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***STRESS, SUSTAINABILITY, AND
DEVELOPMENT OF
LARGE MARINE ECOSYSTEMS
DURING CLIMATE CHANGE:
POLICY AND IMPLEMENTATION***



Large Marine Ecosystems
Volume 18



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Stress, Sustainability, and Development of Large Marine Ecosystems During Climate Change: Policy and Implementation

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Editors: Kenneth Sherman, Sara Adams

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***Stress, Sustainability, and Development
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Climate Change:
Policy and Implementation***

Edited by Kenneth Sherman and Sara Adams

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FOREWORD

Large Marine Ecosystems (LMEs) annually produce 80 percent of the world's marine fish catch. These coastal ocean areas are overfished; polluted; and subject to nutrient over enrichment, acidification, accelerated warming from climate change, loss of biodiversity and key habitat areas under stress—including sea grasses, mangroves and coral reefs. These stressors are impacting the sustainable development of an estimated \$12 trillion in goods and services contributed annually by LMEs to the global economy.

In June 2012, world political leaders at the United Nations Conference on the Environment and Development in Rio de Janeiro (Rio+20) committed to:

“. . . protect, and restore, the health, productivity and resilience of oceans and marine ecosystems, and to maintain their biodiversity, enabling their conservation and sustainable use for present and future generations . . .”

Consistent with meeting the challenge of Rio, leaders directing the world's top financial, scientific, and technical institutions engaged since the mid-1990s in supporting sustainable development of the oceans, came together at an LME Conference convened at Boston's John F. Kennedy Library on 16 February 2013. They came from Copenhagen, New York, Paris and Washington D.C. to present their pathways towards the recovery and sustainability of LMEs during climate change. Other attendees included invited guests, scientists in Boston for the annual meeting of the American Association for the Advancement of Science, the public, and the press.

The institutional leaders from the National Oceanic and Atmospheric Administration, the Global Environment Facility, the International Council for the Exploration of the Sea, the Intergovernmental Oceanographic Commission of UNESCO and the Environment and Energy Group of the United Nations Development Programme spoke of their institutions' partnerships and their commitment to supporting the recovery and sustainable development of the world's LMEs.

The Global Environment Facility, World Bank, and United Nations are partnering with the international coastal ocean community in providing over \$3 billion dollars in financial, scientific, and technical assistance to countries in Asia, Africa, Latin America, the Pacific, and eastern Europe in support of LME projects in over 100 developing countries that are moving toward restoring the health, food security, and economic vitality for billions of people around the globe dependent on LME goods and services.

In addition to the keynote talks of leaders from NOAA, the GEF, ICES, UNDP and IOC-UNESCO on the pathways forward to sustainable development of LMEs, the successful recovery and growth of LME goods and services will require more attention to multi-sectoral agreements for the use of LME space. Multiple uses include hydrokinetic energy, coastal transportation, fisheries, tourism, mining, and gas and oil production. Invited speakers and

panelists shared experiences in coastal and marine spatial planning from generic and case study perspectives.

The Conference at the John F. Kennedy Library was followed by a linked LME science symposium on 17 February at the American Association for the Advancement of Science meeting at Boston's Hynes Convention Center with invited speakers providing results of LME case studies where actions have been initiated for moving toward sustainable development of the Benguela Current, Yellow Sea, and Humboldt Current LMEs.

Following reviews of LME presentations made by the world leaders of ocean finance and scientific institutions and experts on marine spatial planning at the JFK Library Conference, and the papers presented at the AAAS meeting, the results have been edited and arranged into eleven chapters presented in this volume. The chapters represent a substantial commitment of scientific partnerships and financial support by the GEF, ICES, UNDP, IOC-UNESCO, and NOAA, towards the recovery and sustainable development of the world's LMEs.

The Editors
Narragansett R.I.
November 2013

MESSAGE FROM THE CHAIRMAN OF THE CONFERENCE AND SYMPOSIUM ORGANIZING COMMITTEE



When deliberating on the venue for the Conference, the Organizing Committee considered it fitting to link the LME policy and management talks and the AAAS LME science presentations to the ideals and challenges of international cooperation pursued by President Kennedy and illustrated throughout the JFK Library and Museum. Whether the challenge was a dramatic stand-down to a global nuclear exchange, or a challenge to place a man on the moon, it was treated by President Kennedy with careful deliberation, resulting in successful outcomes of global significance.

The unprecedented stress and degraded condition of our oceans and especially the intensely used Large Marine Ecosystems around the coasts of the continents presents another challenge of global significance. We are faced with recovering and sustainably developing goods and services of large marine ecosystems contributing trillions of dollars annually to the global economy. It is in President Kennedy's spirit of responding to global challenges that the Conference was convened at the JFK Library and Museum.

The invited speakers share concerns and offer solutions for improving the condition of the world's LMEs. They are leaders in a collaborative international mobilization of scientific and financial support to over 100 developing nations engaged in the recovery and sustainable development of Large Marine Ecosystems in Africa, Asia, Latin America, the Pacific, and eastern Europe.

Kenneth Sherman, Chairman LME Conference
and AAAS LME Symposium Organizing Committee

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We are pleased to acknowledge the financial and logistical support of the Gordon and Betty Moore Foundation, the Global Environment Facility, the United Nations Development Program, NOAA, the International Union for the Conservation of Nature (IUCN), and the wonderful staff support provided by the Kennedy Library and Museum, especially Kate Hanagan, Special Events Coordinator; Nancy Tobin, our Event Coordinator, and Rhonda Elkins and Gail Delano. We are thankful to Nicole Maylett, Meetings Manager; Ginger Pinholster, Director of the Office of Public Programs; and Cassandra Jones, Program Associate for the Office of Public Programs of the American Association for the Advancement of Science (AAAS) for permission to link the LME JFK Library Conference to the annual meeting of the AAAS and the Symposium on Moving Toward Sustainable Development of Large Marine Ecosystems convened at Boston's John Hynes Convention Center.

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MARINE SPATIAL PLANNING AND LARGE MARINE ECOSYSTEMS IN MEXICO

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Mexico is surrounded by five Large Marine Ecosystems (LMEs), all of them with different bathymetric, hydrographic, biological, trophodynamic, socioeconomic and governance features (Sherman and Hempel, 2008).

Amongst the several policy and planning instruments for the management of coastal and ocean zones, the ecological spatial planning (ESP) approach seems to be the most comprehensive, effective and appropriate for application to LMEs complementing the 5 modular approach to LME assessment and management (Sherman and Hempel, 2008. op.cit). Indeed, ESP is aimed at regulating and encouraging sustainable development with any given land or sea use and its associated productive activities, while protecting the environment through the sustainable use of

its natural resources. The strength of the spatial planning approach is supported by a thorough analysis of trends in environmental degradation and the study of scenarios for decreasing harvesting potential of actual resources.

A spatial planning program aims to establish guidelines and provisions for preserving, restoring, protecting and sustainable harvesting the natural resources that occur at any given area on land, coast or sea, including those of federal jurisdiction, and all of them are subjected to law enforcement as published by a federal, state or municipal decree.

In Mexico, oceans are a federal governance matter. The federal agency in charge of formulating, issuing and executing marine spatial planning processes is the Ministry of Environment and Natural Resources (SEMARNAT), along with other federal agencies, and those corresponding at the state and municipal levels.

THE MARINE SPATIAL PLANNING PROCESS

Spatial planning is a rigorous, transparent, participative and adaptive process of several steps (Figure 1), of which the core formulation of the planning study also involves several stages (Figure 2).

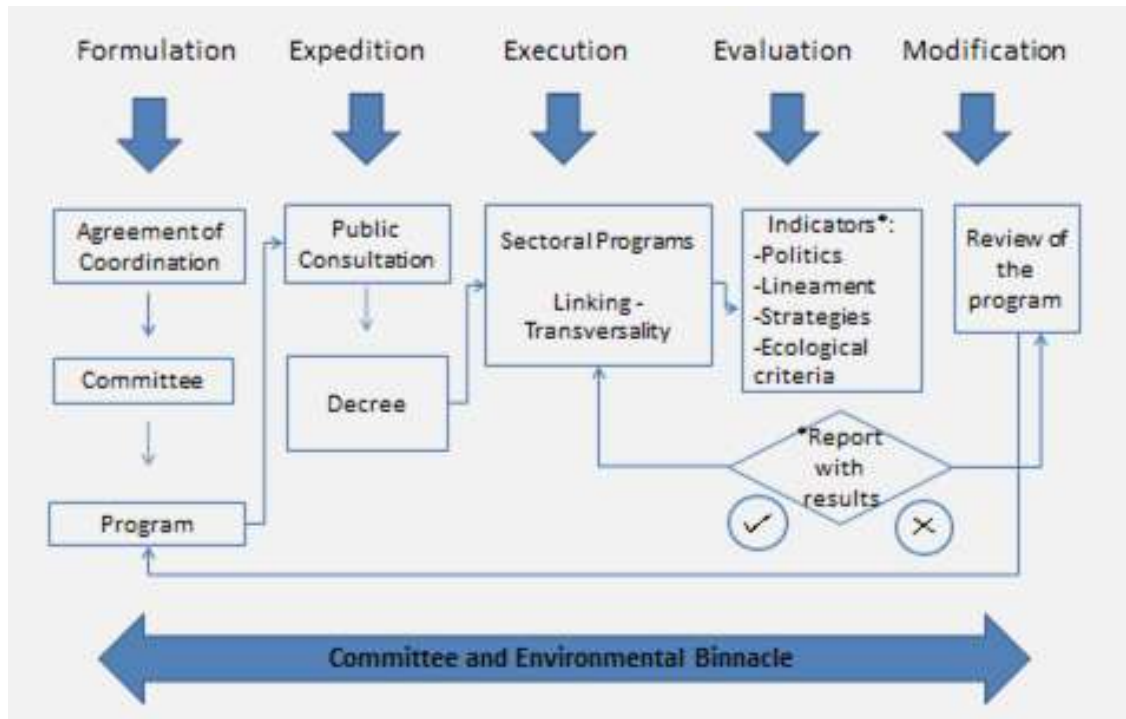


Figure 1. Phases of the policy process of marine spatial planning.

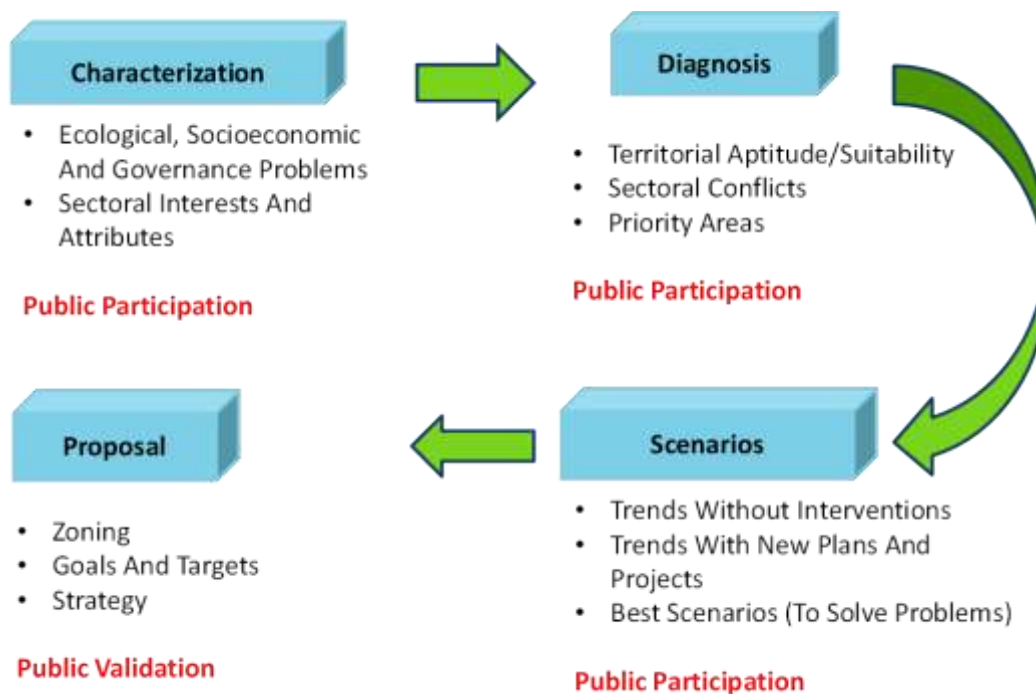


Figure 2. Stages of the technical studies of marine spatial planning

MARINE SPATIAL PLANNING PRACTICE

The Exclusive Economic Zone (EEZ) comprises four regions, each eligible for a particular planning process (Figure 3), in accordance to certain ecologic, social, economic, and governance features, and their issues are differentially approached (Table 1) in relation to their degree of progress (Table 2).



Figure 3. Areas of Marine Spatial Planning in México.

For two LMEs planning processes have been decreed and are currently being implemented (Gulf of California, 2006 and Gulf of Mexico, 2012); the other two LME planning processes are in the formulation stage (Northern Pacific and Central Southern Pacific Ocean). The Gulf of Mexico LME planning process is particularly oriented to regulate activities of the energy, maritime and fisheries sectors, while planning processes in the Pacific consider the interactions among the tourist, conservation and fishery sectors.

The planning process for the Gulf of California was the very first experience of its kind in the country, and was approached more from a scientific basis than from the required managerial foundation, which was actually launched in order to address the continuing spatial conflicts among the tourism, conservation and fishery sectors (Gutiérrez-Mariscal *et al*, 2007). The specific by-law provision on matters of spatial planning (SEMARNAT, 2003), encouraged a more participative process under an integrated framework of principles and procedures, by which conflict resolution became a core theme. From this new managerial vision—which included the signing of a coordination agreement, the establishment of decision committees, and the installation of a dynamic environmental log for the planning process—the core proposal was finally agreed among the several stakeholders, and decreed two years after its launching as the first federal marine spatial planning process.

Table 1. Topics addressed by Marine Spatial Planning for Mexican Large Marine Ecosystems (LMEs) and Regions.

ECOLOGICAL OCEAN USE PLANNING	MARINE AREAS OF THE GULF OF CALIFORNIA LME	MARINE AND REGIONAL AREAS OF THE GULF OF MEXICO AND CARIBBEAN LMEs	MARINE AND REGIONAL AREAS OF THE NORTHERN PACIFIC	MARINE AND REGIONAL AREAS OF THE SOUTHERN CENTRAL PACIFIC
POLLUTION	X	X	X	X
ECOSYSTEM HEALTH	X	X	X	X
FISH AND FISHERIES GOVERNANCE	X	X	X	X
SOCIOECONOMIC PRODUCTIVITY	X	X	X	X
CLIMATIC CHANGE		X		

Table 2. Current State of Processes in Marine Spatial Planning in Mexican Large Marine Ecosystems (LMEs) and Regions.

PROCESS/ REGION	THE GULF OF CALIFORNIA LME	MARINE AND REGIONAL AREAS OF THE GULF OF MEXICO AND CARIBBEAN LMEs	MARINE AND REGIONAL AREAS OF THE PACIFIC NORTH	MARINE AND REGIONAL AREAS OF THE PACIFIC SOUTH CENTER
COORDINATION AGREEMENT	09 OF JULY 2004	28 OF SEPTEMBER 2006	22 SEPTEMBER 2009	10 OF OCTOBER 2011
MEMBERS OF THE COMMITTEE (FEDERAL, STATE AND COUNTY AGENCIES AND STAKEHOLDERS IN THE REGION)	SEMARNAT, SAGARPA-CONAPESCA, SECTUR, SEGOB, SCT, SEMAR, SEDESOL GOVERNMENTS OF THE STATES OF: BAJA CALIFORNIA, BAJA CALIFORNIA SUR, NAYARIT, SONORA, AND NORTHWEST CONSULTATIVE ADVICE FOR THE SUSTAINABLE DEVELOPMENT.	SEMARNAT, SEMAR, SCT, PEMEX, SRA, SEGOB, PEMEX GOVERNMENTS OF THE STATES OF: TAMAULIPAS, VERACRUZ, TABASCO, CAMPECHE, YUCATÁN AND QUINTANA ROO	SEGOB, SEMAR, SEDESOL, SEMARNAT, SENER, SE, SAGARPA, SCT, SECTUR, PEMEX, CFE GOVERNMENTS OF THE STATES OF: BAJA CALIFORNIA, AND BAJA CALIFORNIA SUR.	SEGOB, SEMAR, SEDESOL, SEMARNAT, SENER, SE, SAGARPA, SCT, SECTUR, PEMEX, CFE GOVERNMENTS OF THE STATES OF: JALISCO, COLIMA, MICHOACÁN, GUERRERO, OAXACA AND CHIAPAS.
STAKEHOLDERS	NGO'S, ECONOMIC SECTORS, GROUPS OF INTEREST	NGO'S, ECONOMIC SECTORS, GROUPS OF INTEREST	NGO'S, ECONOMIC SECTORS, GROUPS OF INTEREST	NGO'S, ECONOMIC SECTORS, GROUPS OF INTEREST
CURRENT SITUATION	DECREED THE 29 OF NOVEMBER 2006	DECREED THE 24 OF NOVEMBER 2012	PROPOSAL	DIAGNOSIS

The second experience was the one for the Gulf of Mexico LME. An exceptional exercise indeed, since it considered the explicit interaction between terrestrial and marine ecologic and economic processes as a whole coupled system, and where a high resolution window at the Solidaridad municipality, within the state of Quintana Roo, was also included in order to closely address these sectoral interactions. An additional unique feature of this experience deals with its explicit linkage to the GEF-project of the Gulf of Mexico Large Marine Ecosystem (GoM-LME) project as implemented by Mexico and the United States since 2009. This coupled spatial planning event is also a first as both countries share goals, objectives, and development strategies, which eventually may set the course for similar institutional arrangements for the Gulf of California LME, based on the experience of its execution.

The two remaining exercises, one in the North Pacific (NP) and the other in the Central South Pacific (CSP), are following successful deployment models of the decreed planning processes, such as a highly motivated public participation (Figure 4) by explicitly including also the aforementioned law-enforced regulating principles on the matter.



Figure 4. Public, transparent and accountable Marine Spatial Process.

The CSP experience is including the Ocean Health Index approach (Halpern *et al*, 2008; 2012), in the LMEs project framework (Sherman *et al*, 1996; Hennessey & Sutinen, 2005; Olsen *et al*, 2006), and the International Oceanographic Commission's set of environmental indicators (UNESCO, 2006). The latter, were explicitly considered in designing the core spatial planning studies of the region for its ecological, social-economic and governance dimensions.

THE MARINE SPATIAL PLANNING STRATEGY 2013-2018

In Mexico, several marine spatial planning exercises started as such 25 years ago, but it was not until 2006 that the Gulf of California LME was actually formulated and decreed formally. The experience gathered from this process supported the devising of a National Strategy for the Spatial Planning of Oceans and Coasts a year later (Semarnat, 2007), which as well encouraged further efforts to spatially plan all marine areas of the country. The decree of the Gulf of Mexico LME process in 2012 and the significant progress on the Pacific coast, are examples of these efforts.

In the near future, once these latter processes are decreed, those from the Gulf of California, the Gulf of Mexico and the Caribbean Sea LMEs should be fully implemented for execution, and should be continuously assessed through monitoring system of performance, effectiveness and accomplishment indicators.

Another strategic planning protocol deals with devising guidelines and provisions for the attention of critical coastal ecosystems such as mangroves, coastal lagoons, dunes, and marine grasses and reefs, in order to control both natural and anthropogenic stressors to their

resilience. In addition, this approach also considers the explicit implementation and linking with the National Policy of Coasts and Oceans, as approved by the Inter-ministerial Commission for the Sustainable Management of Oceans and Coasts (CIMARES, 2008-12; Figure 5).

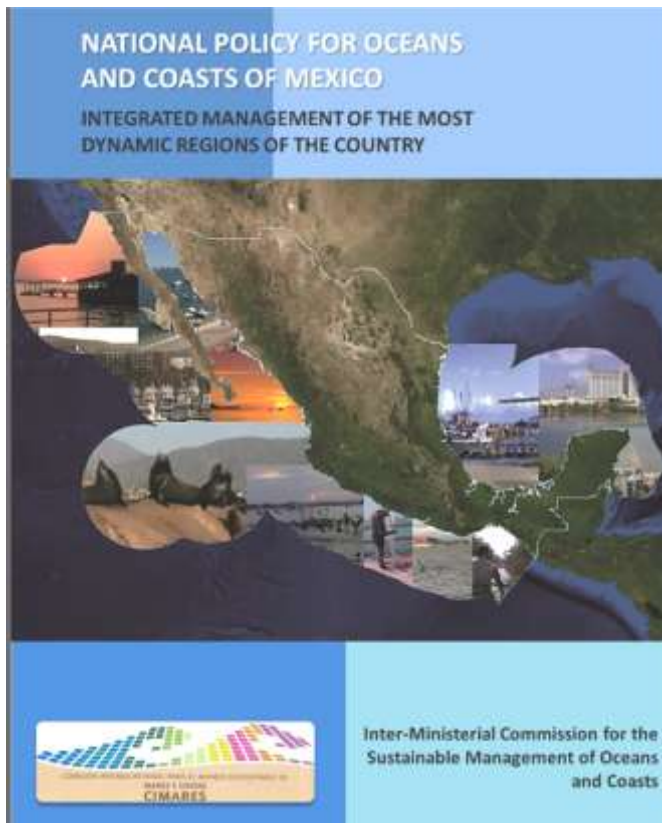


Figure 5. National Policy for Oceans and Coasts of Mexico (Approved by the Inter-Ministerial Commission for the Sustainable Management of Oceans and Coasts in 2012).

A major encouragement to formulate and implement LME projects comes from those projects of which Mexico is a part, such as the Pacific Central American Coastal LME, and the California Current LME, along with the Gulf of Mexico LME and the Gulf of California LME. In order to strengthen these planning and management processes, approaches such as application of the Ocean Health Index and Integrated Coastal Zone Management assessment and management practices will be encouraged, in addition to the continued inclusion of ecological, social, economic and governance indicators for monitoring and assessment. With an integrated perspective, so as to complement other policy instruments, work to decree more natural protected areas and partnerships with near-by countries are also considered, along with the strengthening of LME practices in transboundary areas in order to reduce pollution and other terrestrial impacts. Further efforts include the creation of shelter-from-fishing zones, and the formulation and implementation of Memos of Understanding (MoUs) as for example with U.S. EPA and NOAA (Figure 6).

As enforced by law, government verdicts of environmental impact assessments for federal public works and facilities now consider spatial planning processes' provisions, such as those for fishery and tourism-related sectors of the Gulf of California LME and the Gulf of Mexico LME, notwithstanding the differences of scale in most projects. Indeed, for such local-scale projects, regional planning provisions are mostly applied as guidelines instead of regulations, and the precautionary principle is always considered when relevant information is lacking or insufficient, to prevent further ecosystem degradation.



Figure 6. Examples of international efforts for LMEs, marine planning and ocean policy.

These issues of scale certainly demand that future spatial planning processes are deployed at higher resolutions to include as many pertinent spatial areas as required.

LESSONS LEARNED AND GOOD PRACTICES

Governmental involvement, coordination and public participation, are major features of current planning processes and are considered “good practices”, as derived from seminal experiences. Indeed, the Gulf of California LME planning process had a strong scientific prominence over management, which resulted in a generalized rejection from the several stakeholders who were not involved in the process from the outset. The new legal mandates published in 2003, offered a new vision which vastly improved the different scenario models along with the management of the involved sectoral interactions, allowing the formal participation of governmental constituencies and the effective involvement of stakeholders as early as during the characterization phase of the process. The opening of discussion opportunities, such as the Committee and the public consultations, paved the way for addressing conflict-resolution through discussion of long-term visions at the stakeholders’ meetings. New challenges also appeared, such as devising effective mechanisms for discussion, which eased differences among participating actors through open and candid debate that in the end resulted in a marine spatial planning instrument that was decreed by the government for the first time ever in Mexico.

The MSP instrument has actually allowed for increases in the comprehensiveness of environmental public policies given its explicit linkages with environmental impact assessments, land, ocean and coastal use-change authorizations, and the design of natural protected areas. In addition, it has found a place in the decision making process of major stakeholders such as PEMEX—the Mexican oil company—not only from its regulatory character, but for its planning

competence in designing energy-related projects in a more sustainable way. Moreover, the spatial planning approach has been adopted by several other agencies and constituencies to develop their own scenario models, such as those of the mining industry.

Within this transversal/intersectoral approach, the work of the Inter-Ministerial Commission for the Sustainable Management of Oceans and Coasts (CIMARES) is probably the best example of how effective these discussion opportunities have proven to be. The President established this Commission in 2008 with the purpose of coordinating several multisectoral efforts of the public administration aimed at putting together and implementing national policies related to the oceans and coasts through the spatial planning and sustainable development processes. The structure and accomplishments of the Commission after 5 years of uninterrupted work, are summarized in Table 3.

Table 3. Activities of the Mexican Inter-Ministerial Commission for the Sustainable Management of Oceans and Coast

CREATION	INTER-MINISTERIAL SESSIONS	AGREEMENTS	WORKING GROUPS/WG MEETINGS	CROSSCUTTING PRIORITY SUBJECTS
13 June 2008	8 Meetings (in 4 years)	More than 50	7/60	20

Integrated methodologies – Diagnostics and scenarios

As a technique, the spatial planning process has been vastly improved by the conceptual developments of the *alternative scenario models*, which now include the notion of *sectoral conflicts*, where sectoral interests are identified from the *environmental attributes* of the resources and spaces they use. Multi-criteria and multi-purpose models have been also included in the analyses of these conflicts using *utility functions* with biogeophysical, social and economic variables, and their results are assessed using optimization algorithms for the selection of the best land, coastal and sea-use options.

The spatial planning process has become more comprehensive by including diagnostics and scenarios on several seemingly unrelated environmental issues such as conservation, degradation, desertification, or ecosystem pollution and biodiversity. The maintenance of ecological processes providing environmental services, and the operational linkages with other planning instruments for natural protected areas and critical habitats aimed at protecting terrestrial wildlife, and refuge zones for aquatic species, have also contributed to the aforementioned all-inclusive nature of the spatial planning approach.

Other issues adding to this far-reaching scope include: the importance of natural resources for the development of sectoral activities, the susceptibility of certain spaces and activities to natural risks or the negative effects of climate change, the integrated management of coastal

zones and watersheds, increasing population trends and their concomitant demand for urban infrastructure, equipage and services, and the consideration of causes and effects of cumulative environmental impacts –in space and time.

Transparency, public information, accountability, adaptation and monitoring

Process transparency, openness to the public, and accountability, has been crucial to marine spatial planning development, and the *binnacle log* its major tool. Active participation of stakeholders and the society by and large, is logged and can be accessed by just about anyone interested in how the meetings developed, how sectoral representatives performed, what the Committee decisions were, which events were broadcasted or which public consultations called, among many other issues including actual geographical information resulting from the technical studies.

The adaptive character of the MSP instrument has also been important and has been developed from close monitoring of the process and, in some cases, the actual modification of planning proposals to meet new present conditions. Indeed, in contrast to the terrestrial domain, where 15 percent of the spatial planning experiences has been modified in some way, none of the afore-mentioned marine exercises has been modified.

The legal certainty of the instrument has been granted by its explicit reference in the comprehensive environmental law –the General Law of Ecological Equilibrium and Protection to the Environment (LGEEPA by its acronym in Spanish), and its specific provisions on the matter—where the clarity of the technical and managerial procedures is strongly enforced. From its programmatic nature, the MSP instrument by itself encouraged the Presidential Act, during the last administration (2006-2012), by its application in creating and implementing a National Strategy for the Ecological Planning of the Territory in Oceans and Coasts.

The Work Ahead and Room for Improvement

Outstanding progress has been made on public participation, transparency, accountability, adaptation and technical thoroughness, but there is still room for:

- ✓ Process development and marine models at higher resolution on a wide scale,
- ✓ Improving analytic approaches on sea-level rise scenarios and changes in ocean dynamics deriving from current global warming projections, including but not limited to issues on vulnerability and risk, adaptation, and the integrated management of coastal zones and watersheds,
- ✓ Developing cost/benefit assessments of proposed strategies and programs in order to ensure their effectiveness and accomplishments,
- ✓ Developing the monitoring component of the actual binnacle log for homogeneity and consistency, and as a definite tool for the assessment of objectives accomplished, goals reached and strategy effectiveness, aside of its current service for transparency and event registry,
- ✓ Improving the comprehensiveness of the several planning and policy instruments –e.g., for wildlife management, sustainable forestry, natural protected areas design and other sectors—by considering the spatial planning approach its core foundation. From this perspective, most government subsidies that are currently applied in response to certain stakeholders' benefit, instead of making actual investments based on planned priorities, would be avoided.
- ✓ Improving the inter-sectoral/transversal advantage of planning instruments in order to avoid the insidious effects of current restraining sectoral policies. In fact, by

unambiguously linking spatial planning processes to other planning instruments –for instance those developed in the tourism industry, urban infrastructure, or fishery management plans— the whole territorial planning practice would actually provide for the expected societal benefits of every public expenditure deemed sustainable,

- ✓ Creating automated systems for analyzing and visualizing scenarios, in near-real time, for the several projected impacts of economic activities on a certain zone or region, and for the assessment of concurrent strategic options intended to ease the use of areas and resources by competing stakeholders over coasts and seas,
- ✓ Devising executive schemes for marine spatial planning processes, by using economic, fiscal or technologic instruments which would allow for the accomplishment of any given program objectives, and
- ✓ Ensuring the execution of devised strategies resulting from any given planning process by issuing agreements among stakeholders and by their consideration within pertaining sectoral programs of the several participant institutions.
- ✓ Looking after and incorporating the Mexican experience in current and future LME projects overlapping Mexico's EEZ, particularly on its social, economic and governance dimensions.

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It is inevitable that the 7,120,055,900 people who inhabit the planet as of October 2013 will leave their mark.

It is still possible to make individual and collective choices that will result in restoring and sustainably developing the ocean's full potential for present and future generations.



*Empowered lives.
Resilient nations.*

