lowered levels of toxic substances, such as PCB. Today I see white-tailed eagles quite often, which I couldn't when I grew up. Traditional command and control works.

After the Wall came down, Finland and Sweden joined the European Union, which thereby focused more on the Baltic Sea. The Helsinki Convention was revised and strengthened. Multi-level governance flourished, with firms, municipalities, NGOs, and universities collaborating to an unprecedented extent. Ten years later, the eastern enlargement of the European Union made Russia the only Baltic country outside the union. Again, changes followed and EU policies for chemicals, nutrients, and so on were applied more broadly. Opportunities grew for new structures and policies, such as collaborative forums, and directives on marine strategy and spatial planning. HELCOM adopted the 2007 Baltic Sea Action Plan, and the European Union developed the Strategy for the Baltic Sea Region. Recently, we have also seen a promising reform of EU fisheries policy, and a clear failure to do the same in the agricultural area.

Based on this review, we can identify and learn from themes and trends for policies.

Structurally, the European Union has become increasingly important, but it has also promoted regionalization of marine governance. The latter might be seen to cause tensions with Europeanization, but studies show the trends to be mutually supportive.

Looking at policies, we can see a trend from pollution control to risk governance: individual policies have been matched by sector integration, a polluter perspective has been complemented by the ecosystem approach to management, and nation states have transformed into a multi-level system, with both local and international, horizontal, and vertical governance structures, wherein policies are uploaded and downloaded. All this risk governance is causing a kind of policy thicket, but so far the many cooks have not spoiled the broth.

This is not to say that the most adequate governance structures are in place, not at all. I think fewer, better coordinated and more comprehensive policies are needed, and I imagine that European Union gradually will replace HELCOM as the focal point.

Even more important than structures is policy content. Here, government, including the EU unit, still counts most in the governance landscape of networks, institutions, and actors. Therefore, public policies will be most important also in the future.

But why are there still huge gaps between objectives and measures? One hypothesis is that we know too little about the oceans; that we don't see, consider, or account for marine natural capital; and that we have innovation bottlenecks and technological challenges. Of course, we need more knowledge and data, better models, and natural capital accounting as well as new technologies and tools for stimulating innovation. But I think there are deeper challenges.

We need to ask if science is a key governance bottleneck. In many cases it isn't. A clear example is the huge gap between the science-based recommendations on fish quotas from the International Council for the Exploration of the Seas and the non-science-based decisions made by regulators, grossly exceeding advice and maximum sustainable yields. We also know how to cope with uncertainty. In just the same way as we don't eat unknown mushrooms, we apply precaution, a principle included in the EU treaty and the Helsinki Convention. PCB was banned on the basis of the precautionary principle some two decades before there was full scientific proof of the damage so apparent today in the Baltic Sea, a measure that has saved many white-tailed eagles, seals, and otters, not to mention huge remediation costs. We also know how to apply precaution when setting fish quotas.

Moreover, we know how to transform environmental capital and pollution costs into monetary values, but asking for full valuation of marine ecosystem services would take ages.

Given these comments, I argue that even more important than describing in various ways what is being destroyed, we need to question the false arguments that environmental policies jeopardize competitiveness, innovation, and employment. Theory and empirical findings say the opposite.

So what is the recipe for sustainable governance then? First, we all need to place marine issues higher on the agenda. Second, we should emphasise traditional environmental principles. The polluter pays principle implies phasing out harmful environmental subsidies, which counteract all other efforts. If the money goes in the wrong direction, so does development. Instead, environmental investments in blue and green capital are needed. Furthermore, pricing can be done with or without a detailed cost-benefit analysis at hand. Taxes on greenhouse gas emissions have been shown to be very beneficial for preventing further ocean acidification. Similar price signals are needed for nutrients and hazardous substances. Third, participation is often crucial, both in policy development processes and in implementation, for instance in fisheries and coastal planning. Public decisions, as such, should be made by those who are elected.

Underneath these measures, more systemic change—of institutions and values, for example—seems needed. I am optimistically thinking that we can change even such root causes. I will tell you why.

As a kid, I saw the ocean as robust and enormous. When I grew up, I realized that was not true. Today we find hazardous substances and plastic debris, but smaller and smaller fish stocks, also in the deep sea. But today we also know that neither society is resilient. That makes us vulnerable, but it also enables change, and we have seen a lot of positive change around the Baltic Sea, including in northeast Estonia. This is far from enough, but more than enough to inspire enhanced ambitions.

ECOLOGICAL AND ECONOMIC CHALLENGES TO BETTER OCEAN MANAGEMENT

OCEANS IN PERIL – A WAY FORWARD

Ghislaine Maxwell, Executive Director, The TerraMar Project.org

Approximately 71% of the planet is ocean, and 64% of this lies outside the jurisdiction of any nation. This area is called the high seas, international waters, or the global commons. With no clear owner, the high seas are the most ignored and least explored part of the planet.

Under the United Nations Law of the Sea Convention, signed in 1982 and ratified by 164 countries, the seabed is recognized as the common heritage of mankind, making all its assets collectively ours. The history of our commons dates back to Emperor Justinious in 533 AD and the Public Trust Doctrine (Codex Justianus). The doctrine states that certain resources are preserved for public use and that the government is required to maintain them for the public's reasonable use.

Simply put, our common ocean belongs to us. Its systematic use and abuse by the few with the ability to do so is a huge problem. The mandate of the high seas states that they also belong to generations to come. If we eat the last fish and allow pollution to run rampant, dump trash, and mine at will, where does that leave the next generations?

The TerraMar Project (TMP; http://theterramarproject.org) was founded to bring a spotlight to the vast ocean beyond our national boundaries and to allow the individual, empowered with new digital tools, to have a stake in the high seas.

The oceans are in serious trouble. Swirling masses of plastic and debris converge in the currents. An estimated 3 million tons of rubbish is located between Hawaii and San Francisco alone. Plastic debris kills millions of fish and sea birds every year.

Other threats compound the problem. Acidification kills corals on which millions of species depend for life. Unsustainable extraction of our apex predators like sharks and tuna and other species changes the ocean balance. If we continue to fish at current levels, food security will become a problem. Approximately 16% of the global population depends on fish as a primary source of protein (FAO 2000), and this number is only increasing.

Healthy oceans are critical for life. They create more than 50% of the oxygen we breathe (Roach 2004). They control our weather patterns and our rainfall. Our very existence is predicated on healthy oceans.

TMP's goals are to create a global ocean community, to raise awareness, to educate, and to help create an ocean-specific Sustainable Development Goal (SDG) that the United Nations will vote on. A healthy and sustainable ocean would create jobs, increase food security, and ensure a healthy planet. An ocean-specific SDG would play a critical part in changing how we act and think about the ocean. In 2014, they are replacing the Millennium Development Goals that were created in 2000 to cut global poverty by half and tackle big issues such as AIDs and malaria. Bill Gates once described the MDGs as "brilliant," because they created new partnerships, initiatives, and laws that have helped millions of people (Yarrow 2013). An ocean-specific SDG would galvanize needed changes and have similar brilliant results.

The non-inclusion of the oceans in the SDGs is unacceptable. How can three-quarters of our planet not be part of the plan to secure the sustainable future of our planet?

TMP is a digital hub for the ocean and is on all social media platforms, including Instagram, Facebook, Twitter, YouTube, Tumblr, and Google +.

TMP's daily digital newspaper, the *Daily Catch,* keeps our ocean community informed of all ocean-related breaking news. Paramount to TMP's success is its education platform, which houses lesson plans and interactive features provided by our partner organizations, including National Geographic and Oxford University.

To quote Jacques Cousteau, who recognized the value and the importance of the ocean decades ago and tried to involve a global community then, "For most of history, man has had to fight nature to survive; in this century he is beginning to realize that, in order to survive, he must protect it."

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MANAGEMENT OF THE OCEANS

Henrik Scharin, Ph.D., Swedish National Institute of Economic Research, Environmental Economics Division

To manage a specific part of the ocean, the question of what end-goals we would like to have must be answered. One way to address this question is to identify the ecosystem services provided by the ocean and make a decision regarding what qualities they should hold. In doing so, it is vital to understand the dynamics and interactions among marine ecosystem services. For example, fish biomass, as an ecosystem service, is dependent on the state of a number of other ecosystem services, such as biodiversity, the food web, nutrient buffering, and primary production.

Highlighting the benefits humans derive from various ecosystem services (e.g., food, recreation, transportation) is one way to begin determining what goals should be targeted. When doing so, it is important to take a broad view regarding the benefits obtained. The total economic value (TEV) provides a framework for identifying the different benefits of ecosystem services, because it encompasses use, option, and existence values (Pearce et al. 2006). It is often the case that the values captured by market prices only capture a fraction of total economic value.

Once a decision has been made on what the end-state of an ecosystem should look like, it is possible to determine necessary restrictions for pressures such as nutrient loads, fishing effort, risk of oil spills, and invasive species. The state of a specific ecosystem service is usually affected by a range of pressures (e.g., shipping, agriculture) and drivers (e.g. nutrient load, oil spills, invasive species). For example, oil spills and invasive species can reduce the benefits obtained by mitigating eutrophication, including the

recreational benefits of water clarity (Hyytiäinen and Huhtala 2011). Therefore, management of these pressures needs to be integrated.

The horizontal integration of strategies for different environmental problems is important for a successful management strategy. However, it might be even more important to integrate strategies from different policy areas. For example, policies and legislation that target economic sectors, such as agriculture and fisheries, need to be in accordance with policies and legislation aimed at improving the environmental state. Vertical integration of different local, national, regional, and international management strategies is important to obtain an efficient and transparent management process. As emphasized by Hassler et al. (2011), local, national, regional, and international levels of governance need to be closely coordinated to avoid inefficient overlaps and regulatory gaps.

If there is reason to believe that one or several of the drivers targeted by the management strategy (e.g., agricultural production, shipping, fishing) will increase or decrease in the future, the strategy must be capable of adapting to such a change as well as to new information (for example, regarding the effect of a measure) to ensure that environmental objectives are reached.

In most cases, the values (size of benefits) derived from ecosystem services often also depends on other variables (infrastructure, knowledge, legislation, access rights) that need to be considered in the management of the oceans. If, for example, accessibility to recreation is limited by legislation, the benefits derived from that ecosystem service may decrease even though the state of the service is the same.

To conclude, there is need for an ecosystem-based, holistic, and integrated management strategy to bring about a sustainable approach to the oceans, which could safeguard ecosystem services and the benefits they provide to human societies.

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MANAGEMENT APPROACHES IN THE "FOCUS ON NUTRIENTS" CAMPAIGN

Stina Olofsson, Ph.D., Swedish Board of Agriculture, Project Manager of Focus on Nutrients

The purpose of the Focus on Nutrients project (http://www.greppa.nu/omgreppa/omwebbplatsen/%20inenglish.4.32b12c7f12940112a7c800022239. html) is to reduce nutrient leaching and emissions of greenhouse gases from Swedish farms and to ensure the safe use of plant protection products such as pesticides and fertilizers. Focus on Nutrients offers advice that is free of charge to the farmer and benefits both the environment and the economy. The project started in 2001 and now involves more than 10,000 farmers.

The project is a partnership of the Swedish Board of Agriculture, the Federation of Swedish Farmers, and 17 county administrative boards. It is funded by the Swedish Rural Development Program, which is co-financed by the EU budget and by national environmental taxes on mineral fertilizers.

The project includes on-farm visits, which are performed by more than 250 advisors employed by advisory firms across Sweden. Meetings of individual advisors and farmers constitute the most important part of the project. More than 45 000 farm visits have been carried out since the project's start. A farmer needs to farm more than 50 hectares of land, have more than 25 livestock units, or both to qualify for individual farm visits.

On-farm Visits and Advice on Specific Farm Needs

Focus on Nutrients follows a systematic approach to ensure the quality of advisory services and environmental benefits. The first step is a start-up visit, which includes calculating a farm's nutrient balance and planning advisory visits. The plan is based on the specific challenges that face the farm, depending on type of production and environmental impact.

The nutrient balance calculated at the initial visit, together with data on the farm's production, shows the situation at the starting point. A follow-up visit that is carried out after about six visits shows what has been accomplished and how the farmer may continue the environmental work. All nutrient balances and farm data are collected in a database. The surpluses of nutrients as well as nitrogen leaching and ammonia losses can be calculated and followed for groups of farms.

Courses are carried out both for farmers and for advisors. At the Focus on Nutrients website, farmers can calculate their own nutrient balance. The website also offers tools promoting the efficient use of nutrients, such as manure spreading, and showing how to optimize nitrogen fertilization levels. Farmers can sign up to receive twice-weekly emails providing the latest research reports or other related news. Publications and marketing are also important parts of the project.

Results and Recognition

Nutrient surpluses for farms within the project have declined due to reduced inputs of mineral fertilizers (primarily dairy farms) and feed (primarily pig farms). Purchases of mineral fertilizer have been reduced through better utilization of manure, combined with fertilizing techniques and adjusted fertilizer doses. Reduced inputs of feed have been made possible by better matching feed rations to animal needs, improved utilization of the farm's own grassland, and reduced feed waste.

A report from the Swedish University of Agriculture (Folster, Kyllmar, and Hellgren 2012) stated that there are strong indications that the measures implemented to reduce leaching of nutrients from agricultural land have had the intended effect. Nutrient runoff has decreased, such that the amount of nitrogen ending up in rivers has fallen 20–30% in the last 10 years. Reductions have been greatest in regions where the implemented measures have been most extensive and where Focus on Nutrients has been operating.

Reference

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CHESAPEAKE BAY REPORT CARD STRATEGY

Bill Dennison, Vice President for Science Applications at University of Maryland Center for Environmental Sciences

The concept of transparent, rigorous, and understandable environmental report cards is exemplified by the 2013 Chesapeake Bay report card (http://ian.umces.edu/ecocheck/report-cards/chesapeake-bay/2012/). This report card uses an alphabetic ranking system (A–F) and stoplight colors (green–yellow–red) to denote ecosystem health for 15 reporting regions. Green signifies a healthy and red signifies an unhealthy ecosystem.

The report card reflects the status of the Chesapeake Bay in 2013 and long-term trajectories (improving–no change–degrading), which provides incentives for achievement. The improving trajectories can be related to positive ecosystem feedbacks created by sewage treatment upgrades that led to the resurgence of aquatic grasses. The degrading trajectories can be related to negative ecosystem feedbacks that occur when bottom water oxygen is so low that sediment nutrients are released into the overlying water.

The printed report card provides an overview, which is backed up by a website that explains scores and presents data. A storyboard using conceptual diagrams describes the significant events that contributed to the scores.

Various science communication principles and techniques are used in the production and dissemination of the report card. Simple declarative statements—"active titles"—summarize the information presented. A variety of visual elements, including photographs, maps, conceptual diagrams, graphs, and tables, support the active titles. The report is posted in iconic locations (e.g., bayside locations, restoration sites) and referenced in short videos. Its annual publication is noted in a press release.

The Chesapeake Bay report card provides a skeletal framework for various additional report card efforts that employ citizen scientists. Riverkeeper and Waterkeeper groups around the bay collect, analyze, and report data on relatively fine spatial scales. Handbooks of standardized protocols and methods have been developed to guide these efforts.

Incorporation of environmental report cards into governance has been advanced through the process of "stat-ing," or intelligence sharing. In Maryland, this sharing is achieved through the BayStat process in which department secretaries and the Governor of Maryland and staff gather monthly to discuss how to accelerate Chesapeake Bay restoration. The BayStat website (www.baystatmaryland.gov) tracks bay health, pressures, and solutions. In the six-state Chesapeake watershed, ChesapeakeStat is being created to track bay restoration progress.

In summary, the Chesapeake report card provides a rigorous, geographically explicit assessments of the ecosystem health of the bay as a whole and of 15 reporting regions within the bay. The transparency and accountability provided by the report card allows for unbiased, non-political assessments. Moreover, scores for the regions stimulate peer pressure for preservation and restoration activities.

The Baltic Sea, which faces issues of concern in the Chesapeake Bay (e.g., hypoxia in bottom waters, fisheries declines, harmful algal blooms, toxicants), could benefit from a report card effort. Reporting regions could be based on geographic boundaries defined by bathymetry, residence times, and natural boundaries. The report card could incorporate findings from the water quality, fisheries, and habitat monitoring under way in the Baltic Sea.

A NEW APPROACH TO PHILANTHROPY IN THE BALTIC: REACHING OUT BEYOND THE USUAL SUSPECTS

Allison Robertshaw, Director of Zennstrom Philanthropies

Zennstrom Philanthropies (www.zennstrom.org/environment) was founded by Niklas Zennstrom, the inventor of Skype. The foundation focuses on environmental issues such as climate change, the role of entrepreneurship in addressing environmental issues, and, of particular interest to this conference, the Baltic Sea.

So the question to some extent is why is a foundation focused on technologies? Foundations usually spend their time giving grants to NGOs. So how do our experience, technologies, and the Baltic Sea intersect?

For the first few years of our engagement in the Baltic Sea, we did what foundations usually do—we found a few NGOs that were working on the areas that we were interested in, gave them money and convening space and waited to see results. The problem was, there weren't any results—even recognizing that eutrophication isn't going to go away in two years.

So this year, Niklas Zennstrom, being an innovator during his day job, tasked me and the foundation with finding a new approach to addressing the problems, finding new allies and a new narrative.

This summer we launched the Race for the Baltic (http://raceforthebaltic.com/). This campaign is made up of a coalition of more than 100 organizations, businesses, local and national governments, entrepreneurs, financial institutions, and individuals. The campaign included a cycle trip around the entire Baltic by a team of volunteers to collect stories and signatures and to learn what was being done and what needed to be done if the Baltic was going to be saved.

So, what did we learn?

The failure of the traditional NGO community to engage with businesses around the region was an incredible missed opportunity. Many of these businesses, when approached, were keen to figure out how to create a dialog with their consumers and their staff.

What also emerged is that the technology needed to address many of the environmental problems facing the Baltic already exists. Questions remain about what is necessary to get this technology deployed: Do supply and demand need to be more effectively connected? Do we need demonstration projects? Do we need to scale up what is already there? The answer is that it's probably a combination of all three. If we're serious about fixing the Baltic, we need not only to engage with the business community and the technology providers, but also to advocate on their behalf so that deploying green solutions is easy and profitable.

The other issue that emerged is the role of municipalities needs to be addressed. Our group, having cycled through almost all the municipalities bordering the Baltic, saw that (1) local governments were desperate for more information on what technologies were out there and how they could deploy them and (2) some, in the absence of strong leadership from their national governments, were plowing ahead as they saw fit to draw people to their region and make life better for those already living there.

We, as a foundation and as the Race for the Baltic campaign, will be focusing on these issues (as well as trying to remove barriers to this work, such as lack of finance and lack of information sharing).

A lot of people view environmental work as either policy or business oriented, but we see the two working hand in hand. We plan to encourage green technology scale up and deployment and to work on policy that creates the market signals to drive businesses and technologies toward sustainability.

Addressing these issues is the best way to create change on the ground in terms of improvements in the Baltic's water quality and general sustainability. Civil society needs to engage fully with non-traditional actors around the Baltic Sea: businesses, technology providers, and cities.

SECTION HIGHLIGHTS

- The TerraMar Project's goals are to create a global ocean community, to drive awareness of and educate people on all ocean-related matters, and to help create an ocean-specific sustainable development goal at the United Nations. (**Ghislaine Maxwell**)
- An ecosystem-based, holistic, and integrated management strategy is needed to bring about a sustainable approach to the oceans—an approach that could safeguard ecosystem services and the benefits they provide to human societies. (**Henrik Scharin**)
- In Sweden, nutrient runoff has decreased such that the amount of nitrogen ending up in rivers has fallen 20–30% in the last 10 years. (**Stina Olofsson**)
- The concept of transparent, rigorous, and understandable environmental report cards is exemplified by the 2013 Chesapeake Bay report card. (**Bill Dennison**)
- The Race for the Baltic campaign collected information on what was being done and what needed to be done if the Baltic was going to be saved. (**Allison Robertshaw**)