Asia-Pacific Economic Cooperation

Workshop IV Report on Large Marine Ecosystems

Ansan, Korea
August 12-13, 2013

Table of Contents

APEC LME Workshop Report
Korea, August 12-13, 2013

Background and Objectives

The fourth APEC Workshop on Marine Ecosystem Assessment and Management was held by the Ansan, Korea on 12-13 August 2013. The three previous workshops were held in Qingdao (2007), and Seoul (2009 and 2012) (see Annex 1 for workshop agenda). The workshop participants represented 13 countries from the Asia Pacific Economic Cooperation (APEC) Region, including Korea, China, Indonesia, Malaysia, Philippines, Peru, Mexico, Chile, Sri Lanka, Vietnam, Thailand, the USA and Canada (see Annex 2 for list of participants).

The 27 Large Marine Ecosystems of the APEC Region make a major contribution in marine ecosystem goods and services to the APEC economy. Large Marine Ecosystems (LMEs) are regions of ocean space encompassing coastal areas from river basins and estuaries to the seaward boundaries of continental shelves and the outer margins of major current systems. LMEs are designated based on unique ecological criteria including bathymetry, hydrography, productivity and trophic linkages. The LME assessment and management approach is based on five modules focused on ocean productivity, fish and fisheries, pollution and ecosystem health, socioeconomic conditions, and governance, for recovering and sustaining marine goods and services.

Healthy ecosystems sustain fisheries, maintain critical habitats, and provide a safe and adequate supply of seafood for domestic use and international trade. The LME approach focuses on ecosystem resources and services to advance and sustain economic benefits for APEC countries.

The workshop objectives were to:

i. Report on the status and baseline assessment of the APEC Region's Large Marine Ecosystems in relation to climate change,
ii. Review best practices of ecosystem assessment and management in the APEC Region,
iii. Promote networking of APEC LMEs, and
iv. Identify the socioeconomic benefits of ecosystem-based management.

Welcome addresses

Mr. Hyung-Ki Nam, Director General of Marine Environment Policy Division, Marine Policy Office, the Ministry of Ocean and Fisheries (MOF), welcomed participants on behalf of MOF.

"Good morning Dr. Kenneth Sherman from NOAA, distinguished guests, ladies and gentlemen. My name is Hyung Ki Nam, Director General of Marine Environment Policy Division of the Ministry of Oceans and Fisheries in Korea. It is my great pleasure to welcome all the LME experts to this workshop. Additionally, I would like to welcome and thank the Vice President Mr. Hyun Jong Kim of KOEM, the Vice President Mr. Chan Hong Park of KIOST, and all the staff for their devoted dedication in organizing this workshop despite their busy schedules. It is a great honor for me to address the 2013 APEC LME workshop.

With the launch of the APEC LME workshop in 2009, this year is extremely memorable for the Republic of Korea considering the workshop's fourth phase coincides with the revival of MOF as an independent ministry managing both the ocean and fisheries sector.

The deterioration of the marine environment has raised numerous concerns in the world due to overfishing, increase in pollution, decrease in habitat, and the impacts of climate change. Consequently, this has resulted in changes of ecosystems, increased natural disasters, and decreased our fisheries productivity. Sustainable marine development has become a common goal at the national, regional, and

international levels. International society has strengthened collaborative efforts for the conservation of the marine environment through international cooperative programs.

During this year's APEC 2nd Oceans and Fisheries Working Group meeting held in Indonesia last June, member states acknowledged the importance of ecosystem-based management for the sustainable use of marine resources. In order to restore the marine resources and its environment, the Republic of Korea has contributed and supported various international cooperative programs and will continue to do so in the future. ROK is currently collaborating with China, UNDP, and GEF to launch the 2nd phase of the YSLME project. The ocean possesses great potential for growth. In order to achieve sustainable development through the ocean, we need to share various experience and knowledge, and enhance cooperation.

MOF will continue to be a front-runner for the conservation of the global marine environment through strengthening international cooperation within the APEC region in various marine related fields including the LME. I sincerely hope that the next two days will result in fruitful discussions and valuable information sharing on the assessment and management of LMEs within the APEC region. I would like to once again thank all the LME experts within the APEC region for taking your valuable time to visit the Republic of Korea in order to attend this workshop. Thank you very much."

Mr. Hyun Jong Kim, Vice President, Korea Marine Environment Management Corporation (KOEM) (Korea), next welcomed participants on behalf of KOEM.

"Director General Nam, Dr. Kenneth Sherman, Vice President Park, dear fellows, ladies and gentlemen. Good morning, my name is Hyun Jong Kim, Vice President of the Korea Marine Environment Management Corporation and it is an honor for me to welcome you all to this year's APEC LME Workshop. As a government affiliated public organization working with the Ministry of Oceans and Fisheries, KOEM is the only marine environment management agency in Korea that develops and implements a wide variety of projects including the conservation and management of marine ecosystems, climate change responses, water quality monitoring, and marine pollution reduction.

This is the first year for KOEM to participate in the APEC LME workshop as a co-organizer. On behalf of KOEM, I am pleased to attend this workshop and meet distinguished LME experts from the APEC region. I have heard that the APEC LME workshop has been providing an important venue for APEC economies since its initiation into 2009 to share experience and knowledge on the assessment and management of LMEs. With KOEM's specialty in the conservation and management of marine ecosystems, we would like to enhance cooperative relationships with APEC member countries and continue to support future holdings of the APEC LME workshop. Since 2012, KOEM has been involved with the Yellow Sea Large Marine Ecosystem project and we aim to assist in any way for the successful implementation of the 2nd phase of the project. Furthermore, we aspire to collaborate with other LME projects within the APEC region to identify mutual goals and benefits for our marine environment. The effective management of the 27 LMEs of the APEC region is essential for the sustainable development and conservation of our marine resources and environment. Additionally, LME management can serve as a framework for socioeconomic benefits to ensure economic development and food security, which are the key priorities of APEC. In order to accomplish the various goals set forth by all the experts and stakeholders present in this room, it is not only important to periodically share the lessons learned and best practices amongst our members through the continuation of the APEC LME workshop but also expand this program with non-APEC LMEs around the world. With a large number of participating experts today, I am sure that this workshop will be a memorable, highly educational, and valuable event. I hope that we can have fruitful discussions and draw meaningful insights for the sustainable use and management of our marine environment. Thank you very much for coming and for your attention."

Dr. Chan Hong Park, Vice President, Korea Institute of Ocean Science and Technology (KIOST) (Korea), welcomed participants to the workshop on behalf of KIOST.

"Welcome Mr. Hyung-Ki Nam, Director General of Marine Environment Policy under the Ministry of Oceans and Fisheries, Dr. Kenneth Sherman from NOAA of the United States, and distinguished participants! This is my honor and privilege to have this opportunity to give a welcoming remark at this APEC LME Workshop.

On behalf of the Korea Institute of Ocean Science and Technology (KIOST), I would like to extend special thanks for NOAA, APEC Secretariat, KOEM for organizing this workshop. Marine environments and living resources are a very important asset in the Asia-Pacific region, where many people live near to or earn their living from the sea, especially, accounting for 75% of the world's capture fisheries, over 90% of global aquaculture production. The Large Marine Ecosystem approach is an effective method for integrated management of marine and coastal resources in terms of fisheries, pollution, ecosystem health, socio-economic conditions and governance through cooperation among countries sharing the LME. KIOST has been actively participating in the implementation of Yellow Sea Large Marine Ecosystem (YSLME) projects, especially contributing to scientific and technical assessment and analysis of ocean productivity, pollution, and ecosystem health. KIOST also played a main role in establishing the National Strategic Action Plan (NSAP) based on the assessment of YSLME. This is the fourth time for KIOST to co-host this APEC LME Workshop with NOAA since 2009. KIOST with the Ministry of Oceans and Fisheries has been contributing to this workshop through our experts in sharing their experiences and ideas for future activities for effective assessment and management of the LME region. This workshop focuses on the importance of LME scientific indicators, bottlenecks, and opportunities to increase LME carrying capacities. We also need to discuss how to increase fishery yields and adapt to climate change in the APEC region. In addition, this workshop aims to build capacities to assist new APEC LME projects with securing grant funds from the Global Environment Facility (GEF) for expanding sustainable development activities to recover degraded goods and services of the LME region. I wish this APEC LME to be a model for other regions and a great successful meeting in Ansan. Once again, welcome all of you and thank you for your gracious participation!

Workshop summary

Dr. Kenneth Sherman, Director of NOAA's Large Marine Ecosystem Program, gave a presentation entitled *Overview on the LME Approach and Progress Update.* He discussed the LME project approach and potential for the APEC area for the next 10 years. He talked about the LME approach now entering into its 30th year of development and application in the coastal areas of the world. During the past two decades, marine managers and scientists have progressed from a sector-based approach to the ecosystem-based management approach with LMEs at the forefront of this positive change. The transition from sector-based to ecosystem-based management has advanced through the application of the five LME modules (productivity, fish and fisheries, pollution and ecosystem health, socioeconomics, and governance). Sherman indicated that the LME approach leads to increased socioeconomic benefits to countries participating in GEF-supported LME projects. This proposition is supported by the GEF and other UN agencies. Results are described in a recently completed volume in the published LME series. The Executive Summary of the book *Stress, Sustainability, and Development of Large Marine Ecosystems During Climate Change: Policy and Implementation Volume* can be downloaded from the LME website (www.lme.noaa.gov).

Sherman demonstrated that with the financial support of the GEF, intellectual support of ICES, and the pragmatic support of UNDP and other UN agencies, there is a rare opportunity to move ahead toward recovery and sustainability of LME goods and services. He highlighted the successes with implementation of the YSLME project by the People's Republic of China and the Republic of Korea. Sherman emphasized the importance of a growing number of international organizations and agencies moving forward in the same direction toward LME sustainable development.

Sherman drew attention to a new paper soon to be published: Carlisle *et al.* entitled *The large marine ecosystem approach: application of an integrated, modular strategy in projects supported by the Global Environmental Facility*. Prints will be available on request from the LME Program Office at the NOAA Fisheries Laboratory in Narragansett, Rhode Island.

Dr. Antonio Diaz de León Corral, Director General de Politica Ambiental e Integracion Regional y Sectorial, presented the *Pacific Central American Coastal LME: Socioeconomic Module for LME Assessment.* He explained that LME contributions in terms of goods and services annually to the global economy is approximately $12.6 trillion USD, which is an estimate from Costanza *et al*. (1997).

The socioeconomic module emphasizes the practical application of scientific findings to managing LMEs, and the explicit integration of social and economic indicators and analyses with other scientific assessments, to ensure that prospective management measures are cost-effective. Economists and policy analysts work closely with ecologists and other scientists to identify and evaluate management options that are scientifically based and economically practical with regard to sustaining optimal socioeconomic benefits of goods and services in LMEs.

The LME economic accounting paradigm requires that resource managers of the different sectors of stakeholder interests incorporate the cumulative assessments of changing ecosystem productivity, fish and fisheries, pollution and ecosystem health and their effects on socioeconomic conditions and governance jurisdictions, as both additive and integrative effects for improving ecosystem conditions. These latter components of the LME approach to marine resources management have been described as the human dimensions of LMEs (Hennessey and Sutinen 2005). A framework has been developed by the Department of Natural Resource Economics at the University of Rhode Island for monitoring and assessment of the human dimensions of LMEs and for incorporating socioeconomic considerations into an adaptive management approach for LMEs (Sutinen 2000; Juda and Hennessey 2001; Olsen *et al.* 2006). A method for indexing the relationships between marine activity and socioeconomic development has been developed by Hoagland and Jin (2008) of the Marine Policy Center of the Woods Hole Oceanographic Institution.

De León Corral listed indicators of socio-economic benefits including food provision, artisanal fishing opportunities, natural products, carbon storage, and coastal protection. These benefits represent the goals to achieve for integrated management of LMEs. Other benefits include coastal livelihoods and economies, tourism and recreation, sense of place, clean waters, and biodiversity. These latter benefits are not frequently evaluated. He reported the Ocean Health Index (OHI) as a score between 0 and 100 and indicates overall ocean health. Currently, the OHI score for the APEC region is between 40 and 70. The lower scores are the regions with strong problems such as in South America, Western Pacific, and South China Sea.The OHI score of Pacific Central American Coastal (PCAC) LME are between 40 and 60. Problems in Central America contribute to lowering the score, with the exception of the coastal region of Costa Rica, which is performing very well. The area considered here is over 2 million km^2, which is relatively large. Individual country ranks are available. For example, Mexico has a score of 55 compared to the average global score of 79. The PCAC LME has an average of 52.36, with a tendency towards decline. Assessing individual communities in the future can identify which indicators are failing. He indicated that other methods of performing socioeconomic assessments include socioeconomic indicators from the OHI Handbook. Large amounts of resources are needed to work with these indicators, including expertise in law, economics, and sociology. The Cumulative Impacts Model indicates the distribution of human impacts on marine ecosystems. This model is derived from Halpern *et al.* (2008), which is available to the public upon request.

Final remarks by de León Corral follows:

- Compared with the world scores, the current and future situation of the health of the PCAC is not as good as we expected.
- Some areas inside the region need more urgent actions than others in order to revert negative tendencies.

- Information is available (Halpern *et al.* 2008) to identify areas and trends at a regional scale.
- This approach is useful at first glance for a Rapid and Quick Appraisal Assessment
- Some adjustments of the indicators may be needed to improve them and to compare countries in a better fashion at the PCAC scale.

Mr. Yihang Jiang, YSLME Coordination Consultant, presented on *Governance Conditions in LME Assessments*. The governance study and regional synthesis of the YSLME reports include an analysis of the legal, institutional, and stakeholder conditions. Jiang referred to a report entitled *The Yellow Sea: Analysis of Environmental Status and Trends* (UNDP / GEF 2007). Copies are available from the YSLME website (http://iwlearn.net/iw-projects/790/reports/analysis-of-environmental-status-and-trends-for-yslme/@@view-simserver-related-items.html)

Jiang illustrated this with an aquaculture production example. Approximately 70% of global total of aquaculture production is derived from China and the YSLME. The economically important capture fishery species are on the decline. Jiang exemplified this with a comparison of the age structures of small yellow croaker collected during the spring and autumn surveys. Overall, the yellow croaker catch is dominated by very young fish less than 2 years old. The maximum age of yellow croaker can reach 23 years. Possible causes of this trend include overfishing which results in jellyfish blooms, and diatom shifts to dinoflagellates due to nutrient changes. Hot spots of nitrogen and phosphorus increases include areas near the estuary between the Chinese and North Korean border river, the Yalu River. Also, hypoxic conditions in the Yellow Sea estuary contribute to these nutrient changes. Jiang demonstrated that these nutrient changes cause sea star blooms during one year followed by macro algae and jelly fish blooms. Jiang stressed that action can be taken and the YSLME Strategic Action Program can be a good model to follow. He illustrated that reducing fishing efforts, meeting gaps with mariculture, and an integrated multi-trophic aquaculture management can help to alleviate over-fishing pressure and environmental impacts. Jiang described how regional geopolitical situations may affect mechanisms of cooperation. For example, the geopolitical conditions of the Yellow Sea are as follows:

- There is no peace agreement for the region since WW-II
- Different political systems in the coastal countries
- Different levels of economic development
- Different status in participating in the YSLME Project, and
- The language of Recent UN Security Council Resolutions 1718(2006) , 1874 (2009), 2087 (2013) and 2094 (2013) (resolutions available from: http://www.un.org/en/sc/documents/resolutions/index.shtml)

Existing mechanisms for cooperation are related to scales and working together within the global, Pacific, and East Asian regions. The management requirements for better governance are identified in the Regional SAP. Eleven different targets are as follows:

- 25-30% reduction in fishing effort
- Rebuilding of over-exploited fish stocks
- Improved mariculture techniques
- International contaminant requirements met
- Reduction in nutrient loading
- Reduction in marine litter
- Reduction in contamination of beaches
- Better prediction of ecosystem change
- Improved biodiversity status
- Maintenance of habitats
- Reduction in risk from introduced species

Effective cooperation can be provided through:

- Agreement seeking mechanisms based on the consensus rule. This would facilitate the YSLME Commission to adopt and implement necessary decisions considering the small number of participating countries as well as unique geopolitical and cultural background in Northeast Asia.
- Conflicts solving mechanisms should be based on cooperation. When any dispute arises between or among the participating governments, it must be solved based on the consultations and negotiations along with other peaceful means of conflict-solving including good offices and fact-finding.
- Sustainable financing mechanisms can be categorized into two forms:
    - Trust Fund
    - Other contributions

Additional considerations include:

- Legal and institutional arrangements are important, but stakeholders' participation is, at least, equally important
- "Governance" not only means "control", but also "working together"
- "Governance" in the Yellow Sea needs participation of all the coastal countries
- "Governance" needs not only talking and writing, but needs more in actions.

Dr. Kenneth Sherman presented the *Importance of Indicators of Primary Productivity in LME Assessments.* He explained the importance of chlorophyll and primary productivity data for estimating fisheries biomass yield from the point of view of all LME modules. He described the ecological criteria used to determine the areal extent of LMEs, which are bathymetry, hydrography, productivity, and trophodynamics.

Approximately 80% of the world's fisheries are produced in 64 LMEs. Highest levels of primary productivity supporting the fish stocks and other goods and services of the global oceans occurs in coastal LMEs where people are living and economies are operating. Sherman illustrated the *Then to Now* study by Jackson *et al*. in Science (2001). *Then to Now* refers to the human expansion causing over-fishing, pollution, habitat destruction, introductions of non-indigenous species, and climate change. There are no pristine LMEs left no matter which index is used. Ecosystems are under stress all over the world. LMEs are global centers of efforts to reduce coastal pollution, restore damaged habitats (coral reefs, mangroves, sea grasses), and recover depleted fishery stocks. There is promise of LME recovery and sustainability with respect to financial commitment from the GEF for countries with developing economies. The GEF is supporting projects from countries committed to introducing and practicing ecosystem-based assessment and management of LME goods and services.

Currently, 110 countries are implementing 17 international GEF-funded LME projects in Africa, Asia, Latin America, and Eastern Europe. They are supported with $3.1 billion in financial assistance in GEF grants, World Bank investment loans, and donor country contribution for application of ecosystem-based practices for the recovery and sustainability of marine resources. Sherman outlined the pathway for expanding GEF support in the APEC region for the Indonesian Sea, Sulu-Celebes Sea, and Pacific Central American Coastal LMEs.

Dr. Sinjae Yoo, Principal Research Scientist, KIOST, presented on *Decadal Changes in the Marine Ecosystems Adjacent to the Korean Peninsula*. Yoo reminded us of the macro-algae overgrowth that occurred in Qingdao, China in July 2008. The overgrowth first occurred in 2007 and reappeared in 2008. This is the largest macroalgae bloom noted in the world to date.

The regional characteristics of YSLME were noted by Yoo. YSLME has an average depth of 44 meters and extends to the East China Sea LME. At first glance, the YSLME has a high chlorophyll concentration at the coasts, however this is not all chlorophyll but includes suspended sediments. Yoo cautioned that without the correct algorithms, incorrect chlorophyll readings may occur. The stressors that

affect the Yellow Sea include warming, overfishing, nutrient enrichment, changes in nutrient balance, land reclamation, non-indigenous species, and the Three Gorges Dam. The stressors that affect the East Sea include warming, overfishing, and non-indigenous species. The YSLME has a high SST warming trend. A regime shift occurred in 1988 from cold to warm water. This shift is attributed to intensification of the air pressure system located in the equatorial Pacific. Also, a shift in water temperature occurred around the same time period in the East China Sea shelf, and Kuroshio Current. Concurrent with this shift, changes in the zooplankton biomass in the eastern Yellow Sea and northern East China Sea were observed. A study by Lin *et al.* (2005) evaluated time series analysis of nutrients in the western Yellow Sea. Of the changes reported in the past decades, nutrient ratio change in the basin is best documented. Nitrate had continuously increased in 1984-2000, while phosphates decreased after 1994 and silicates decreased after 1980. Overall effects were increase in N:P and N:Si. The basin-scale impact of the change in the nutrients ratio on the ecosystem is not clear yet. Compared with data from the Korean side, dissolved inorganic nitrogen increased by more than 250% while phosphate increase rates were not significant. These trends were consistent with earlier observations. The effects of these changes in nutrients are a rise in Harmful Algal Blooms (HABs). Since the 1980s, HABs have occurred more frequently in the Yellow Sea both in Chinese and Korean waters.

The Yellow Sea is usually considered the most productive sea in the North Pacific. However, there is evidence of overfishing. Catch data shows a trend of overfishing, and catches have decreased steadily in the Yellow Sea LME and East China Sea LME since 2000. Fish catch composition has also changed in both the Yellow Sea and East China Sea when data from 1997-2002 are compared with data from 2003-2008. In the Yellow Sea, anchovy catch changed from 15.5% to 21.6%, and common squid from 2.8% to 8.3%. In the East China Sea, anchovy catch changed from 25.4% to 28.9%, Spanish mackerel from 2.5% to 4.3%, and common squid from 13.2% to 11.1%. A study by Zhang *et al.* (2009) showed mean trophic level of the fisheries catch in the Yellow Sea increased during 2003-2008 due to increased catch of demersals and cephalopods. Mean trophic level of the fisheries catch in the East China Sea was similar in 1997-2002 and 2003-2008. Global trends of mean trophic level of fisheries landings decreased from 1950 to 1994 (Pauly *et al*. 1998). Recent blooms of giant jellyfish *Nemopilema nomurai* are concurrent with shifts in zooplankton biomass. In areas were jellyfish and squid do well, Pollack disappeared in the 1980s.

In summary, the most prominent pressures to Asian LMEs studied in the past decade were overfishing, eutrophication, climate change, land reclamation and disturbances in the freshwater budget. Signs of rapid changes include species shifts in fisheries, changes in plankton and benthos biomass, increasing outbreaks of HABs, jellyfish blooms and macroalgal blooms. A complicated network of pressures, anthropogenic as well as natural, is at work in these ecosystems with an anticipation of even more changes in the near future. These changes are expected to have a significant impact on the resource utilization of the Yellow Sea and East China Sea LMEs.

Dr. Villy Christensen, Professor at the University of British Columbia, presented on the *Concept of Carrying Capacity of LMEs for Fish, Fisheries, and Other Goods and Services*. Carrying capacity for a species is usually defined as the maximum population size that the environment can sustain in the long-term. However, from a management perspective this is not a very relevant measure as the surplus production for species at carrying capacity is negligent. Surplus production is the foundation for sustainable fisheries. To maximize surplus production a population must be reduced to the biomass that produces maximum sustainable yield (MSY). This level is of interest for management. It should be noted that while individual species in principle can be managed to obtain MSY, there are trade-offs between species because of trophic interactions, and these make it impossible to obtain MSY for all species in an ecosystem at the same time. LME-level MSY is always lower than the sum of the MSY by species. When discussing carrying capacity at the LME level we, however, often think about what can sustainably be extracted from LMEs, so in essence we tend to equate LME carrying capacity with the ecosystem-level MSY. Because of the trade-offs it is necessary to define what it is that is to be optimized with due

consideration for ecological, economic, and social factors. To do so calls for an ecosystem approach such as is the foundation for LME projects, and ecosystem modeling is a key tool for this.

At the same time it is clear that overfishing combined with climate change will add additional severe stress to the tropical and sub-tropical LMEs. It is important for LME projects to develop capacity for making projections about the future ocean conditions. Only with projections can we start to anticipate what mitigating measures may be required to adapt to climate change. For such projections, it is worth noting that ecosystem modeling has reached a stage where it can be used as a policy tool. Taking initiatives to make such projections is a crucial next step for LME projects. The group at UBC Fisheries is developing considerable capacity for making future projections for LMEs, and welcomes cooperation with APEC LMEs on joint initiatives.

Dr. Jae Ryoung Oh, Director, Library of Marine Samples, KIOST, presented on *Pollution and Ecosystem Health Conditions in LMEs*. He raised some questions to think about when considering sustainability of resource extraction and tourism in the seas. He questioned whether industrial and urban development is sustainable. Are coastal ecosystems heavily impacted by changes in catchment land use? Is climate change affecting coastal ecosystems? Are there relevant impacts of atmospheric deposition of chemicals? Which are the overall trends of coastal ecosystem health in LMEs? Coastal ecosystems are heavily impacted by changes in catchment land use. Impacts include physical alteration, sewage, nutrients, sediment mobilization, POPs, hydrocarbons, heavy metals, litter, and radionuclides. These impacts are all derived from land-based pollution sources.

The National Aquatic Resource Surveys (USA) published the National Coastal Condition Report last year (reports available from www.fws.gov). Key objectives of the survey were to answer the following questions: what is the extent of waters that support healthy ecosystems, recreation, and fish consumption? How widespread are the most significant water quality problems? Is water quality improving? Are we investing in restoration and protection wisely? The National Coastal Assessment was the first national survey using the EMAP survey design. Four national reports were produced since 2001. These National Coastal Condition Reports include statistical assessments of 100% of the nation's estuaries in the contiguous 48 states, Puerto Rico, and Hawaii. Great Lakes information are included but collected from State of the Lakes Ecosystem Conference indicators (see link for more information: http://www.epa.gov/owow/oceans/nccr/).

The report addresses key indicators of ecological health: water quality, coastal habitat loss, and fish tissue contaminants. Colour coding is applied to rank the overall condition of areas. Coastal management issues are identified: habitat degradation/loss, coastal development pressures and impacts, water quality degradation, wetland impairment or conversion to other uses, coastal hazards/catastrophic events, coastal erosion, fisheries decline, shellfish stock health, seafood/drinking water contamination, groundwater degradation, rare and protected species, and resource management and restoration.

Coastal pollutants are identified as: bacteria and viruses (pathogens), heavy metals especially in organic compounds, arsenic, cadmium, cobalt, copper, lead, mercury especially methyl mercury, manganese, selenium, zinc, uranium, industrial waste products such as PCBs (polychlorinated bipenyls), PAHs (polycyclic aromatic hydrocarbons), toxic organic compounds (herbicides, pesticides), nutrients (nitrates, phosphates), hot water discharge from power plants, alien species (e.g the European Green Crab and the aquatic weed *Carcinus maenas* on the US west coast), trash (plastic), and noise (e.g. noise disruption to marine mammals and other animals' communication and hearing abilities).

How can we approach Marine Ecosystem Health Assessment (MEHA)? Habitat characteristics to examine are water quality, unhealthy marine life, and sediment quality. These marine ecosystem components to consider are an example of Integrated Ecosystem Health Assessment. An integrated assessment involves looking at the biological response (plankton, sea grass, and benthos), chemical pressure (water quality, sediment quality, and tissue residual), and physical background (water circulation, and watersheds). Approaching MEHA requires selecting core problems and targeting relative

pollutants. Some examples include targeting eutrophication, hypoxia, and dead zones. MEHA involves designing a system for interconnection between assessment and management of marine ecosystems.

The *Marine Strategy Framework Directive* by the European Commission is the European Union's (EU) legal instrument for the protection of seas (EC 2008). The overall objective of the *Directive* is to achieve or maintain Good Environmental Status (GES) of the EU's marine waters by 2020. The *Directive* is committed to sustainability including ecosystem-based and integrated approach to the management of all human activities that have an impact on the marine environment. The *Directive* would like a regional approach to implementation and coherence between marine regions.

The definition of GES is "the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive" (MSFD, art. 3(5)). In addition, GES means that:

- Ensuring ecosystem services are used sustainably by present and future generations;
- Ecosystems are fully functioning and resilient to human-induced environmental change;
- The decline of biodiversity caused by human activities is prevented and biodiversity is protected;
- Human activities introducing substances and energy into the marine environment do not cause pollution effects.

Eleven qualitative descriptors for GES are as follows:

1. Biodiversity is maintained
2. Non-indigenous species do not adversely alter the ecosystem
3. The population of commercial fish species is healthy
4. Elements of food webs ensure long term abundance and reproduction
5. Eutrophication is minimised
6. The sea floor integrity ensures functioning of the ecosystem
7. Permanent alteration of hydrographical conditions does not adversely affect the ecosystem
8. Concentrations of contaminants give no effects
9. Contaminants in seafood are below safe levels
10. Marine litter does not cause harm
11. Introduction of energy (including underwater noise) does not adversely affect the ecosystem

Oh discussed trends in pollution of coastal ecosystems: retrospective ecosystem assessment and sediments as environmental archives. Assessment of environmental parameters fall in two categories: anthropogenic impacts and natural records. Anthropogenic impacts include metals, organic pollutants (PCBs, PAHs), radionuclides, soot, and sediments. Natural records include pollen and diatoms. If the age of sediments can be measured, then the history of contamination can be demonstrated since they show near identical profiles.

Oh described details of the NOAA mussel watch program, which has been operational in the USA for 26 years. The program supports ecosystem-based management through integrated nationwide programs of environmental monitoring, assessment and research to describe the current status and changes in the environmental condition of the Nation's estuarine and coastal waters. Mussels, oysters, and zebra mussels are collected at 300 sites nationwide, and half of the sites are monitored annually. Approximately 150 contaminants are routinely analyzed in mussels, oysters, and sediments. Mussels and oysters are collected in winter, with the exception of the Great Lakes and sediments are monitored periodically at 10-year intervals. Mussel watch species include:

- Blue mussel (*Mytilus edulis*)
    - Maine to Cape May (NJ)
- American oyster (*Crassostrea virginica*)
    - Delaware south and throughout the Gulf of Mexico
- *Mytilus* species and *Mytilus californianus*

    - West Coast
- Oyster (*Ostrea sandvicensis*)
    - Hawaii
- Smooth-edge jewel box (*Chama sinuosa*)
    - Florida Keys
- Mangrove oyster (*C. rhizophorae*)
    - Puerto Rico
- Zebra mussel (*Dreissena polymorpha, D. bugensis*)
    - Great Lakes

Mussel Watch analyses started as subset of an EPA priority contaminants list. Other contaminants are added (e.g. butyltins, radionuclides, and contemporary pesticides) as needed or recommended. Thus far, the program has established a long-term contaminant database suitable for assessing temporal trends. The program has also conducted regional assessments of contamination. This baseline data is used to evaluate the impacts of oil spills and other adverse events. In comparison, the Korean Mussel Watch operated from 1997-2001. This project is now ongoing with KEOM. The program found spatial distribution of organic carbon levels and temporal changes of PCBs, DDTs, HCHs, and CHLs in bivalves. Cumulative probability of organic carbon concentration is high in bivalves and surface sediments from the coast of Korea.

Oh discussed the Analytical Quality Control Services (AQCS) of IAEA. Samples (sediment or biota) are sent to participants from UNEP's Regional Seas Programs and they are distributed periodically free of charge. Results are reported to MESL and evaluated statistically. Results of an inter-laboratory comparison are as follows:

- Inter-laboratory comparison exercises offer analysts the possibility to:
    - Test analytical methods
    - Control laboratory performance
    - Assess accuracy of results

The inter-comparison exercise involved 245 laboratories worldwide who participated in IAEA-142. 84 labs provided organochlorine data, for which:

- 25% of the results were outliers
- 50% fell outside the range of acceptable precision
- Only 11 identified the POPs

Oh concluded by proposing an "***APEC LMEs Mussel Watch Program (Bivalves and Sediments)"***. This would be easier to analyze than water samples, capabilities can be assessed, and quality guaranteed. Pollution makers and trends can be compared for APEC countries.

Mr. Rodolfo Serra, Principal Scientist, Instituto de Formento Pesquero, presented *Towards Ecosystem Management of the Humboldt Current Large Marine Ecosystem a Bi-Lateral Project by Chile and Peru*. The Humboldt Current LME (HCLME) extends along the west coast of Chile and Peru, off western South America. It encompasses a complex mosaic of currents that support some of the most productive fisheries on earth and houses biodiversity (BD) of global importance. It is characterized by strong upwellings that have high productivity; the relatively short food chain enables massive energy transfer to higher trophic levels. There is large environmental variability been El Niño and La Niña phenomena as well as interdecadal variability. In addition, climate change is a source of variability. Pelagic fisheries catches by Peru and Chile account for 16% to 20% of the global fish catch (1950-2006). Other important fisheries resources include hake, swordfish, shark, and giant squid as well as a great variety of molluscs, crustaceans, echinoderms and algae. Five species of pelagic schooling and demersal fish dominate this LME: Peruvian anchovy (*Engraulis ringens*), Chilean sardine (*Sardinops sagax*),

Chilean jack mackerel (*Trachurus murphyi*), mackerel (*Scomber japonicus*) and hake (*Merluccius gayi*). Some of the fisheries resources are shared between Chile and Peru. Total annual fish catch for these countries combined averages over 10 million MT annually with a record of 19.4 million MT in 1994.

The goal of the bi-lateral project is to advance towards a sustainable and resilient HCLME that can maintain biological integrity, diversity and ecosystem services for current and future generations despite changing climatic and social pressures. The project's objective is to adopt ecosystem-based management in the HCLME through a coordinated framework that provides for improved governance and the sustainable use of living marine resources and services. Four outcomes are expected in order to achieve this objective:

- Planning and policy instruments.
- Institutional capacities strengthened for SAP implementation and for up-scaling the results of pilot interventions to the systems level
- Implementation of priority MPA and fisheries management tools provides knowledge of options for enhanced protection of HCLME and SAP implementation.
- Implementation of pilot MPAs underpins ecosystem conservation and resilience.

There has been progress in strengthening capacity through training courses in the ecosystem management approach, Transboundary Diagnostic Analysis and Strategic Action Planning (GEF IW-Learn Manual), and Ecological Risk Assessment. In addition, fisheries certifications are a tool to strengthen capacity as a market mechanism. An awareness program on EBM for decision-makers, sectors, and resource-user groups include items such as workshops and scientific meetings in Chile. These meetings occur on a yearly basis with scientists that present their results and communicate on the ecosystem approach. The progress results of the first outcome (planning and policy instruments) are as follows:

- Five thematic modules were completed: (i) productivity, (ii) fish and fisheries, (iii) pollution and ecosystem health, (iv) socio-economics, and (v) governance;
- Environmental problems identified and Causal Chain Analysis done;
- TDA to be completed at the National level and at the Regional scale.

The progress results of the second outcome (institutional capacity building and tools) are as follows:

- MSC Certification process and pre-assessment for Paracas (Peru).
- Promotion of human consumption of anchovy.
- Some candidates (pre-assessment) for MSC certification include: shrimp and squad lobster Coquimbo (Chile), and rock lobster of Juan Fernandez Island

The progress results of the third and fourth outcomes (priority and in situ interventions) are as follows:

- Legislation developed for vulnerable marine ecosystem areas in Chile (New Fishing Law 20,657)
- In situ interventions
- Reserva Nacional Sistema de Islas, Islotes y Puntas Guaneras (RNSIIPG): process to produce a "development" in 33 locations by mean of 14 associations, 18 local fisheries, and the design of a Master Plan (Peru).
- Juan Fernandez Island: proposal for a MPA of multiple use (Chile).
- Marine Canyon Working Group established (Chile).
- RNSIIPG: Peruvian Guano Islands, Isles and Capes National Reserve.

Serra highlighted the assessment and management progress to date in Chile:

- Environmental problems identified and working towards a diagnosis

- Present state of main fish stocks
    - Of 33 main fisheries: 15 are fully exploited, 10 overexploited and 3 depleted
- New Fishing Law: ecosystem approach in fisheries management is an objective.
    - Lessons learned: shift from mono-specific to ecosystem management.
    - Marine vulnerable subsystems
- New Fishing Law requests for management plans and rebuilding objectives/strategy for overexploited stocks.
    - Scientific Committees: provide advice
    - Strengthening of the Fisheries Institute and enforcement is recognized
- Holistic or inter-sectorial interaction is still weak

Mr. Santiago de la Puente, Investigator, Centro para la Sostenibilidad Ambiental, presented *GEF-UNDP Project: Towards Ecosystem-Based Management of the Humboldt Current Large Marine Ecosystem - A Brief Update on Peruvian Activities.* He discussed that although Peru and Chile share the same language and have similar cultures; their governments have a difficult time reaching agreements on many issues. One of the issues is a boundary conflict, which has made it challenging to deal with transboundary stocks.

The main objective of the GEF-PNUD HCLME Project is to achieve ecosystem-based management in the HCLME advanced through a coordinated framework that provides for improved governance and the sustainable use of living marine resources and services. The first strategy applied to achieve this objective is informed planning:

- Concluded activities:
    - Development of 5 thematic reports for Peru (Dec. 2012 to Jul. 2013)
    - Causal Chain Analysis Workshop (May 2013)
- Pending activities (Aug. 2013 to Aug. 2014):
    - Development of an Ecosystem Diagnostic Analysis
    - Development of the Transboundary Diagnostic Analysis
    - Development of the Strategic Action Plan

The problems/impacts and immediate and underlying/root causes of each component were discussed: productivity, fish and fisheries, pollution and ecosystem health, socioeconomic aspects, and governance. It was noted that consultants developed these reports and stakeholders were able to review and comment. The sectors that were the least represented were those involved with land-based pollution. For example, the Ministry of Mining and the Ministry of Urban development were not represented. A key underlying issue is that decision-makers are making decisions without all the information. There is a lag between current problems and development of spatial planning and management.

The second strategy used to achieve the objective of EBM is institutional capacity building and tools:

- Training courses for key stakeholders:
    - Introduction to EBM (Jan. 2012)
    - IW:LEARN / TDA-SAP Methodology (Sep. 2012)
    - Importance of EBM and MPAs (Mar. to Aug. 2013). Three-day workshops were held for fisheries managers and regional developers where they were introduced to EBM.
- Concluded Marine Sustainability Council pre-assessment for anchovy caught by the artisanal fleet and directed for human consumption in Paracas. The focus is on small-scale fleets. Seven vessels from one company participated, but there is no information yet on the ecosystem effects of the fishery. The GEF project is assisting companies to identify these baselines and protocols for operators.

The third strategy used to achieve the objective of EBM is implementation of priority interventions:

- Ecological Risk Assessments on the 3 pilot sites (Oct. to Nov. 2012). This has been a collaborative effort with fishermen.
- Advances in the development of the Master plan for the RNSIIPG (March to August 2013)

A law was passed to set up a National Protected Area system. Some of the islands within the system have a significant amount of guano from sea birds. This guano is used as fertilizer. Thus, the Protected Area encompasses safe havens for biodiversity throughout the coast.

The fourth strategy used to achieve the objective of EBM is in situ interventions:

- The Sustainable Guano Harvest Campaign in Punta San Juan (Aug. to Oct. 2012)
- The joint enforcement activities in Lobos de Tierra Island (February to May 2013). This involves onsite enforcement with judges and prosecutors present.
- The repopulation of macroalgae in Pisco (Oct. 2013 to Oct. 2014)

Other important activities in the Peruvian part of the HCLME include:

- Development of a EwE model with a coupled value chain for Peru.
- Research activities in the RNSIIPG on mapping marine spatial use of top predators (pilot sites). For example, one project assesses how MPAs help protect fur seals, penguins, and other animals.

Dr. Siew Moi Phang, Director, Institute of Ocean and Earth Sciences, **Dr. Norasma Dacho**, National Coordinator, UNDP GEF SCS LME, and **Dr. Connie Fay Komilus**, Senior Lecturer, presented on *LME Research and Assessments in Malaysian Waters: Bay of Bengal, South China Sea, and Sulu-Celebes LMEs*. The Bay of Bengal, South China Sea and the Sulu Celebes Sea LMEs border Malaysia. In Malaysia, management of the marine environment is under several agencies, with research and development being coordinated by the National Oceanography Directorate. The Fisheries Department conducts resource assessments, while the marine environment is managed by the Marine Parks Department and the Department of Environment. Research is carried out at research centers in universities.

The five indicators of ecosystem health and sustainability used in LME assessments namely productivity, fish and fisheries, pollution and ecosystem health, socioeconomics and governance, have been included in the on-going initiatives. The BOBP LME program has identified overexploitation of living aquatic resources, critical habitat degradation (mangroves, coral reefs, and sea grass) and land-based sources of pollution as main issues.

The South China Sea LME program lists coastal wetlands and fish habitats as additional critical habitats. The Malaysian government has pledged to increase the marine protected areas from 0.77% to 10%. Mangroves cover 2% of total land area, with 60% of the mangroves located in Sabah, 23% in Sarawak and 17% in Peninsular Malaysia. Despite having more than 100 mangrove reserves, 22% of mangroves have been lost in recent years. One major reason is sea level rise, where a 3.45 mm rise per year has been recorded for Sandakan, Sabah. The loss of 20% of mangroves may be translated to a loss of about 70,000 tons of prawn production valued at about $100 million USD.

Coral bleaching events are on the rise, with massive bleaching occurring in reefs of the islands. Five years of monitoring of the coral reefs in Malaysia by ReefCheck Malaysia has provided a list of indicator species, including grouper, parrot fish, giant clam, and the sea cucumber. Issues faced by the islands were identified as inadequate sewage treatment systems, ineffective solid waste management, tourism (e.g. divers and snorkelers) and land development activities.

Coastal and deep-sea fisheries contribute 26% of total fish production in Malaysia. Fish landing statistics show a small reduction in landings in 2011. In the Malacca Straits, there was an increase in shore landings but a decrease in deep-sea landings for 2009 to 2011. The opposite was observed for both

the South China Sea and the Sulu Celebes Sea. Of 966 fish species evaluated, 16% were ranked as highly threatened, 13% as moderately and 42% as least threatened. Threatened species included the Largetooth sawfish, Longcomb sawfish, Pondicherry shark, Mottle eagle ray and Indian Humphead. Main threats were habitat degradation (76%) and over-harvesting (27.1%). Turtles and dugongs are highly endangered with main threats being illegal poaching, incidental catch, blast fishing, habitat loss, pollution, and harmful tourism practices.

The Ministry of Agriculture and Agroindustries have identified the seaweed industry as one of three priority areas for development. The mariculture of the carrageenophyte *Kappaphycus* is the focus of efforts in Sabah and will be an important contribution to enhancing the livelihood of the coastal and maritime communities of the Sulu Celebes Sea region and the Coral Triangle. Potential impacts of the expanding seaweed mariculture may be an important issue to consider for the LMEs. There have been marine scientific expeditions conducted by the NOD, and the universities, in addition to the fisheries resources survey by the Department of Fisheries. The expeditions have contributed much needed resource and marine environmental data for management of the LMEs. Much of the data are stored in the MyNODC, the database of the National Oceanography Directorate. The University of Malaya's Bachok Marine Research Station serves as the gateway to South China Sea research activities. As part of the Coral Triangle Initiative (CTI), two major projects have been established in Malaysian waters of the Sulu Celebes Sea LME, which are the Sulu Sulawesi Marine Ecoregion (SSME) program and the Tun Mustafa Marine Park.

In conclusion, there is still a need to complete the inventory of marine bioresources, understand seasonal variations in productivity and responses to climate change and other emerging threats, establish a framework of policies, regulations, and laws to facilitate conservation, minimize threats to marine ecosystems, and use these results for science-guided policy decision-making.

Mr. Dhana Yingcharoen, Department of Marine and Coastal Resources, and **Ms. Praulai Nootmorn**, Director, Marine Fisheries Research and Technological Development Institute, presented on *LME Research and Assessments in Thailand waters: Bay of Bengal and Gulf of Thailand LMEs*. The Bay of Bengal Large Marine Ecosystem (BOBLME) Project includes Bangladesh, India, Indonesia, Malaysia, Maldives, Myanmar, Sri Lanka and Thailand. The project aims to improve the lives of the coastal populations through better regional management of the Bay of Bengal environment and its fisheries. Over a five-year period, the first of two phases of the Project are focused on gaining a better understanding of major marine resources. This involves identifying the critical issues and the underlying causes contributing to the decline in the ecosystem health of the Bay of Bengal. With that knowledge, strengthening and harmonizing management capabilities will be initiated in each participating country in preparation for the second phase of the project. The main activities are emphasis on healthy ecosystems and fisheries management, full stakeholder involvement and diagnosis of stakeholders to develop a joint Strategic Action Program, and a road map for addressing priority issues identified by the member countries.

The Master Plan of Marine Fisheries Management of Thailand, DOF, has taken the heavy responsibility for ensuring that healthy fish stocks are available. The Department has been well aware that resources are depleted because of fishing fleet overcapacity, difficulties faced by the intricateness of distant fishing arrangements, aggravating and widespread conflicts among these fishery resource users, and severe competition in the world market. In order to tackle each of these problems, a series of consultative meetings were held with the various stakeholders. It was agreed that a Marine Fisheries Management Master Plan should be used as a key instrument in the consultation/negotiation among all fishery stakeholders as a common vision, goals, and objectives for marine fisheries management. The Master Plan will be used to guide all concerned agencies and stakeholders and to share the responsibilities and roles as agreed. This Master Plan will serve as the key guideline for problem-solving and strengthening of the marine fisheries sector. For the sub-sector's integrity, the vision crafted for the

Master Plan highlights the concept of 'sustainable fisheries development based on the sufficiency economy that places the people at the center'.

The Master Plan was to be commissioned for a period of 10 years beginning 2009. Its three immediate objectives are: 1) the sustainable and stable marine fisheries shall continue to generate 1.7-2.0 million tons of quality fish catch comprising at least 80% of high value fish from the EEZ, and 1.0-1.5 million tons from the distant waters; 2) at least one fishermen organization in each province is established to take the responsibilities for the management and networking with the neighboring provinces; 3) at least 10 coastal communities take the initiative to manage their fishing and fishery resources with active community participation under the concept of co-management. The contributions to this Master Plan of various working committees, anglers' associations, academes, and other stakeholders are highly appreciated.

Ms. Ngueyn Thi Trang Nhung, Deputy Director, Department of Science, Technology, and International Cooperation, presented on *Lessons Learned from GEF South China Sea Project and MPA Network Establishment in Vietnam*. With the support from international communities and great efforts from the Vietnamese Government, the Marine Protected Area Network has been established. Also, the Fish Refugia network has been developed in Vietnam. The presentation showed the obstacles to developing an MPA network. The social, economic and biological indicators of the fisheries objective showed that anglers' income was limited 4 years after the MPA was established. The approach of MPA establishment in Vietnam lacks the notion of biological conservation and sustainable use in marine fisheries. This leads to an inability to meet optimum levels of biodiversity conservation or long-term economic effectiveness.

Nhung discussed the result from the GEF South China project. The project applied the Fisheries Refugia Concept to develop an innovative approach to integrate fisheries and habitat management for the benefit of regional fish stocks and biodiversity. The project proposed a framework for a regional system of fisheries refugia in the South China Sea and Gulf of Thailand. Nhung raised some discussion issues such as the need of integrating fisheries management into biodiversity conservation. The Fisheries Refugia Concept is one approach for integrating fisheries with MPAs but the management scheme may be difficult. Even though Vietnam has been involved with creating MPA reserves for 4 years, there is a high likelihood that the pressure on marine and coastal resources will continue. For example, the monthly income of fishers is around the poverty threshold for rural communities. Other possible impediments to integrating MPAs and fisheries include the following issues:

- The approach to marine biodiversity conservation has tended to be opportunistic and independent rather that strategic and coordinated.
- There has been notable progress in developing a MPA Network plan and establishing a few individual MPAs, but there has been little attention paid to their application in biodiversity conservation or sustainable fisheries management. This has resulted in the inability to meet the optimum levels of biodiversity conservation or long-term economic effectiveness.
- The lack of mainstreaming biological conservation and sustainable use in marine fisheries will only lead to a continued degradation of biological diversity and unsustainable use of marine and coastal resources.

Mr Romeo Trono, Regional Project Manager, presented *Assessment and Management of the Sulu-Sulawesi Marine Ecoregion (SSME)*. Trono provided an overview of the SSME:

- Covers about 1 million km^2 in area. The SSME boundaries expand into watershed areas as a result of consultations among the three countries during the TDA. This recognizes the importance of watershed and land-sea impacts in the LME TDA process.
- The SSME is located within the global center of tropical marine diversity, supporting the highest number of species of coral reef fish, demersal fish, turtles, and algae (DeVantier *et al.* 2004).

- The mangrove forests, seagrass beds, coral reefs, and coastal and offshore waters are richest in number of species in the tropics.
- The bounty of these seas provides food and livelihood to about 40 million people living along the coastline of the ecoregion.

Trono provided the following background information:

- In 2001, Indonesia, Malaysia, and the Philippines formed a common 50-year vision for biodiversity and sustainable productivity in the South China Sea LME (SCSLME).
- More than 70 marine scientists, socioeconomic experts, resource managers and policy-makers from the three countries participated in the formulation of the vision for the SCSLME.
- SCSLME is characterized by overlapping boundaries, shared resources, and marine life.
- The vision consists of 58 priority conservation areas identified through overlaying locations of importance for mangroves and estuaries, marine plants, coral reefs, demersal fishes and invertebrates, pelagic fishes, and charismatic species such as sea turtles and marine mammals.

Trono highlighted the major threats to the SCS area:

- Overfishing reduces the populations of fish as well as commercially important invertebrates such as mollusks and sea cucumbers to unproductive levels.
- Destructive fishing practices destroy fish species populations and coral reefs habitats.
- Organic pollution and sediment runoff from land slowly cover seagrass beds and coral reefs.
- More frequent and intense storms bring freshwater to coastal waters, which drastically lowers the salinity of coastal waters and kills organisms with low tolerance to changes in salinity.
- These storms also cause rivers to swell and carry organic substances and sediments to sea, increasing the stress to seagrass beds and coral reefs.

The Ecosystem Conservation Plan (ECP), Long Term Vision and Trinational MOU is a developing ecoregion production plan. The MOU formed the basis for the Vision and ECP. The Vision entails:

- A marine ecoregion that remains to be unique and a center of diversity with vibrant ecological integrity, including all species assemblages, communities, habitats and ecological processes.
- A highly productive ecoregion that sustainably and equitably provides for the socioeconomic and cultural needs of the human communities dependent on it.
- An ecoregion where biodiversity and productivity are sustained through the generations by participatory and collaborative management across all political and cultural boundaries.

The Conservation Plan (ECP) involves:

- Assessments (biophysical, socio-economic, stakeholder analysis, institutional political regimes, and analysis of threat/issues) which all formed the basis for the Vision and ECP.
- From the vision, an LME-wide Conservation Plan for Sulu-Sulawesi Marine Ecoregion (SSME) was developed through a participatory process.
- The consultation process entailed 12 workshops across the three countries and engaged the participation of 153 stakeholder organizations from the local and national levels.
- The SSME Plan consists of country action plans and an ecoregion-level action plan.

First iteration of the plan involved 10 objectives, which are:

- Establish management strategies and coordinated institutions for effective conservation
- Establish a functional integrated network of priority conservation areas to ensure ecological integrity

- Develop sustainable livelihood systems that support marine and coastal conservation across the ecoregion
- Shape economic development compatible with biodiversity conservation
- Enhance understanding of biodiversity resources and factors affecting them to form a basis for management decisions
- Develop communication, education, and outreach programs and strategies to motivate people to take conservation action
- Develop sustainable financing mechanisms to support the cost of conservation and resource management
- Build and enhance the capacity of stakeholders to effectively manage the conservation of the SSME
- Implement coordinated protection of threatened marine species to ensure maintenance of viable populations and protection of critical habitats
- Improve coastal, oceanic and other types of fisheries resource conditions and management by developing a framework strategy, institutions and appropriate interventions.

Two main levels of planning are involved:

1. Country-level action plan (National Plan of Action)
2. Ecoregion-level action plan (Regional Plan of Action)

The stages of formation of the SSME Tri-National Committee involved:

1. Tri-National Technical Working Group (TWG) for the SSME (Jan.-June 2003). Completed the ECP development in June 2003
2. Preparatory Committee for the SSME (June 2003-Jan. 2006). Facilitated the adoption of the ECP, the ratification of the tri-national MOU on the adoption of the ECP, and the formation of a tri-national governance mechanism.
3. Tri-national Committee for the SSME. Formally established on March 1, 2006. Created 3 sub-committees:
    1) Sub-committee on the Endangered, Charismatic and Migratory Species (Marine Turtle)
    2) Sub-committee on Marine Protected Areas and Networks
    3) Sub-committee on Sustainable Fisheries

As part of SSME Governance, the role of NGOs involves:

- World Wide Fund for Nature (WWF), through its SSME Program, played a critical role in the development of the SSME-ECP and formation of the Tri-National Committee in 2006. The WWF SSME Directorate/Coordination Unit served as the secretariat of the Preparatory Committee for SSME.
- Conservation International (CI) has played a major supporting role to strengthen the Tri-National Committee since its formation. CI also actively contributed to the implementation of the ECP and facilitated its evolution into the Comprehensive Action Plans (CAP) through implementation of its Sulu-Sulawesi Seascape Project
- CI and WWF are both members of the SSME Tri-National Committee and its subcommittees.

The Tri-National Committee rotates every 2 years with 5 to 6 delegates from each country. The current chair is in Indonesia with the Ministry of Marine Affairs and Fisheries. The Committee meets at least once per year, and there is discussion around having meetings that are more frequent with new projects coming online.

The ECP evolved into a Comprehensive Action Plan (CAP):

- ECP was ratified by the 3 countries in 2006

- In 2009, ECP was transformed into a Comprehensive Action Plan (CAP) with the following features:
    a. With 5 conservation outcomes (3 outcomes for the 3 sub-committees, and 2 cross-cutting outcomes)
    b. Conservation outcomes are then translated into shorter-term purpose statements. These purpose statements are then broken down into strategies or key result areas, which are further broken down into a set of activities.
    c. Indicators are provided at the level of short-term purpose statements and estimated costs are provided for the implementation of the strategies or key result areas.
    d. A list of potential revenue generating mechanisms is provided, along with an overview of how each country has implemented or sees the potential of implementing these mechanisms.
    e. Lessons learned in the previous Action Plans are adopted for the implementation of the Comprehensive Action Plans as they remain highly relevant in achieving this document's objectives.

Notably, the first iteration of the CAP did not consider climate change, but this latest version includes climate change as a stress to be addressed. Lessons learned in previous action plans are adopted in the current CAP.

Trono highlighted the SSME Tri-National Committee Accomplishments:

- Formation of the Sea Turtle Marine Protected Area Network
- Secured funding from GEF to implement the SCS-SFM Project which included the conduct of a TDA and the formulation of a SAP
- Secured funding from Germany to implement a German-SSME Project to support implementation of the CAP. The total value is approximately 7 million €.

SSME Governance is unique for each project. There is a unique SCS-SFMP organizational structure. Thus far, assessments conducted include:

- ECP Development
    - Biophysical assessments
    - Socio-economic assessments
    - Stakeholder analysis
    - Threats and issues
- Sulu-Sulawesi Seascape Project
    - Fish eggs and larval dispersal patterns
    - MPA networks
    - Climate vulnerability assessments
    - Sea turtle MPA network
- SCS-SFM Project
    - TDA
    - Understanding small pelagic stocks and fisheries
    - Baseline data and profiling of demonstration sites in the Philippines, Indonesia, and Malaysia. These demonstration projects are used to feed into the larger picture as baseline data. There is a strong impetus for all three countries to work together and share this data resource.
    - Socio-economic assessments at demonstration sites
    - Genetics of small pelagic fish

Some challenges to overcome include:

- Complex geopolitical, institutional, social, cultural and economic contexts
- Reorganizations in governments of Indonesia, Malaysia and the Philippines sometimes slows down implementation and achievement of conservation goals
- Over commitment of partners to numerous tasks and responsibilities affects timely implementation of scheduled project activities leading to delays in delivery of results
- Financing CAPs ($154 million USD over 4 years) and SAPs. These need to be finalized and SAPs endorsed by all three countries to be able to submit to GEF for future funding.

Opportunities for the future include:

- Management and protection of a sea turtle corridor that encompasses Northeast Sabah, Malaysia, the Turtle Islands (jointly managed by Malaysia and Philippines), and East Kalimantan, Indonesia, where major nesting populations of green and hawksbill turtles in Southeast Asia are located
- SAP can open new opportunities for joint small pelagic fisheries management and transborder enforcement to address illegal wildlife trade and illegal, unreported and unregulated (IUU) fishing. Possibilities for transboundary ecotourism development.
- Recognition of SSME by 6 CTI countries as the 1st Priority Seascape under the CTI
- Pursuit of joint projects, such as the SCS-SFM Project, the German-SSME Project, and GEF-ADB CTI SEA RETA Project

Dr. Young Nam Kim, Senior Researcher, presented on *Marine Ecosystem Survey and MPA Designation of the Korean Coastal Areas and Tidal Flats*. The significance of the National Survey of the tidal flats is to understand the status of tidal flats for the establishment of conservation policy. The spatial distribution of tidal flats in Korea is largely located in the Chunnam province with approximately 40% of the surface area. According to the Wetland Conservation Law, Article 4, the national survey of wetlands must occur every 5 years.

The first phase of the national survey of tidal flats was named Survey of Tidal Flat Ecosystem and Sustainable Use. The period was from 1999-2004 with KIOST as the main investigator, and NFRDI, KMI, and several universities and NGOs as partners. The survey investigated 11 areas and discovered 687 species of animals, and 164 plant species. 5 sites were designated for coastal wetland protection areas, and 4 sites for marine ecosystem protection areas. 69 big-scale units and 660 other units were classified in the tidal flat inventory. Also, marine environmental leader training programs were established with over 300 leaders. A Korean Tidal Flat publication was created and a National Coastal Wetland Conservation Plan was established.

The second phase of the survey changed the title to Basic Survey of Tidal Flats. Other action items included:

- Producing quantitative data of all survey elements
- A Composition Survey Working Group organized by Experts
- An Investigation manual for Survey of Coastal Wetland(2008)
- An MPA citizen monitoring project : MOF Regional office
- An education and training program : City and County

The objectives of the second phase were to understand the ecological and socio-economic status for providing basic data to decision-makers for establishment of political strategies. Also, the objective included management for conservation and wide use of tidal flats to enhance the quality of life of local citizens. The period of this phase was from 2008-2012 with the primary investigators as KOEM, 3 universities, and 4 private industries.

Four different types of surveys are considered: general survey, in-depth survey, contingency survey, and monitoring. The purpose of the general survey is to figure out the general information on the tidal flat and to decide which places need further in-depth surveys. Examples include sediment

characteristics, ecosystem health status, macrobenthos, and socio-economics. The purpose of the in-depth survey is to evaluate tidal flats for designations of Coastal Wetland Protected Areas (CWPA). Examples include the natural environment, sediment characteristics, hydrology, ecosystem health status, macrobenthos, water birds, halophytes, macroalgae, and fishery resources. The purpose of the contingency survey is to understand the possible emergent situation such as a local reclamation project. Examples include macrobenthos, water birds, and social awareness. The purpose of the monitoring survey is to collect data regarding the status of CWPA. Examples include macrobenthos, water birds, social peoples' awareness, and sediment characteristics.

From the survey results, the biodiversity of Korea's tidal flats may be divided into three regional groups by macrobenthos distribution pattern:

- Kyunggi, Chungnam, Chunbuk
- Chunnam
- Kyungnam

The annual economic value is 16 trillion won (total tidal flat area 2,489.4 km^2), which is very important to the Korean economy.

The national survey of coastal areas also known as the National Investigation of Marine Ecosystem (NIMO) surveyed 8 sections of the coast since 2006. The first phase is funded through to 2015. The sampling period is 4 times per year (February, May, August, and November). Physical, chemical, and biological factors are sampled from seawater, sediments, and organisms. Eleven universities and institutes are involved. Three main stages are drafted to complete the NIMO:

- First stage (2005): Establishment of Master Plan Preparation of Protocol
- Second stage (2006-2013): Census of East·West·South Sea, policy implementation (e.g. MPA), intensive investigation of major coasts
- Third stage (2014-2015): Mapping of ecosystems in Korea, library completion, 2^{nd} census of marine ecosystems, and reviews of protocol

The marine life census throughout the NIMO region indicated very high numbers of species in the region, including new species. This information is being used to make ecological rating. Legislation for conservation and protected areas in Korea has three main administrative tiers: The Ministry of Oceans and Fisheries, the Ministry of the Environment, and the Cultural Heritage Protection Administration. Currently, the uninhabited islands are targets for special protection. MPAs in Korea total 360.31 km^2, with KOEM as the MPA center. Directed activities of the center include education, research and database establishment, management and assessment, and public awareness programs. Some of the challenges for future MPA management in Korea include how to enhance public participation and voluntary activities. There are limited local pools since most residents in/adjacent to MPAs are engaged in fisheries and agriculture. There are also a limited number of young people. In the future, action items include encouraging public participation in the planning process of the management plan, and developing site-specific support systems with real benefits to the local people.

Dr. Antonio Díaz de León Corral presented on the *Pacific Central American Coastal LME*. This LME is shared by 9 countries: Mexico, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Colombia and Ecuador. There are over 180 million inhabitants, mostly in Columbia and Mexico. The LME has the following characteristics:

- High productivity (Costa Rica Dome)
- Wind forces upwellings and nutrient inputs from river run-offs along tropical areas, which brings life to the sea.
- Seasonal movements of the Inter-tropical Convergence Zone

- Tropical marine fauna
- Many peninsulas, gulfs, bays and coastal lagoons
- 17 different subsystems
- Vulnerable to ENSO phenomena

The main environmental problems affecting the PCACLME are:

- 40% of reported landings supplied by fully exploited stocks
- Overexploitation in several countries
- Bycatch of demersal species and habitat modification by shrimp fisheries
- Threatened species: turtles and sharks
- Some mollusks and crustacean species are overexploited or fully exploited
- Anthropogenic pressures: population growth, urban development, tourist, industrial and agricultural activities
    - About 95% of the wastewaters produced in the bordering countries is untreated and reaches the Pacific Ocean
    - Agricultural run-off – levels of pesticide use in the region is one of the highest in Latin America
- Occurrence of eutrophication and harmful algal bloom events
- Mangrove destruction and coral reef damage

The PCACLME history is highlighted as follows:

- 1999, San Jose de Costa Rica, IOCARIBE VI Session
    - Intergovernmental Oceanographic Commission (IOC) instructed the Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE) to consider the PCACLME project proposal
    - IOCARIBE supported the proposal
    - Daniel Lluch Belda was appointed as IOCARIBE Regional Project Coordinator.
- 1999-2000
    - Creation of the Project Steering Committee: Kenneth Sherman (NOAA), Antonio Díaz de León (México) and Manuel Murillo (Costa Rica).
    - Preparation of a PDF Block B, requesting $350,000 USD, signed by México, Costa Rica, Guatemala, Nicaragua, and El Salvador
- 2000 Honduras
    - Workshop with UNIDO (Pablo Huidobro) to include Fonseca´s Gulf in the PCACLME project
- 2004 Recife, Brazil, IOCARIBE VIII Session
    - IOCARIBE, UNEP, and UNIDO would develop a concept paper to submit to UNDP-GEF, considering the new specifications given by GEF
    - IOCARIBE reiterated support and offered to seek financing for a workshop of international experts and participating countries to develop the concept paper
    - IOCARIBE (César Toro) sent designations of the focal points in Guatemala, El Salvador and Ecuador
    - ➢ The funding was never assigned
- 2005-2007
    - UNEP (Jorge Illueca) proposed OMI as the leading agency of the project
    - ➢ Conflict among agencies agendas and project stalled
- 2009 Australia, GEF Session
    - UNDP (Paula Caballero) proposed OSPESCA working together to develop a Project Identification Form (PIF) for PCACLME project
    - WWF and TNC would make contact with México, Colombia & Ecuador

- 2009
    - GEF signals: priority to assign International Waters Program funding in Africa
- 2009-2012
    - OSPESCA prepared PIF proposal and sent it to the countries for review
    - Focal area: International Waters
    - GEF Resources requested: US$ 6,600.000
    - GEF signals: there are funding possibilities for the PCACLME project
- 2012
    - Paula Caballero leaves UNDP to work for the Colombian Government
    - UNDP informed GEF of interest in incorporating FAO in the project
    - UNDP-GEF has to decide the role of the agencies involved
    - José Vicente Troya - UNDP (Panamá) is responsible for follow-up of the project
- 2013
    - OSPESCA and UNDP talked about reactivation of the PIF review and endorsement process

The way forward includes:

- Antonio Díaz de León contacted José Vicente Troya-UNDP and OSPECA to inform them of the México's interest in reactivating the project
- Troya was informed that the PIF´s update process cannot be reactivated yet, because the availability of GEF funds is very limited. He suggested the proposal be presented at the GEF session in June 2014. He proposed to arrange a teleconference with the authorities of the all countries to agree on the next steps
- The proposed way forward:
    - Sept-Nov 2013: PIF´s review and update by a working group
    - Dec-February 2014: PIF´s draft review by authorities of the all countries
    - March 2014: Integration of PIF´s final version
    - April 2014: PIF´s endorsement
    - May 2014: GEF Council 5th General Assembly - invitation is extended to everyone to attend the meeting in Cancun.

Highlights of progress thus far include:

- Marine and spatial land plans
    - Gulf of California signed in 2006
    - Gulf of Mexico and Caribbean plans signed in 2012
    - Mexico signed in 2012
    - North Pacific to be signed 2013
    - Likely examples of information pushing forward:
    - Mining suitability index
    - Biodiversity index
    - Fisheries in the Pacific. Most fisheries are at MSY or beyond.
    - Marginality and governance.

Progress up to date includes:

- Creation of the Marine Spatial Planning Committee: National, regional and local governmental agencies and local stakeholders are already involved
- Identification of the main coastal and marine environmental problems
- Identification of sectoral interests (land suitability analysis) and inter-sectoral conflicts
- 2014
    - Finish the technical study and assessment (prognosis and regulatory proposal)

- 2015
    - Announcement of a Marine Spatial Plan National decree (legally bounding).

Dr. Kenneth Sherman gave a presentation entitled *Influence of Climate Change on Large Marine Ecosystems and the APEC Area o*n the second day of the workshop. Sherman drew attention to global warming trends in LMEs and the projected decline in primary productivity in warmer latitudes with serious consequences for fisheries. Modeling indicates that there will be an increase in primary productivity in sub polar areas with losses of sea ice and warming of surface waters. Developing countries from 20 degrees N to 20 degrees S will likely be negatively impacted by lower primary productivity due to increasing stratification of the upper water layers. If projections hold true, food security in 14 LMEs will be at risk from reduced levels of primary productivity and fish. In these LMEs, the average length of fish in the catches is declining. Sherman said this is a very serious issue and could lead to a tipping point. He stressed the importance of extending GEF support in these LMEs where food security was extremely important. Countries bordering these 14 warming LMEs should consider options for implementation of the precautionary principle and precautionary approach for optimizing fisheries catches.

The total GEF funding for 21 LME projects in 110 countries reached a level of $3.1 billion and by 2020 Sherman would like to see that amount double to $6 billion. He indicated the greatest current need to ensure recovery and sustainability of LMEs is the training of 10,000 practitioners in the ecosystem approach through a certification program. Currently, an estimated 2,500 LME experts and practioners exist worldwide. To train thousands of others, Sherman recommended large-scale interactive programs via the web, for example by creating a massive open online course (MOOC) to train and certify LME practitioners.

Mr. Yihang Jiang presented on *Emerging Science from the GEF-Supported Yellow Sea LME Project*. Jiang showed that nutrients are a constant problem, but we need to understand the science a little better. Harmful Algal Blooms (HABs) are a priority environmental problem, especially for the Yellow Sea. A new hot spot in the Yellow River Estuary was found. There is a high nutrient load into the Yellow River even though it passes through only two Chinese provinces. It is not yet clear where the exact inputs and nutrient sources are originating. The progress of understanding nutrient loading is still limited. Efforts should be directed toward improved understanding of nitrogen and silicate inputs to the YSLME, based on recent findings of a declining level of silicate imports to the ecosystem. Collecting data in this part of the world is not an easy task.

The SAP for the YSLME project was adopted in 2009 and a full endorsement was received in 2010. GEF approval was received in 2013. The goal is to mitigate and implement actions towards recovery and sustain YSLME goods and services. Information gathered on nutrients and DO from YSLME joint cruises found hypoxic areas previously unknown. Possible causes of nutrient shifts may be from overfishing which leaves more space for jellyfish, and diatom shifts to dinogflagellates due to reduction of silicate. However, there are conflicting hypotheses on this issue and more studies are needed to understand the whole picture. For example, nitrogen increases in 2007 and 2008 (data from YSLME cruises) did not agree with the predicted trend. There was a demonstration project on the effect of nutrient ratio changes on the plankton. However, there was no clear relationship between nutrients and dinoflagellates. Thus, a limited time-frame study (3 months) does not support the hypothesis of a dinoflagellate/diatom regime shift.

Professor Qisheng Tang, Director of the Yellow Sea Fisheries Research Institute, Functional Laboratory on Marine Fishery Sciences, presented on *Best Practices of Recovery and Sustainability of the Yellow Sea LME Under Multiple Stressors*. Over the past half century, coastal ocean ecosystems have changed greatly due to multiple stressors including over-exploitation and utilization, climate change (global warming and natural fluctuations), and environmental pollution in which the Yellow Sea Large Marine Ecosystem is the most representative. It is mainly manifested in the changes of biodiversity and

productivity of the ecosystem; as a result, larger, higher trophic level, and commercially important demersal species were replaced by smaller, lower trophic level, pelagic, less-valuable species.

The analysis showed that coastal ocean ecosystems can be controlled by multiple factors. This leads to the complexity and uncertainty of ecosystem changes, which can be difficult to identify and manage. Integrated Multi-trophic Aquaculture (IMTA) is an effective way to respond to multiple stressors for recovery and sustainability of coastal ocean ecosystems. Tang discussed the scientific basis for development of IMTA. He discussed the practice of IMTA and its effect in Sanggou Bay located in the Yellow Sea. He also discussed the carbon budget and ecological service function of IMTA. For future development, the diversification of the IMTA model needs further research. In addition to further studies on the biology and regional ecology of mariculture species, Tang indicated that a study on the functions and processes of mariculture serving as a carbon sink needs to be examined. He also proposed that the impact of ocean acidification on cultured organisms and adaptive strategies in ecosystem-based management should also be further examined.

Mr. Arjan Rajasuriya, presented on *Marine and Coastal Resource Management in Sri Lanka: Experiences of a Developing Country*. He is the coordinator of the IUCN Sri Lanka Marine Program. Marine resource management in Sri Lanka goes back more than 100 years when the pearl fishery was managed in the Gulf of Mannar. Since then many attempts were made to manage marine resources including coral reefs. Today Sri Lanka has 4 marine protected areas and two of them are Marine National Parks and two are Marine Sanctuaries. Two of them have been subjected to Special Area Management Planning with the financial and technical support through USAID and the Asian Development Bank (ADB).

Sri Lanka has dedicated government departments to manage these resources and has been involved in coastal zone management since the 1980s. There are also many laws and regulations, but the country is still lacking elements of marine resource management. Some of the main management problems are:

- Lack of enforcement of fisheries regulations
- Violation of regulations in development activities, especially tourism infrastructure, aquaculture, and construction of salt pans.
- Difficulty or inability to implement regulations due to political interference
- Conflicting needs: conservation and sustainable utilization versus resource extraction and development
- Overlapping responsibilities of government authorities
- Lack of carrying capacity estimates
- Partiality in implementing the law

Rajasuriya an overview of the difference between practice and policy in Sri Lanka. Sri Lanka has progressed in a theoretical exercise in CZM and resource management but the actual act of managing at the ground level has been elusive. The threats to preserving biodiversity and sensitive habitats in the region include:

- Rising sea surface temperatures and levels
- Possible changes in breeding patterns of marine organisms
- Increases in number and intensity of hurricanes and cyclones
- Increasing concentrations of CO_2 and ocean acidification
- Increased resource extraction and habitat alteration due to human activities
- Increased pollution and sedimentation of coastal and marine waters
- Continued lack of implementation of regulations (business as usual)

Dr. Subhat Nurkahim, Arafura and Timor Seas Ecosystem Action (ATSEA) Program Secretariat, and ATSEA National Focal Point for Indonesia, presented on the *Indonesia Sea LME Assessment and Management Developments*. The Indonesian Sea Large Marine Ecosystem (ISLME) consists of a large area of the Indonesian archipelago located within the territorial waters of Indonesian jurisdiction. The ISLME includes 4 Fisheries Management Areas out of the total 11 within Indonesia waters. The four FMAs in the IS-LME are: FMA 712 (the Java Sea); FMA 713 (Makassar Strait, Bone Bay, Flores Sea, and Bali Strait); FMA 714 (Tolo Bay and Banda Sea); and FMA 715 (Tomini Bay, Maluku Sea, Halmahera Sea, Seram Sea and Berau Bay). These areas can be viewed as a "donut hole" that has not been part of any GEF-LME projects.

The Indonesian Sea LME plays an important role in providing food security for Indonesia and the Asia-Pacific region. Other important features of ISLME are:

- Inclusion in the Coral Triangle Initiative (CTI) Region
- Migration pathway of highly migratory species
- Area connected by currents from the Pacific to the Indian Ocean (Indonesia Trough Flow)
- Part of Indonesian archipelagic sea lane
- Possibilities some pelagic fish species are straddling stocks with neighbouring Countries
- An extensive habitat of seagrass species, mangroves and coral.

From the fisheries management point of view, there have been several issues related to the IS-LME such as:

- Some species of fish are over-exploited
- Increases in the threat level from coastal development
- Increased land base and marine pollution as well as unfriendly fishing practices
- Lack of integrated management as the utilization of marine and coastal zones undertaken by different sectors
- Fisheries Management Plan (FMP) has not been well developed

Nurkahim discussed the steps for improved management of the ISLME:

- Treat the LME as contributing to the Coral Triangle Initiative and direct dedicated project funding towards it
- Consider the current FMA 712; 713; 714; 715 as a larger unit; and consolidate / expand the existing Fisheries Management Plans for those FMA
- Expand ATSEA in its 2nd phase to include these areas for a larger "ATSEA II", with a higher percentage of Indonesian Waters but still an "International Waters Transboundary Project", eligible for GEF-funding.

Potential collaboration with other GEF projects in the region is also being explored. The prospect of developing a proposal on IS-LME with support from other organizations and governments was discussed with items for moving forward such as:

- Form a Task Team to draft a road map to develop a project idea (e.g. PIF).
- Develop Strategic Partnership with GEF and its agencies (FAO, UNDP and UNEP)
- Consult with the Ministry of Marine Affairs and Fisheries (MoMAF) Indonesia on key objectives
- Develop partnerships with other ministries and organizations as implementing partners
- Develop partnerships with the other GEF-LME projects in the region (BOB-LME, Sulu-Celebes, South China Sea, PEMSEA, and ATSEA)
- Implementation approach should be through a patchwork of partnerships (e.g. with competent partner agencies, including UNEP (GPA, CRU, COBSEA), FAO, UNESCO-IOC WESTPAC (INDOGOOS), and WWF.

Mr. Romeo Trono presented on *Transboundary Diagnostic Analysis for the Sulu-Celebes Seas*. The SCSLME is the apex of the Coral Triangle and designated as the first priority under the CTI RPOA. The region contains an important source of food and livelihood for over 40 million people in Indonesia, Malaysia, and the Philippines.

The objectives of the TDA were:

- To identify and prioritize the transboundary problems in the SSME and to update the earlier assessment Global International Waters Assessment Project (GIWA 56) conducted in 2002
- TDA results will serve as an objective basis for the formulation of a common program for management.

The processes of the TDA were:

- Conservation International-Phil. was engaged to facilitate conduct of the TDA with Technical Task Teams from Indonesia, Malaysia and the Philippines
- Technical staff of the Project Management Office (PMO), SCS-SFMP provided technical guidance
- Conducted a series of workshops at the regional and national levels
- Transboundary problems were identified and prioritized
- Governance, stakeholder, and policy analysis
- TDA was drafted and presented to the SSME subcommittee on Sustainable Fisheries for review and acceptance
- During its meeting in Tawau early 2012, the subcommittee accepted the TDA Report
- The subcommittee will endorse the report to the SSME Tri-national Committee for approval

Major issues to consider include: 1) unsustainable exploitation of fish, 2) habitat and community modification, 3) climate change, 4) pollution, 5) freshwater shortage, and 6) alien and invasive species.

1) Unsustainable exploitation of fish: the marine capture fisheries production increased steadily in the last 60 years, with an almost 10-fold increase in the aggregate production from Indonesia, Malaysia, and the Philippines in the last decade. This is a combined production of more than 53 million metric tons relative to the 1950s of only about 6 million metric tons.

2) Habitat and community modification: the main causes are overexploitation, IUU fishing, pollution, coastal development and habitat conversion, and natural causes and climatic regimes.

3) Climate change: socioeconomic impacts of climate change include changes in productivity in agriculture, forestry, and fisheries; changes in resource distribution and political jurisdiction; changes in potable water availability; increased human health care expenses and needs; increased response/mitigation costs to extreme weather events; loss of income and employment from fisheries and agriculture; loss of opportunity for both domestic and foreign investments; damage in infrastructure; and loss of life. The TDA process identified six (6) stressors of climate change: increased frequency and intensity of typhoons; increased frequency/volume of rainfall resulting to flooding; ocean acidification; sea level rise; sea surface temperature increase; and shifts in ocean circulation.

4) Pollution: this includes marine water pollution, solid waste, heavy metals, harmful algal blooms, and oil and other hazardous natural substances. Socioeconomic impacts and decline in fisheries harvest, reduction in revenue from coastal and marine resource use/harvest, loss of livelihood and employment, costs incurred in clean-up, and increase in morbidity (e.g. waterborne illnesses and diseases) and decline in birth rate.

5) Freshwater shortage: this is largely due to human activities causing modification of stream flow (sand mining), contamination of existing supply (water quality), changes in the water table, loss of freshwater sources, sewage from palm oil industry, loss of watershed due to development, dead rivers/water source, and seawater intrusion.. Socioeconomic impacts include loss or interruption of potable water supply; added cost for infrastructure and water services; increased costs of irrigation;

increased cost in power (e.g. effects to the city of Mindanao whereby more than 50% of its power supply is hydro-based); potential damage to infrastructure; reduction in future use options; potential conflict from competition among water users, between sectors, and even between countries and regions sharing a common water resource. All these will translate to disruptions in agro-industrial activities that will result in loss of investments and income, which leads to an increase in poverty.

6) Alien and invasive species: anthropogenic activities leading to introductions of alien species include commercial fishing; aquaculture and fisheries; drilling platforms; canals; aquarium industry; recreational boating; dive practices; and floating debris. Apart from maritime transport, many alien species are also introduced through the ornamental trade (Padilla and Williams 2004) or through aquaculture. Studies are needed on the quantitative ecological and socio-economic impacts of invasive alien species and even the specific resilience of ecosystems in the SCS. This will inform decision-makers on how to address the problem and for stakeholders to weigh the consequences of their actions.

From six identified problems identified under SCS-SFMP, four were prioritized which are:

- Unsustainable exploitation of fish
- Habitat and community modification
- Marine pollution
- Climate Change

Some of the identified priority transboundary problems may be localized and can be addressed independently through national policies. Other identified priority transboundary problems require closely coordinated, but separate, national policies (e.g., law enforcement against destructive fishing methods).

Recommendations include reviewing and amending the existing SSME MOU based on the results of the Transboundary Diagnostic Analysis (TDA) to address priority transboundary problems and provide the basis for SAP implementation. The amended MOU could also reflect how the plans, projects, and programs will enable the three countries of Indonesia, Malaysia and the Philippines deliver on their commitments to international conventions such as CBD, UNFCC, CITES, CMS as well as regional cooperative mechanisms such as CTI-RPOA; PEMSEA-SDS-SEA; ASEAN; BIMP-EAGA; APEC, among others. It is also necessary to develop and maintain a dynamic synergy between and among the three subcommittees of the SSME (Threatened, Charismatic and Migratory Species, Marine Protected Areas and Networks, and Sustainable Fisheries). It is important to actively communicate and demonstrate that the SSME has been identified as the first priority and the most advanced seascape in the Coral Triangle Initiative (CTI); and that the CAPs are in fact aligned with the Regional Plan of Action (RPOA) of the CTI. There is a need to increase the leveraging potential of SSME with other donors to secure financing for the implementation of its CAPs. Lastly, a fast track towards SAP finalization, a political process is needed. There is little time to finalize the SAP. Endorsements from all countries need to be secured.

Dr. Daniel Lluch-Belda, presented *Transboundary Issues and Priorities for the Pacific Central American Coastal LME*. Lluch-Belda discussed how to get all countries working together on transboundary issues. Transboundary issues for the PCACLME are set in a dynamic political setting where changes are occurring all the time. Incorporating all 9 developing countries in the region is a difficult challenge. In his experience, many people will sign an agreement but the following month they will be removed from their position due to political shifts. With 9 countries like this, coping with such unexpected change is difficult. This has been a long-term problem, and there needs to be a search for institutional networking. A good example is the InterAmerica Tropical Tuna Commission. This has been working very well for managing tuna resources in the area, and thus there is hope.

The PCACLME is mostly a deep ecosystem with major differences between the coastal mountain regions and the depths of the ocean. There are also major mountain passes with winds that blow strong and drive upwellings and currents. The PCACLME has the largest tuna catches in the eastern Pacific

Ocean but other fish are important such as dolphin fish and sharks. Wild and farmed shrimp are also an important part of the LME. Almost all wild shrimp are overexploited, as well as the bycatch species, and farmed shrimp is not far behind. Artisanal fisheries are also facing overexploitation as they provide the most food for local populations.

In terms of ecosystem health, PCACLME is one of the world's hotspots for ship traffic due to the Panama Canal. Oil and ballast water spills are common with high ship traffic, which heavily impacts the area. Land-based pollution sources are from banana plantations, untreated water, and sewage and runoff directly into the ocean. Several viral epidemics have resulted in shrimp population declines.

Climate change including global warming affects the region greatly. The PCACLME is affected by ENSO variations that disrupt normal operations and provoke losses to industries. For example, El Nino can increase shrimp production, but most others will increase flooding and sea levels, which create major economic losses. The North Pacific decadal variation is also present, as well as the Atlantic Multidecadal Oscillation that result in ecosystem changes. When looking at global warming, the recent trends at the PCAC are contradictory, showing warming in the Caribbean, cooling in the Pacific region and no discernible change at the different areas.

In summary, transboundary issues are broad and serious. In past 10 years we have basically not advanced at all, it has been a very slow LME implementation. For 6 years there were no focal points for the project, until 4 countries declared interest. But this has been lost, and there is still a long way to go.

Dr. Kristen Honey, NOAA's Large Marine Ecosystem Coordinator, gave an overview of the *Global Environment Facility (GEF) Funding Process* and key documents in this process: the Project Identification Form (PIF), Transboundary Diagnostic Analysis (TDA), and Strategic Action Program (SAP). In order to receive funding, proposed projects must follow a specific project cycle with submission processes that have specific requirements. GEF agency International Water (IW) staff with requisite experience and knowledge can guide LME projects through the GEF funding process. The United Nations (UN) agencies serve as partners to support LME projects through the PIF, TDA, and SAP process. UN agencies that provide planning and execution support include UNDP, UNEP, UNIDO, FAO, and IOC-UNESCO.

Some LME projects, such as the Yellow Sea LME project with its lessons learned, have secured GEF funding with the aim of long-term sustainability of LME goods and services using the 5 modular ecosystem-based approach: (i) productivity, (ii) fish and fisheries, (iii) pollution and ecosystem health, (iv) socioeconomics, and (v) governance. The GEF funds a broad array of project types with grants that range from thousands to millions of dollars contingent on the scope of the project. Community-based organizations (CBOs) and non-governmental organizations (NGOs) can apply for GEF grants through the Small Grants Program, while large country-driven LME projects aim for medium-sized and large-scale projects. GEF funding varies in size depending on available resources, project needs, and issues addressed by the proposed project. To be taken into consideration, a project proposal for medium-sized or large-scale projects must fulfill the following criteria, as detailed on the GEF website (http://www.thegef.org):

- It is undertaken in eligible countries. It is consistent with national priorities and programs.
- It addresses one or more of the GEF Focal Areas, improving the global environment or advance the prospect of reducing risks to it.
- It is consistent with the GEF operational strategy.
- It seeks GEF financing only for the agreed-on incremental costs on measures to achieve global environmental benefits
- It involves the public in project design and implementation.
- It is endorsed by the government(s) of the country/ies in which it will be implemented.

The GEF funding process involves a series of sequential steps. First, GEF Agencies can submit PIFs to the GEF Secretariat on a rolling basis, endorsed by the country GEF Operational Focal Point. GEF Secretariat review of a PIF focuses on the following:

- Country eligibility
- Consistency with GEF strategic objectives/programs
- Comparative advantage of GEF Agency submitting PIF
- Estimated cost of the project, including expected financing
- Availability of resources for the GEF grant request within the Focal Area and under the Resource Allocation Framework
- Milestones for further project processing

Second, LME projects (in collaboration with GEF and UN Agency partners) write a TDA, which provides the technical basis for development of a SAP in the IW area of the GEF. The TDA is a scientific and technical assessment, through which the water-related environmental issues and problems of a region are identified and quantified, their causes analyzed and their impacts, both environmental and economic, assessed. The analysis involves an identification of causes and impacts at national, regional, and global levels and the socio-economic, political and institutional context within which they occur.

Third, LME projects (in collaboration with GEF and UN Agency partners) write the SAP document, which is an agreement among participating countries on actions needed to resolve priority threats to international waters. The SAP identifies actions for the national benefit of each country, actions addressing transboundary issues, and institutional mechanisms at regional and national levels for implementation of actions.

To facilitate the GEF funding process and support LME project efforts, the GEF's International Water Learning Exchange and Resource Network (IW:LEARN) is an excellent resource. The IW:LEARN repository includes example PIFs, TDAs, and SAPs, as well as other LME project documents, visualization tools, and news (http://iwlearn.net).

Honey concluded by highlighting the GEF Project "Strengthening Global Governance of LMEs and their Coasts," which recently held its first stakeholder workshop in Paris in July 2013. As part of this effort, in the near future, this GEF Project of Strengthening Global Governance of LMEs and their Coasts will provide another excellent resource. It will emphasize LME project-to-project learning and direct information exchange between projects, including best practices for successfully funded projects. IOC-UNESCO in Paris, France, will host the future Secretariat for this international clearinghouse of LME resources for the Strengthening Global Governance of LMEs and their Coasts project. In the meantime, until this GEF project is further along, the best resources for funding information for LME projects remain the GEF and IW:LEARN websites:

http://www.thegef.org:
http://iwlearn.net

Mr. Yihang Jiang presented the *Yellow Sea LME Case Study: Insights from YSLME GEF Funding Process.* Jiang discussed that project documents cannot be used until they are approved and endorsed by the GEF, and approval and endorsement are different. After a project is endorsed, it is not necessary to go to the GEF council and the funds can be spent. Once the money is spent, deliverables are expected and the cycle continues.

Before a PIF is created, a concept paper needs to be drafted. This can be done with the help of APEC. GEF has a strict 8-page limit. Overall the process is from concept paper to PIF to ProDoc to TDA and finally to SAP. GEF encourages collaboration with three or more projects and is more likely to provide funding for larger projects. The developing documents should be very detailed and very specific. There are specific criteria that action items are checked against which are: useful, doable, and efficient. In general, endorsement from governments will take a long time so in the interim it is a good idea to

undertake demonstration projects. The YSLME has 24 demonstration projects, and a book titled *The Scientific Justification for Practical Management in the Yellow Sea* on 22 of the demonstration projects was published (UNDP/GEF 2011).

The first step of the TDA is data and information collection. A pollution data chart is available which was collected for the YSLME. China has a strong national policy on data sharing and this information should be open access in a database to be established in the future. It is important to perform a Causal Chain Analysis (CCA) in the TDA to identify the root causes of the transboundary issues identified. If a CCA is not performed, the GEF will not accept the TDA. A lot of science is needed to perform a CCA and it is a good procedure for assessment of program priorities. Once the TDA is finished, management actions can be identified and priority programs established. This is part of the SAP, and management targets need to be identified. The SAP needs to have:

- Tangible and realistic management targets
- Management Actions under each Management Target
- Governance actions address legal, institutional and stakeholder requirements
- While drafting the SAP, consideration needs to be given to approvals needed from all governments participating in the project.
- Draft SAP needs to be reviewed by major stakeholders
- SAP needs to be endorsed by all the governments.

Timeframes need to be established including accounting for delays since it takes some time for the SAP to be endorsed by all governments. The SAP needs to be reviewed by all stakeholders from different sectors so it is important to consider structuring the SAP for easy approval. Approval of an SAP can be very difficult and lead to major delays and frustrations. Once actions are established, a budget needs to be drafted which includes the amount to be requested from GEF, national co-financing, and other financing opportunities.

Development of the SAP in the YSLME was based on the carrying capacity of the ecosystem, which was based on the four ecosystem surveys conducted in the marine assessment. Examples of major targets include a goal of 25-30% fisheries reduction and 10% nutrient reduction within 5 years. To obtain approval of these targets, the YSLME consults with all relevant agencies and obtains buy-ins at each step. If members of the GEF Council provide comments, it is important to address them and keep in mind that many of them can be critical and difficult to address. All targets need to be technically feasible and politically and socially acceptable.

To obtain signatures and to ensure SAP endorsement, the YSLME project organized a signing ceremony with all the people who can sign on behalf of their appropriate government ministries. This included members from the People's Republic of China, Republic of Korea, and the Democratic People's Republic of Korea. Interestingly, agreement was only reached 15 minutes prior to signing. It was a very difficult process to get the political agreement needed for the SAP endorsement. Following endorsement, technical clearance is needed for the PIF. Both implementing and executing agencies are needed to ensure formal commitment from participating countries. UNDP is the implementing agency of the GEF, but WWF and other players can be involved in project financing. The whole process is complicated and it is important to pay attention to all the details at every step.

Prior to adjournment, **Dr. Antonio Diaz de León Corral** informed the workshop of the following events: convening by the GEF of their International Waters Biannual Meeting during the last week of October 2013 in Barbados and that Mexico is hosting the 5th GEF General Assembly in Cancun, 25-30 May, 2014, an event to which APEC members are encouraged to attend. The host country expects participation from all 183 GEF member Countries.

Recommendations – Adopted Unanimously 13 August 2013

(1) A science-based precautionary approach is recommended for capping and sustaining fishery biomass yields in LMEs under stress from climate change and predicted declines in primary productivity for LMEs in the APEC area between 35 ºN and 35 ºS.

(2) Encourage the collection of scientific data on physiological and reproductive responses of fishery species to climate change and other environmental stressors to facilitate more accurate interpretation of fish biomass yield data.

(3) Raise the profile, commitments and prospects for GEF funding by leveraging other donors for co-financing, and contributions of value-added activities complementing LME Project effort through linkage with existing international, national, NGO, private, and other projects and programs.

(4) Connect LME programs and lessons learned directly with one another through ongoing APEC LME efforts, including future meetings.

(5) Conduct a review of published information and/or existing data and/or collected samples of fish remains in sediments of select LMEs around the world, identifying critical areas yet to be covered to undertake an integrated analysis for identifying long-term global trends and shared dynamics of small pelagic fishes.

(6) The workshop participants agreed to support on-going efforts and the drafting of three PIFs: one each for the Pacific-Central American Coastal LME, Indonesian Sea LME, and Sulu-Celebes Sea LME.

(7) The workshop participants support on-going efforts in the West Bering Sea LME project.

(8) The workshop participants agreed to hold an APEC LME Workshop Phase V in Korea in 2014. Funding will be sought from the APEC Secretariat, the Government of the Republic of Korea, and other co-sponsoring economies.

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