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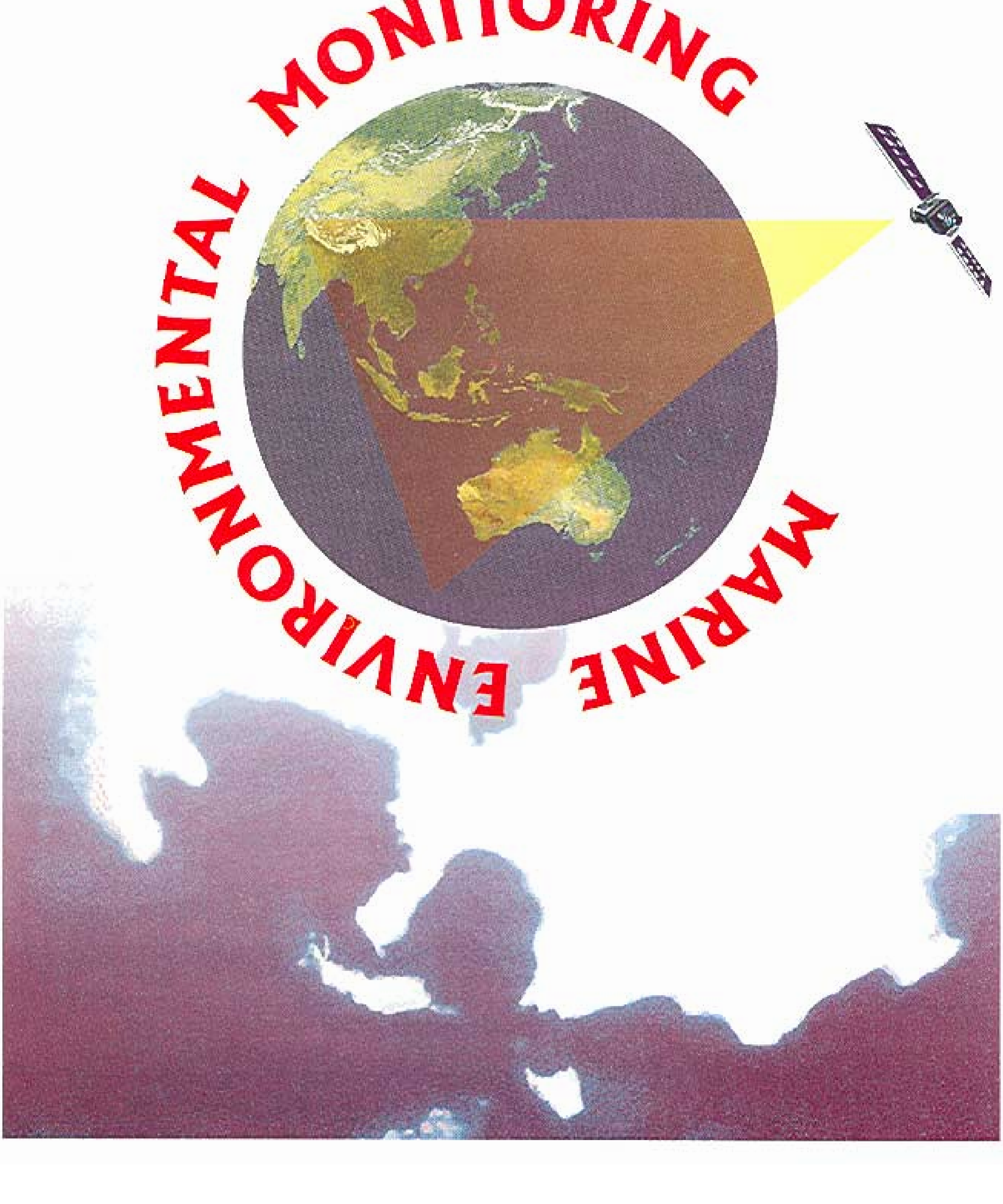

EDITORIAL

Value Added on Information from Environmental Monitoring and Baseline Studies

Acquisition of environmental data on the coastal and marine environments is typically undertaken through surveys and monitoring programs. For most littoral countries in the East Asian Seas Region, surveys are generally conducted on a project by project basis, of short-term duration and infrequent. Only a few countries have regular government funded monitoring programs but even in these cases, the number of parameters being measured vary due in part to funding, capacity and priority, among others. For more than two decades, developments in information and space technologies have contributed to a better understanding of the environment. Computers enable the storage, analysis and transfer of voluminous data sets, such as those from monitoring programs, at relatively lower cost and shorter time periods, making the data sets available for decision or intervention purposes. Satellite and aerial remote sensing have greatly enhanced the inventory of resources and monitoring of human-induced activities sometimes providing continuous temporal coverage. These technologies have significantly improved understanding and awareness on the coastal and marine environments of the region. Yet, the environmental quality is seriously deteriorating and the coastal and marine resources are being overexploited or degraded as reviewed by Dr. Gil Jacinto in the lead article of this issue of *Tropical Coasts*.

Many countries in the region typically report monitoring data such as water quality parameters in terms of percent exceedance with respect to adopted standards in addition to the use of descriptive statistics. The information obtained from such analyses, while useful, is oftentimes insufficient to resolve management issues which have cross-sectoral and sometimes multidimensional characteristics. The advances in information technology, particularly on computers, enable the deployment of analytical techniques and models that can provide value added to environmental data sets acquired through monitoring and surveys. Such techniques and models even if available, are not being utilized by agencies and institutions undertaking environmental monitoring for several reasons; among them are unfamiliarity, under validation/testing for possible adoption, deemed irrelevant/inappropriate, too complex/complicated to use or too costly.

This issue of *Tropical Coasts* contains several articles on analytical techniques and models like environmental risk analysis and environmental impact assessment, which were applied to existing environmental data compiled by some countries in the region, providing important findings and insights in the resolution of identified management issues. Environmental risk assessment which is the determination of the likelihood that an environmental condition caused by human activity will result in harm to a target, has been applied to data largely available from the Malacca Straits Environmental Profile, as described in the article by Mr. S. Adrian Ross and Ms. D. Padilla. The article discussed a number of risk assessment techniques including the Risk Quotient (RQ) approach which is the ratio of the measured or predicted concentration of a target parameter over its threshold no-effect level. Risk assessment was also undertaken in Batangas Bay, Philippines and Xiamen, China for pesticide contamination. Drs. D. Calamari and M. Delos Reyes discussed such assessment using three synergistic methods. Essentially, the whole pesticide risk assessment framework provides quantitative indications as to what type of pesticides pose risk and the level of that risk to a target group (e.g., marine fauna). Such information can then be used to define appropriate strategies to respond to the risk. Assessment of the impacts of economic activities on the environment requires the integration of ecological factors into socioeconomic analysis enabling its characterization from a multidimensional perspective. Thus, robust quantitative information will result in the formulation of practical mitigative measures and strategies. This integrated impact assessment framework has been applied in three areas of Xiamen, namely, Tong'an Bay, addressing aquaculture; Western Sea, assessing the impact of industrial discharges, and the Eastern coastline, to look into the impacts of tourism.

With increasing complexity of the environmental problems facing the coastal and marine environments of the region, innovative analytical methods and technologies are needed to provide better resolution and quantitative measures to address the sources of concern and their impacts. Such innovative techniques and technologies are available but should supplement rather than replace some of the existing conventional methods being used, especially in monitoring programs. We should use or adopt them, but we also need to understand their limitations and constraints so that we do not draw the wrong conclusions.

James N. Paw, *Issue Editor*

contents

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PRELIMINARY ASSESSMENT OF MARINE POLLUTION ISSUES IN THE EAST ASIAN SEAS REGION AT THE END OF THE MILENNIUM

This review is an attempt to focus on the state of the marine environment in the East Asian region, with emphasis on marine pollution problems and issues. It builds upon some of the earlier reviews on the region (Morgan and Valencia, 1983; Gomez et al., 1990) and will further assess marine contamination problems in the area in order to appraise how the situation may have changed since the last major assessments were made. In addition, the adequacy of marine pollution monitoring efforts to determine the status and changes of the marine environment vis-à-vis the major contaminants will be examined.

For the purposes of this discussion, the East Asian Seas Region will be considered as bounded on the north by the Yellow Sea, the Andaman Sea on the west, the Indonesian Seas on the south, and the waters in between (***Figure 1***).

Figure 1: The East Asian Seas Region.

Marine Pollution Issues Then

GESAMP (1990) stated that "while no areas of the ocean and none of its principal resources appear to be irrevocably damaged, while there are encouraging signs that in some areas marine contamination is decreasing, we are concerned that too little is being done to correct or anticipate situations that call for action, that not enough consideration is being given to the consequences for the oceans of coastal development and that activities on land continue with little regard to their effects in coastal waters".

A subset of the GESAMP review, the state of the marine environment in the East Asian Seas region completed at the end of the 1980s (Gomez et al., 1990), noted that in the region, marine contaminants have been analyzed only sporadically in water, sediments and biota. Limited capability in the region was considered a factor hampering the determination of many contaminants. The need was identified to improve the quality of data and manpower capability. Sewage was considered to be the major source of organic pollution, much of which was discharged raw into coastal waters directly or through rivers and waterways. Eutrophication of some coastal waters was apparent and red tide episodes, both toxic and non-toxic, were recorded in virtually all the countries in the region. A few major oil spills had occurred in the region and both port and shipping lanes were exposed to some oil contamination because of the large volume of petroleum products conveyed through these areas.

Marine Pollution Issues Now

It has been almost ten years since the review was made of the region and it is useful to consider how much has changed since. Goldberg (1995) states that "the primary factor driving coastal ocean pollution is the increase in populations that will be more affluent and hence use more energy and material resources". Despite the recent devaluation of currencies and the crash of the stock market in the region, most countries in Asia have had phenomenal growth in their economies, standard of living and population size in the last decade. With these developments have arisen the concomitant problems in the region's coastal and open seas. It appears that the same pollution issues raised and discussed at the start of the 1990s remain, albeit, widening in extent and increasing in magnitude. Moreover, a few other issues have emerged and are now viewed with a lot more concern (e.g., the impact of aquaculture/mariculture on the marine environment).

Sewage, Nutrients and Eutrophication

Experience and perception over the past decades have changed the order of priority in the list of marine pollutants, and two that were almost disregarded in the sea in earlier times have now moved up the list—sewage and nutrients (McIntyre, 1995).

In countries where aquaculture is a major activity in coastal areas (e.g., China, Indonesia, the Philippines and Thailand), effluents discharged from these aquaculture farms also contribute significantly to high nutrient loads in the receiving marine waters. Levels of nitrogen, phosphorus and other water quality parameters are generally higher in effluent than inflowing water (Macintosh and Phillips, 1992).

The problem of eutrophication is probably most pronounced in bay areas where not only is there a very large human population discharging untreated sewage but the tributaries and watersheds that drain into such bays are also characterized by significant agriculture and aquaculture activities (e.g., Manila Bay).

Harmful Algae

Harmful algal blooms (HABs) have been occurring in the Asia-Pacific region with increasing frequency in the last 20 years. The impacts of algal blooms include paralytic shellfish poisoning, diarrhetic shellfish poisoning, ciguatera, tetrodotoxin poisoning, fish kills and tainting of fish and shellfish (Corrales and Maclean, 1995). Countries that periodically experience HABs such as the Philippines continue to invest significantly in the routine monitoring of the organism's vegetative cells and the toxicity of the affected marine organisms.

Heavy Metals

Trace metal pollution in the region's marine environment is generally localized with high concentrations of trace elements found in water and sediments in areas where mine tailings reach the sea (e.g., Honda Bay and Macajalar Bay in the Philippines) or in the immediate vicinity of effluent outlets. Of the dozen or so metals routinely monitored in seawater, only three have actually been involved in well-established pollution episodes—tributyltin, methyl mercury and organically-bound copper (Goldberg, 1995).

Another pertinent issue for the region is that while it remains difficult to accurately determine trace metals in seawater compared to marine sediments, criteria values (concentrations which if not exceeded are considered to be protective of the body of water for its designated use) are available for seawater but not for sediments. This situation prevails despite the generally recognized greater utility of sediments over seawater in assessing trace element contamination.

Plastics

Goldberg (1995) warned of the "plastics problem" as evident in many well-used beaches and coastal areas of heavily populated cities. The principal concern with plastics on sediment is their ability to inhibit gas exchange between the overlying waters and the pore waters of the sediments. As a result, anoxia and hypoxia can result near the water-sediment interface (Goldberg, 1992). Except for one study on the impact of marine debris on subsistence fishermen at two beaches close to Jayapura, Irian Jaya province, Indonesia (Nash, 1992), there have been no other reports nor is there any monitoring program on sea floor debris in the East Asian Seas to ascertain whether or not the coverage of the coastal sea floor is increasing so that life processes are threatened.

Endocrine-disrupting Chemicals

Associated with the contaminants that come from aquaculture, agriculture and other land-based activities is the widespread occurrence of endocrine-disrupting chemicals (Stone, 1994). Many of the compounds act as anti-estrogens by interfering with the activity of estrogen receptors or by reducing the number of receptors in the organisms (Goldberg, 1995). Colborn et al. (1993) have identified a number of potential endocrine-disrupting chemicals which include herbicides, fungicides, insecticides, nematocides and other industrial chemicals (***Table 1***).

In the region, biocides continue to be used extensively in agriculture and aquaculture, and endocrine-disrupting industrial chemicals end up in the coastal and open waters. Recently, studies have been done on sediment samples collected from Xiamen Harbour and Victoria Harbour, Hong Kong (Hong et al., 1995). The study found that NAH levels in Victoria Harbour indicated that there was significant petroleum contamination in the harbor, while Xiamen Harbour was slightly more contaminated by DDTs. It was suggested that Victoria Harbour is more polluted than Xiamen Harbour.

Oil and Petroleum Hydrocarbons

Asia is one of the largest offshore oil-producing regions in the world. About 4,000 million barrels of crude oil a day is imported by Malaysia, Indonesia and Vietnam, representing 23% of the global total. Every year, approximately 200 million tons of oil travel through Vietnam's offshore waters from the Middle East to Japan and Korea (Roop et al., 1994).

Table 1: Chemicals with Widespread Distribution in the Environment Reported to Have Reproductive and Endocrine-disrupting Effects (Colborn et al., 1993).

BIOCIDES					INDUSTRIAL CHEMICALS
Herbicides	Fungicides	Insecticides		Nematocides	
2,4-D	Benomyl	β-HCH	Methomyl	Aldicarb	Cadimum
2,4,5-T	Hexachiorobenzene	Carbaryl	Methoxychlor	DBCP	Dioxin (2,3,7,8-TCDD)
Alachlor	Mancozeb	Chlordane	Mirex		Lead
Amitrole	Maneb	Dicofol	Oxychlordane		Mercury
Atrazine	Metiram-complex	Dieldrin	Parathion		PBBs
Metribuzin	Tributyltin	DDT and metabolites	Synthetic pyrethroids		PCBs
Nitrofen	Zineb	Endosulfan	Toxaphene		Pentachlorophenol (PCP)
Trifluralin	Ziram	Heptachlor and H-epoxide	Tranmonachior		Phthalates
Lindane (γ-HCH)					Styrenes

Figure 2 summarizes the major oil spills that have taken place in the region in recent years. However, long-term studies are indicating that while a spill in restricted water could be a local disaster, and that in some circumstances oil residues could persist in patches for as long as 10 years, operational discharges from ships contribute a greater overall volume of oil to the world's oceans and could be a more widespread threat to birds and beaches than the annual quota of shipping accidents (McIntyre, 1995).

How Are These Pollution Issues Being Addressed In The Region?

Capacity Building

Over the past decade, more centers with improved facilities and better trained staff have emerged in the region. Recognition of the quality assurance and quality control concerns has also begun to pervade the conduct of pollution assessments and monitoring. Intercomparison exercises, often done through international agencies such as the Intergovernmental Oceanographic Commission (IOC) and the International Atomic Energy Agency (IAEA) have also significantly improved the reliability of analytical techniques employed and data obtained in pollution work. Individuals with advanced degrees (e.g., MSc and PhD) earned within and outside the region have also returned to their countries and are now manning various academic and government institutions involved in marine scientific research. Thus, a critical mass of experts is now emerging in the region who are provided with adequate facilities to conduct marine pollution studies.

Regional Programs

Several programs have also been initiated in the region during the 1990s that focused entirely or at least partially on marine pollution problems and issues. Some of these are listed and described in *Box 1*.

The Way Forward

Contamination will continue and will likely increase with the inevitable population and economic growth in the region. More efficient technologies to mitigate pollution will emerge but the receptivity of the private and government sectors to these developments will vary among countries. As beginning to be shown particularly in China and in the Philippines, the ICM strategy could be a way to increase the receptivity of coastal resource users, especially the private sector, to adopt and spend for needed interventions to protect the marine environment.

Eutrophication will undoubtedly remain a problem in the region and understanding the course of this phenomenon will require a long-term commitment to a monitoring program. Enhanced capability for the determination of pollutants, particularly organic compounds, will be required in the region.

Some of the more conspicuous contaminants, such as marine litter, especially plastics, can seriously interfere with the normal functioning of ecosystems and may alter the make-up of life on the sea floor (Goldberg, 1992). Monitoring programs to determine whether or not the coverage of the coastal sea floor is increasing so that life processes are threatened should be initiated.

Monitoring programs on trace elements in seawater should be downsized to focus on those metals involved in well-established pollution episodes (tributyltin, methyl mercury and organically-bound copper). Similarly, metal pollution assessments should focus instead on sediments and sentinel organisms such as bivalves.

A network of "reference laboratories" in the region should be established that specialize in the determination of specific contaminants and that can provide for field and laboratory training on marine pollution. Associated with this network would be the desirability of sharing data and

Figure 2: Chronology of the Worst Oil Spills in the East Asian Seas in Recent History.

1993

1 **21 January**—SINGAPORE/INDONESIA/MALAYSIA—The 255,312-ton Singapore-registered tanker *Maersk Navigator* collided with the empty tanker *Sanko Honour* in the Andaman Sea en route from Oman to Japan. It was carrying a cargo of nearly 2 million barrels of oil. Its ruptured port side leaked burning oil and spread a slick up to 35 miles (56 km) long off Sumatra drifting towards India's Nicobar Islands.

1994

2 **6 March**—THAILAND—About 105,670 gallons of diesel fuel spilled into the sea some four miles (6.4 km) off the eastern Sriracha coast after a chartered oil tanker and an unidentified cargo ship collided. The tanker, the *Visahakit 5*, was carrying about 1.06 million gallons of diesel and liquefied petroleum gas.

3 **8 May**—VIETNAM—The 1,220-ton Vietnamese *Chanoco I*, carrying 1,012 tons of fuel oil, and a 10,000-ton Taiwanese ship *Unihumanity* collided in the Long Tau river near Ho Chi Minh City. About 200 tons spilled into the river from the Vietnamese ship causing a 200-ton oil slick, which killed fish and other wildlife.

4 **17 October**—CHINA—1,000 meters of beaches and reefs at Dongshan, a resort area at Qinhuangdao in Hebei province were polluted by an oil spill blamed on the *Huahai Number Two* tanker, owned by the state-run Huahai Company of Beijing.

1995

5 **5 June**—SINGAPORE—About 100 tons of fuel oil leaked from a bunker fuel barge after it collided with the freighter *Sun Pulse*. The fuel oil had begun washing up on the island's east coast.

6 **25 July**—SOUTH KOREA—Oil leaking from the 275,782 deadweight ton *Sea Prince*, a burning tanker off South Korea, formed a slick 20 miles (32 km) in diameter. The ship was loaded with 83,000 tons of crude oil. It was drifting toward the country's best known sea resort. 700 tons of fuel oil estimated to have been leaked.

1997

7 **7 January**—JAPAN—Coastal fishing villages in northwestern Japan braced for economic and environmental catastrophe as oil slicks from sunken Russian tanker *Nakhodka* coated beaches and threatened prized shellfish beds. The spill from the ruptured tanker leaked 5,200 tons (36,400 barrels) of heavy fuel oil.

8 **2 July**—JAPAN—A supertanker struck a shallow reef in Tokyo Bay, a famed fishing ground, leaking an estimated 1,500 tons of crude oil.

9 **15 October**—SINGAPORE—A tanker carrying 120,000 tonnes of fuel oil collided with an empty VLCC. More than 25,000 tons of oil leaked out from the vessel, and despite huge amounts of dispersant chemicals being applied both from the air and from vessels, the beaches of several smaller islands off Singapore are covered with greasy sludge.

Box 1: Regional Programs Focusing on Marine Pollution Problems and Issues, 1990s.

- ***GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas***—Designed to address marine pollution issues in the East Asian Seas Region. There are eleven participating countries in the Programme, which is being implemented by the United Nations Development Programme (UNDP) and has a duration of five years (1994-1998). The International Maritime Organization (IMO) is the executing agency.
- ***ASEAN-Canada Cooperative Program on Marine Sciences II***—This 5-year program, ending in 1998, is being implemented with the support of the Canadian International Development Agency (CIDA) in Southeast Asia. The broad objective of the Program is to upgrade ASEAN marine science capabilities through cooperative endeavors of participating ASEAN countries and Canada.
- ***IOC/WESTPAC***—(1) *Assessment of River Inputs.* The project aims to determine pollutant load reaching the coastal environment through specific river system. The initial effort has been made to assess nutrient fluxes. (2) *Monitoring Heavy Metal and Pesticides Using the Mussel Watch Approach.* In cooperation with UNEP and the United Nations University (UNU), a program plan is being prepared and necessary training will be carried out in the region to investigate the use of bivalves and other sentinel organisms as indicators of persistent cumulative pollutants.
- ***APEC Initiatives (http://www.apecsec.org.sg/mrcw1.html)***—The Marine Resources Conservation Working Group (MRCWG) of the Asia-Pacific Economic Cooperation (APEC) was launched in 1990. The working group has concentrated on the following projects: the Marine Algal Toxins (red tide/harmful algal blooms) Programme; the UNCED Follow-up Project; and the Integrated Coastal Zone Management Project.
- ***LOICZ (http://kellia.nioz.nl/loicz/)***—The Land-Ocean Interactions in the Coastal Zone (LOICZ) Project is one of eleven Programme elements of the International Geosphere-Biosphere Programme (IGBP). The overall goal of this project is to determine at regional and global scales: how changes in various components of the Earth system are affecting coastal zones and altering their role in global cycles; to assess how future changes in these areas will affect their use by people; and to provide a sound scientific basis for future integrated management of coastal areas on a sustainable basis.
- ***HOTO/GOOS (http://www.unesco.org/ioc/goos/hoto.htm)***—The objectives of the Health of the Oceans (HOTO) Module of Global Ocean Observing System are to provide a basis for the assessment of the state and trends in the marine environment regarding the effects of anthropogenic activities, including increased risk to human health, harm to marine resources, alterations of natural change and general ocean health.

information among laboratories in both the formal (peer-reviewed publications) and informal (reports and internet webpages) modes. As a result, periodic assessments of the state of the marine environment can be facilitated. This is one of the themes of the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas.

Finally, models of multi-sectoral pollution monitoring programs need to be developed and replicated. For most countries in the region, national government institutions are unable to effectively implement pollution monitoring programs because of various constraints, not the least of which is inadequate financial resources. Thus, pollution monitoring activities at specific sites (e.g., bay areas) linked with the local government, the private sector and possibly non-government organizations may be the way to sustain monitoring activities.

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RISK ASSESSMENT IN SUBREGIONAL SEA AREAS AND TROPICAL ECOSYSTEMS: THE MALACCA STRAITS EXPERIENCE

Determination of the likelihood that an environmental condition caused by human activity will result in harm to a target is known as **environmental risk assessment.** This approach involves estimating the potential for harm being done to human health and/or ecosystems through factors emanating from human activities that reach their targets via the natural environment. Hence, it usually combines an understanding of the inherent capacity of a substance to cause harm (hazard identification) with an understanding of the likely levels of exposure in targets (exposure assessment).

Environmental risk assessment implies that it is possible to use scientific techniques to specify likely consequences for targets of human influences. For instance, chemical contamination and/or pollution is a major concern in environmental management. However, in practical terms, managing an environmental threat to the limit, such as imposing on chemical industries a zero discharge requirement, is likely to bring economic costs both for the industry and those benefiting from its use. The cost of control increases as chemical concentration is being reduced to the zero limit. In effect, cost-effectiveness of controls reduces as it moves toward zero discharge.

With risk assessment, it can be assumed that an industrial chemical can be managed on the basis of its likely effect on target organisms. If the derived effect or no-effect concentrations of certain chemicals being discharged in the environment suggest that these chemicals are likely to have effects at very low concentrations, then they should be excluded from the environment or what is known as the **zero concentration approach.**

An alternative approach is the **precautionary approach**. This approach works on the basis that there are uncertainties associated with defining the no-effect concentrations such that there are no assurances that some kind of important effect(s) would not occur and so applying a more stringent requirement is needed as a precaution. But such precaution does not necessarily require zero concentration, but a lower non-zero concentration.

Identification of the main elements of risk may be carried out in two directions using the retrospective approach and the prospective approach.

The **retrospective approach** works on the premise that there already exists information on the causal agent(s)—chemical, physical, biological, and that from this information, the target(s)—human, ecological or societal, can be identified and the likely effect(s) to the target calculated.

The **prospective approach** provides an estimation of the probability of effect given the distribution of effects in targets relative to exposure and the distribution of exposure concentrations through space and time.

Clearly the two approaches are related in that prospective analyses provide the basis for assertions made in retrospective analyses, and retrospective analyses provide a check on the predictions for prospective analyses thus helping the latter define appropriate issues for prospective analyses.

In both cases, it is important to ensure that the problem is clearly formulated in terms of targets, causal agents, and the boundaries of the study before proceeding to risk analysis and characterization and it should be clear that the risk assessment is being carried out to make conditions better, by management.

Application in the Straits of Malacca

As part of the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, an initial risk assessment was conducted in 1997 providing both a retrospective and prospective appraisal of the Malacca Straits (Calow and Forbes, 1997). The assessment was based on data from the Malacca Straits Environmental Profile (Chua et al., 1997).

Based largely on available information in the Profile, the approaches used for assessment and/or analysis focused on addressing two major concerns:

(1) What evidence is there for problems with: human health; habitats such as mangroves, peat swamps, seagrass beds and coral reefs; and commercial and non-commercial marine species? What are the likely causes (**retrospective approach**)?

(2) What problems might be caused to human health and ecological systems by conditions known to exist, or expected in the future, in the Straits (**prospective approach**)?

A separate assessment was employed on societal risk. When considering **societal risk assessment,** the project looked at the impact of environmental degradation and its effect on the economy of the Straits. This involves risk-benefit analyses that drew upon the risk assessments with emphasis on what should be done as societal priorities, with insufficient economic information available. However, the development of cost/benefit analysis models was deemed necessary and proposed as a future activity.

The Initial Risk Assessment of the Malacca Straits

Retrospective Assessment

The key ingredients of the retrospective risk assessment which were identified and applied in the Malacca Straits were:

- targets and endpoints;
- significant adverse changes;
- possible causes of these changes; and
- possible consequences of the changes for ecosystems and human welfare.

Ecological systems

The retrospective assessment showed clear indications of decline in mangroves, peat swamps, seagrass and commercially exploited fish species. Most of the declines were attributed to physical removal for biomass or to make way for development (***Table 1***).

Table 1: Summary of Retrospective Analysis of Declines in Key Habitats for the Straits as a Whole.

Habitat Type	Areal Extent	Decrease in Quantity	Decrease in Quality	Ecological Consequences	Economic Consequences
Mangroves	Large	Large	Moderate[S]	***	**
Peat swamps	Large	Large	NI	***	**
Coral reefs	Small	NI	Moderate to large	**	*
Seagrass beds	Moderate	NI	Moderate[S]	**	*
Soft bottoms	Large	No decrease	Moderate	**	**

Legend: *(NI = no information was provided in the Profile; S = information from Singapore; * = relative seriousness of consequences for ecology of the Straits or the economies of the littoral States).*

Biodiversity for commercial and non-commercial species in the Straits showed evidence of decline. The Indonesian sector showed a reducing catch per unit effort (CPUE) of pelagic fish with fishermen moving their activities from the Straits to other waters. The Malaysian side has also been experiencing a fall in total catch and catch rates, a fall in CPUE, as well as a reduction in the ratio of commercial fish to trash fish. The major causes of decline were attributed to overfishing, losses of nursery ground, and chronic and acute pollution of the Straits.

For non-commercial species, there was evidence of changes in species composition, disappearance of other species and increasing numbers of species being threatened. Sting rays and sea cows which were once abundant in the Straits, and other species associated with the seagrass ecosystem, have decreased in number, and are now scarce. In Singapore, a total of 77 species were recorded extinct—52 fish species; 13 species of corals and sea anemones; and 12 species of crustaceans—and more than 50 other species were considered threatened. Causes of reduction were attributed to loss of major habitats and direct ecotoxicological effects of contaminants of various kinds (***Table 2***).

Human health

The initial risk assessment was not able to provide an in-depth analysis on the state of human health, given that the Profile provided no specific quantitative information on the levels of morbidity and mortality for human populations in the littoral States. For future assessment, it was recommended that more needs to be known on the diets of people living in the littoral States and the extent of variability of contamination of shellfish.

Table 2: Summary of Retrospective Analysis of Decrease in Biodiversity in the Straits.

Biodiversity of	Evidence for Decline	Ecological Consequences	Economic Consequences
Non-commercial species	Little	Unknown	Unknown
Commercial species	Much	Unknown	Considerable

Prospective Assessment Using the Risk Quotient

The prospective analysis was directed towards estimating the probabilities within which activities, and the effects/actions/results emanating from these activities, were likely to cause problems for human health and ecological systems in and around the Straits. To arrive at (a) the distribution of effects in targets relative to exposure and (b) the distribution of exposure concentrations through space and time, the risk quotient approach was used.

Risk quotient approach generally compares the ratio of a measured or predicted environmental concentrations over threshold no-effect levels, such that:

$$\frac{\text{Estimated Exposure Concentration}}{\text{Threshold No-Effect Concentration}} = RQ$$

where

$RQ \geq 1$ (environmental concentration greater than the no-effect level) there is a problem or a likelihood of effect increases with the ratio

$RQ \leq 1$ (environmental concentration less than the no-effect level) problems are unlikely or the likelihood of effect is low and not of concern

Ecological system

For ecological risk assessment, the ratio of measured environmental concentrations (MECs) and/or predicted environmental concentrations (PECs) with predicted no-effect concentrations (PNECs) and/or standards (STD) were compared, such that:

$$RQ = \frac{\text{(MEC or PEC)}}{\text{(PNEC or STD)}}$$

Water column impacts on ecological systems of the Straits were rated in decreasing order of importance—mercury as a general contaminant; copper in certain locales; total suspended solids (TSS); oils and hydrocarbons; and tributyltin (TBT), in specific places. Not especially important were pesticides, biochemical oxygen demand (BOD) and nutrient contents of the Straits (***Table 3***).

Table 3: Concentrations and RQs of Heavy Metals in the Water Column for the West Coast of Peninsular Malaysia.

Metal	Highest Mean MEC (µg/l)	RQ[1]	RQ[2]	RQ[3]	FES[4]	BG (µg/l)[5]	BQ[6]
Lead	108	540	19	1	✓✓✓	0.001-0.05	108,000
Mercury	68	680	227	68	✓✓	0.0005-0.0025	136,000
Copper	34	34	11.7	0.34	✓✓	0.06-0.2	567
Cadmium	114	570	46	11	✓✓✓	0.04-0.011	28,500
Arsenic	8	?	?	0.08	✓	1-1.5	8
Chromium	62	?	?	0.12	✓	0.15-0.5	413

Legend: [1] - *RQs based on the national environmental standards (KLH, Indonesia);*
[2] - *RQs based on the Danish standards for environmental water quality;*
[3] - *RQs based on the Interim Standards for marine quality (DOE, Malaysia);*
[4] - *the relative frequency of samples exceeding the Danish standards and proportional to the number of ✓;*
[5] - *background values obtained from Laane (1992)*;*
[6] - *highest mean value/background value.*

Source: *Calow and Forbes (1997).*
**Laane, R.W.P.M., Editor. 1992. Background concentrations of natural compounds in rivers, seawater, atmosphere and mussels. Summary of the group reports during the International Workshop on Background Concentrations, 6-10 April 1992, The Hague, Rijkswaterstaat, Tidal Waters Division, Report DGW-92.003.*

Table 4: Risk Quotients for Pesticides in Sediments.

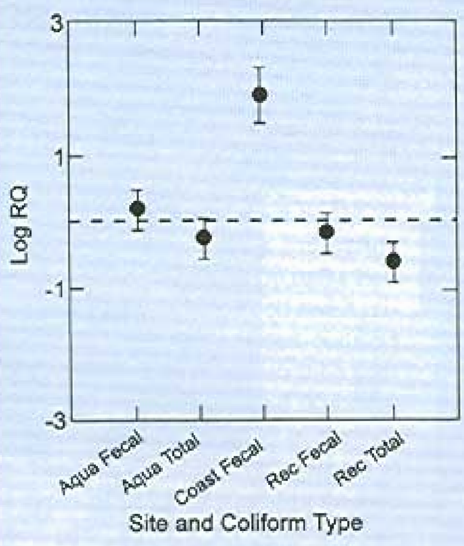
Pesticide Type	Highest MEC (GM MEC) (µg/kg)		Critical Sediment Concentration (µg/kg)	$RQ_{highest}$ (RQ_{GM})	
pp-DDT	5,392	(275)	158.9	33.9	(1.7)
Endrin	143	(31.6)	6.7	21.3	(4.7)
Dieldrin	4,374	(187)	14.9	293.6	(12.6)
Aldrin	4,374	(477)	17.1	255.8	(27.9)
Heptachlor	243	(15.6)	153.9	1.6	(0.1)
Endosulfan-I	1,448	(309)	0.4	3,620	(772.5)
λ-HCH	1,378	(52.5)	15.2	90.7	(3.5)

Legend: GM MEC - geometric mean of MEC

Source: Calow and Forbes (1997).

Notes: The highest MEC represents the worst-case scenario which is compared with the geometric mean of the ranges of MEC taken from Siak Estuary, Riau, Indonesia. Critical sediment concentration is the calculated sediment threshold concentration from published water quality criteria and the partition coefficient of the pesticide being assessed. The sediment RQ is the ratio of MEC (from sediment) and the critical sediment concentration.

Figure 1: Comparison of Mean Log RQs for Total and Fecal Coliforms among Different Types of Stations in the Straits.



Notes: *Error bars - 95% confidence limits; Aqua - aquaculture sites on the west coast of Peninsular Malaysia; Rec - recreational sites on the west coast of Peninsular Malaysia; Coast - coast sites.*

Likewise, sediment impacts on the ecological systems of the Malacca Straits showed the outstanding importance of pesticides, followed by oils and hydrocarbons, and metals in certain places (***Table 4***).

Results also show that accidents at sea can lead to acute exposures of oil and grease followed by chronic contamination. As far as oil tankers are concerned, it was concluded that accidental events are important with regard to contamination of localized areas in the Straits, rather than the Straits as a whole. In the same way, normal vessel operations can lead to oil losses which are believed to impact on specific resources and activities in the Straits.

Human health

For human health impacts, the ratio of measured effects level (MEL) and/or predicted effects level (PEL) and predicted no-effects level (PNEL) and/or tolerable daily intake (TDI) were compared, such that:

$$RQ = \frac{(MEL \text{ or } PEL)}{(PNEL \text{ or } TDI)}$$

Results show that coliform pollution, pesticide and metal contamination of food need further attention. A special effort is required to determine the extent to which shellfish and fish make up dietary intakes in the littoral States and the variability in contamination of shellfish and fish tissues from place to place and time to time. There is also a possibility of dermal exposure to these contaminants but not of great importance (***Figure 1***).

Due to insufficient data on the likely exposures to particular substance, either dermally or through the food chain, risk assessments could not be carried out for oils and hydrocarbons, though many of the possible hydrocarbons involved are known to be hazardous.

The RQ analysis provided initial insights into relative risks in the Straits. Although there are several uncertainties cited regarding the comparison of risks across different contaminants, the procedure can provide signposts as to where further effort and assessment are required. For example, if the RQs for any substance are less than 1, there would be no immediate causes for concern. On the other hand, if RQs are greater than 1,000, immediate risk reduction measures are probably warranted. Between these extremes, risks require more consideration, possibly with a more detailed risk assessment, and with increasing urgency as values increase in order of magnitude.

Comparative risk profiles for contaminants in the Straits, in terms of ecological entities, have been prepared. In ***Table 5***, the lines represent general conditions in the Straits, with their extent reflecting either different values for different species of contaminants and/or uncertainties. Points represent highest values at specific localities. It is important to highlight the fact that all RQs are based on conservative assumptions and often worst-case scenarios.

Table 5 also summarizes comparative uncertainty analyses as a basis for judging the strength of the assertions based on RQs and as a way of indicating where further work is required.

Table 5: Comparative Risks and Uncertainty Assessments for Ecological Entities Within the Straits for Waterborne Contaminants.

RQs → Contaminants ↓	<1	1-10	10-100	100-1,000	>1,000	Uncertainty (major sources)
Metals			———	———	Copper ● Port of Singapore	Stds
Pesticides	———	———				Variability in MECs
TBT		———		● Port Klang		"
BOD	———	———	E. Coast ● N. Sumatra			Lack of MECs
TSS	———	———	———			"
Oils & hydro-carbons			———		●● Kukup & Riau	Lack of STDs & MECs for specific HCs

Source: Calow and Forbes (1997).

A refined risk assessment is now underway taking into account those parameters and targets for which problems were identified. A more sophisticated approach will be utilized in predicting levels of the selected pollutants in the marine environment as well as employing more realistic assumptions of scenarios wherein human and ecological targets are exposed to pollutants. The refinement process will also include a critical review of uncertainties associated with the numerator and the denominator of the risk quotient, leading to conclusions on the reliability of the data, and the probability of the risk. In addition, efforts will focus on societal risk and the impact of marine pollution on the lives of peoples of the Straits.

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RAPID APPRAISAL OF ENVIRONMENTAL RISK FROM PESTICIDE POLLUTION IN BATANGAS BAY AND XIAMEN WATERS

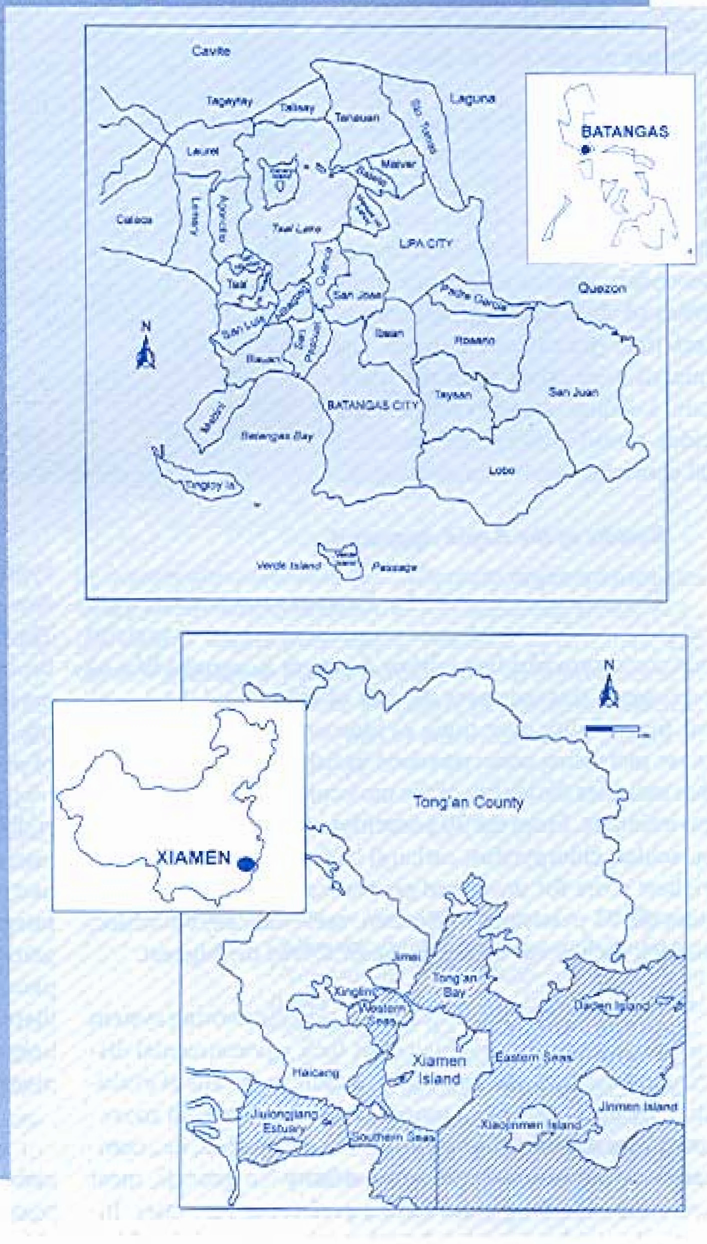
During the past several decades, pesticides have played a significant role in increasing agricultural production in the East Asian Region, and are viewed as the quickest path to food self-sufficiency. With increasing pesticide consumption, its environmental cost raises significant concerns. The problem is that even with extremely small amounts of pesticides applied on a given area, less than 0.1% of many insecticides actually reaches the target organisms. The remainder becomes an environmental contaminant. Applied pesticides can dissipate in the air as vapor, in the water as runoff, or in the soil by leaching to the groundwater. Many modern pesticides are particularly toxic to water-dwelling insects, plankton, crustaceans and fish. Some pesticides accumulate in the tissue of exposed organisms, extending their destructive potential far beyond the farm. Animals highest on the food chain, including humans, are often at the greatest risk.

A collaborative project on hazardous waste management was conducted through a Memorandum of Agreement between the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas (MPP-EAS) and the Food and Agriculture Organization of the United Nations (FAO) at the two MPP-EAS demonstration sites in Batangas Bay, Philippines and Xiamen, China. *Figure 1* shows the location of the two study areas. The specific objectives were to: a) identify the types of pesticides used in the two demonstration sites; b) rank the pesticides according to potential environmental risk; c) determine the environmental distribution and fate of pesticides at the sites; d) produce site-specific data for risk assessment studies; and e) recommend measures and actions to be taken to avoid or dissipate identified risks.

Risk Assessment Methods

Risk assessment is a process which involves many elements, i.e., hazard identification, effects assessment, exposure assessment and risk characterization. It is a process that can be performed at different levels of sophistication, from qualitative to precise evaluations, including statistical and probabilistic considerations.

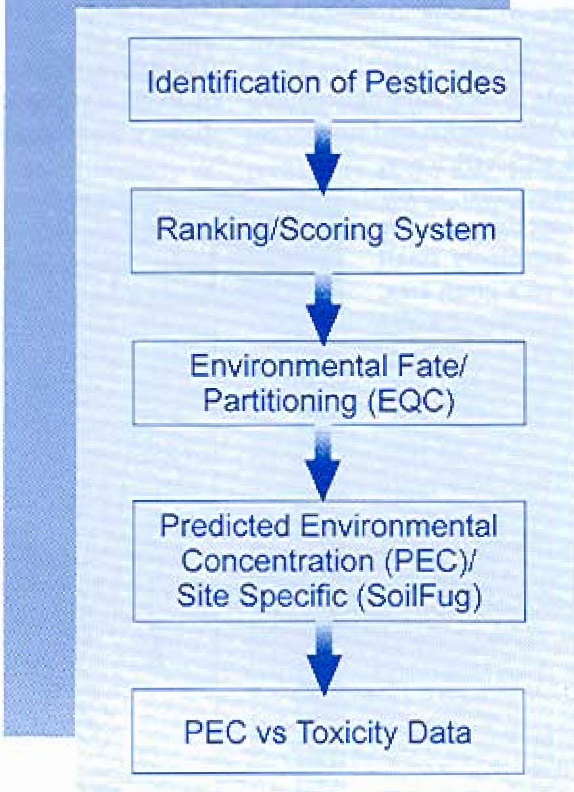
Figure 1: Study Areas on Pesticide Pollution in the Regional Programme Demonstration Sites of Batangas Bay, Philippines and Xiamen, China.



whenever possible or when considered necessary.

Initially, a compilation of data on toxicological properties of pesticides used at the two sites was made. A diagram on the assessment framework/methodology is shown in ***Figure 2***. The three methods applied were: a) the scoring or ranking system, which basically derives indices of risk among a group of pesticides; b) the EQC (equilibrium criteria) model, which calculates partitioning, transport and transformation of pesticides in the environment; and c) the SOILFUG (soil fugacity) model, which is used to predict potential surface water contamination derived from pesticide use on agricultural fields.

Figure 2: The Risk Assessment Framework/Methodology.



Information for the study came from the coastal environmental profiles of Batangas Bay and Xiamen, local government offices and institutions, private chemical dealers and secondary literature. Intrinsic properties of the chemicals, soil characteristics, groundwater depth and rainfall were taken from the literature. Loading rates of various pesticides, runoff rates and environmental concentrations were calculated.

Results of the Rapid Appraisal

The pesticides identified in Batangas and Xiamen were ranked according to intrinsic properties such as: a) toxicity that could provoke fish kills or damages to aquatic life; b) persistence that increases the risk of effects and the potential for mobility over time; c) bioaccumulation that could cause increasing concentrations in fish; and d) leachability that indicates the ability of the molecule to reach the aquatic environment. From the 30 pesticides identified in Batangas, butachlor, chlorpyrifos, carbaryl and cypermethrin had the highest score for unwanted properties. On the other hand, from the 25 pesticides in Xiamen, carbendazim, butachlor, dicofol, dichlorvos and carbofuran scored the highest.

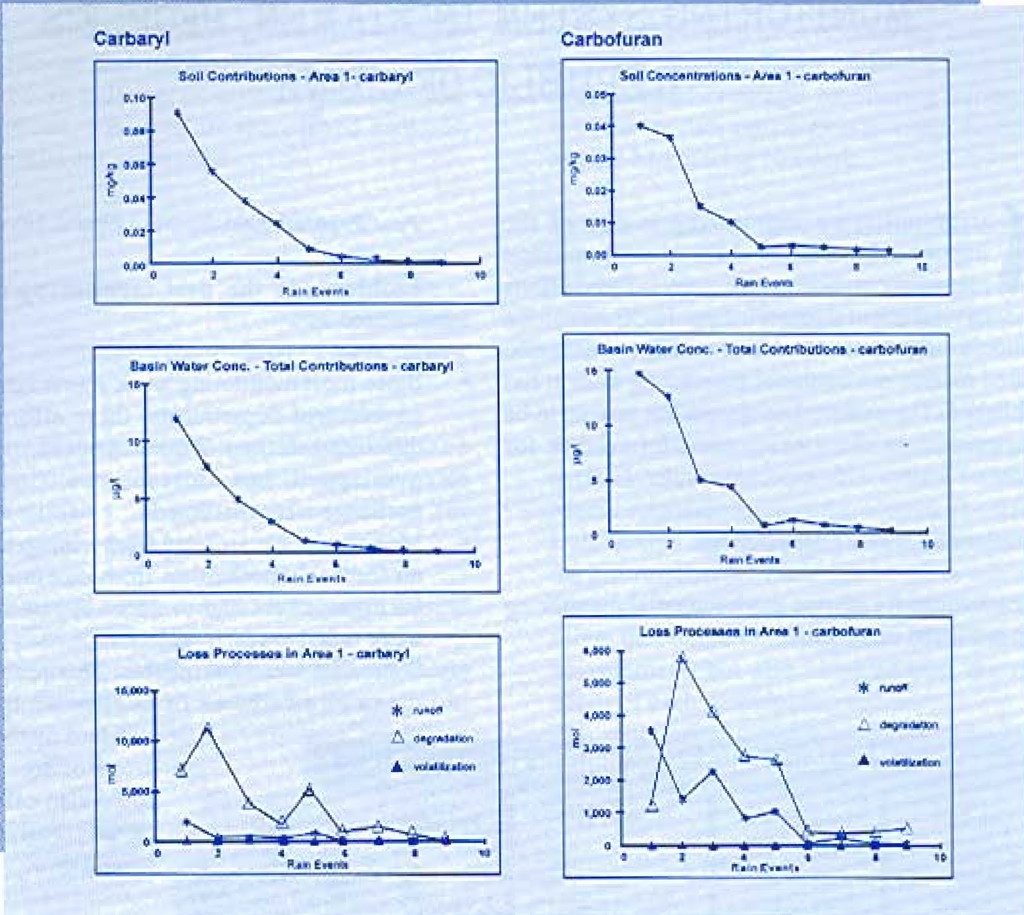
The chemicals identified in the ranking/scoring system method were further evaluated for their environmental distribution and fate, and potential exposure by means of evaluative models. The EQC model defines a chemical movement from its point of entry to its final destination, i.e., compartment for which it has more affinity. In general, most herbicides and fungicides have a preference for water. Insecticides such as organophosphates have a variety of behavior (e.g., chlorpyrifos has less affinity for water than metamidophos). Insecticides such as carbamates have a strong affinity for water while pyrethroids have an affinity mainly for soil.

After a generic evaluation of the chemicals at a certain stage using EQC, the SOILFUG model was applied. The evaluation requires information on the environmental media into which a substance used is discharged to identify site specific conditions where increase in concentration of the substance could occur. ***Figure 3*** shows the result of the SOILFUG modelling conducted at the two demonstration sites.

The results of the evaluation in Batangas Bay indicate that the insecticide carbaryl is a potential risk to aquatic fauna. However, it has less probability to affect marine life due to its short half-life, especially in saline environment. The extremely toxic insecticide cypermethrin has a low probability to reach marine waters due to its high affinity for suspended solids and sediments. There were some indications that certain pesticides such as the herbicide butachlor and insecticide chlorpyrifos may be present in marine waters, and should be considered a warning. Overall, the assessment indicates that agricultural use of pesticides in Batangas Bay under current conditions represent a relatively low risk to the marine environment. This is due primarily to the relatively low pesticide application rate, an average of 0.24 kg/ha, in the catchment basin. As part of the Philippine Department of Agriculture's ongoing Integrated Pest Management Program, environmentally dangerous pesticides (i.e., organochlorines and some organophosphates) have already been banned or regulated. Synthetic pyrethroids are mostly available in the market which help reduce consumption and increase efficiency of treatments.

In Xiamen waters, results show that the insecticide carbofuran is a potential risk to aquatic fauna. The herbicide butachlor and insecticide carbendazim are also a potential risk to fauna in marine waters. The use of the insecticide

Figure 3: SOILFUG Modelling Results for Carbaryl (Batangas Bay) and Carbofuran (Xiamen).



dichlorvos in the area at the current application rate probably causes, and will continue to cause, massive aquatic organism mortality. Agricultural usage of pesticides in Xiamen waters is a major concern due to the high application rate of pesticides (an average of 7.6 kg/ha) in the catchment basin and the rivers in the area are relatively short and thus, runoff waters enter the sea quickly. Mortality can be predicted where mariculture is intensively practiced. Considering retrospective risk assessment for persistent organochlorine chemicals in Xiamen waters, the situation is not serious for HCH; however, DDT is at present posing minor risks.

Measures and Actions to be Taken

In order to change the actual agricultural practices and improve the environmental condition with regard to pesticide use, recommendations for consideration were presented in the final report. In Batangas Bay, pesticide use, particularly of the insecticide carbaryl, should be reduced. In Xiamen, several recommendations were cited, namely: a) improvement/limitation of pesticide utilization; b) rotation of insecticide treatments (i.e., alternate organophosphates with pyrethroids); c) selection of less impacting groups (e.g., less mobile organophosphates, synthetic pyrethroids, and the new generation pseudopyrethroids); d) improvement of agricultural practices and, whenever possible, introduction of crop rotation systems; and e) enhancement of integrated pest management practices.

*Based on the paper presented by **Dr. Davide Calamari**, FAO Consultant and Professor, University of Milan, Italy and **Dr. Mario Delos Reyes**, Consultant, Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, at the Regional Workshop on Partnerships in the Application of Integrated Coastal Management, 12-14 November 1997, Burapha University, Bangsaen, Chonburi,*

DEVELOPING AN INTEGRATED MARINE POLLUTION MONITORING SYSTEM IN XIAMEN, PEOPLE'S REPUBLIC OF CHINA

Marine pollution monitoring is one of the important links in the chain of environmental management. There were many isolated efforts on marine environmental monitoring in Xiamen. To improve monitoring efforts to address management needs, an integrated marine environment monitoring system has been established. The monitoring system has proven to be a vital instrument in the management framework for Xiamen marine waters with expected results.

Institutions of Marine Monitoring

The institutions for marine environmental monitoring in Xiamen are listed in *Table 1*.

Table 1: Main Marine Monitoring Units in Xiamen.

Working Unit	Management Department	Work Area	Previous Monitoring Duty
Third Institute of Oceanography, SOA	State Oceanic Administration (SOA)	Marine science research, monitoring technical study	1. Xiamen marine investigation 2. Red tide study 3. Specific study tasks from SOA
Environmental Monitoring Station of Xiamen	Xiamen Environment Protection Bureau (EPB)	Environmental monitoring	1. Routine marine monitoring 2. Routine nearshore monitoring 3. Xiamen seas monitoring tasks from EPB
Environmental Research Center of Xiamen University	State Education Committee	Environmental science, research, education	Various tasks funded by the National Natural Science Fund
Monitoring Station of Fujian Fishery Institute	Fujian Aquaculture Department	Marine aquaculture, environmental monitoring	Routine marine aquaculture monitoring tasks from Fujian, Xiamen Aquaculture Department
Fujian Institute of Oceanography	Fujian Science and Technique Committee	Marine environmental research and study	
Monitoring Station of Xiamen Port	Xiamen Port	Port environmental monitoring	Routine port environmental monitoring (was not carried out before executing this subproject)

Past Problems

Problems in the past monitoring efforts can be summarized as:

- Since most monitoring work was funded by individual government departments, these efforts have gone in different directions. Work was not harmonized and often overlapped; human resources, finances and data exchange were inefficient.
- Monitoring was isolated from management. There was no feedback mechanism from monitoring to measures for management improvement. A part of the monitoring work failed to reach targets.
- Some data were not reliable. This problem was due to the poor awareness of quality control and lack of standard methodologies. Poor monitoring methodology could also caused a low level of reliability and comparability of the data.
- There was high cost with low output of useful information.
- Monitoring data were not effectively utilized. Data were mainly provided by the researchers in the form of scientific papers which were not suitable for use by managers and policy-makers.

Thus, a cross-sector marine monitoring was needed to overcome these problems and to meet management requirements.

The Xiamen Demonstration Project under the Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas (MPP-EAS) has brought together existing individual monitoring efforts, encouraged sharing of experience and information and developed a collaborative network and program under which monitoring efforts are optimized, resources are shared, and methods, standards and results are exchanged.

Setting Up the Marine Monitoring Network

Network Organization

Table 2 is a summary of the division of work among the network members.

Each participating institution designates one coordinator. The coordinators then form a panel to guide the network activities. The terms of reference for coordinators are as follows:

- to coordinate and carry out the integrated marine monitoring plan of Xiamen;
- to standardize the monitoring technique of the network;
- to organize training and interlaboratory analytical calibration;

Table 2: The Network of Marine Monitoring in Xiamen.

Working Unit	Assignments
Third Institute of Oceanography, SOA	Routine water quality monitoring Poisonous residuals in organisms
Environmental Monitoring Station of Xiamen	Surface seawater quality monitoring
Environmental Research Center of Xiamen University	Sea bathing water monitoring
Monitoring Station of Fujian Fishery Institute	Aquaculture area monitoring
Fujian Institute of Oceanography	Sediment monitoring
Monitoring Station of Xiamen Port	Port environment monitoring

- to supervise quality control and data examination;
- to summarize and analyze monitoring data, as well as to compile reports;
- to assess the results of environmental management and to provide suggestions for management improvement;
- to submit and exchange monitoring information; and
- to exchange data and cooperate within the Eastern Asia Marine Monitoring Network.

Incentives for Participation in the Network

For the first time, Xiamen has organized a cross-sectoral monitoring network. The network has shown certain advantages such as:

- Human resources and finances can be used more efficiently within an integrated monitoring plan for the network.
- Monitoring techniques and quality can be standardized. Data quality and comparability can be enhanced and the information provided can be more valuable.
- Data and information can be shared, which not only serves the integrated management of the Xiamen marine environment, but also helps address the monitoring needs of each participating sector.
- The monitoring capability and performance can be improved through cooperation, training and technical assistance among the network members.

Integrated Marine Pollution Monitoring Program

In order to successfully execute marine monitoring, a comprehensive monitoring plan and a team with high caliber technical expertise were needed.

The monitoring plan included six items:

- large-scale water quality monitoring;
- 24-hour continuous water quality monitoring at selected sites;
- monitoring of aquaculture areas and sea bathing water quality;
- port water quality monitoring;
- monitoring of poisonous residuals in organisms; and
- sediment monitoring.

Characteristics of the Integrated Monitoring Program for the Marine Environment

- The monitoring program did not replace the existing sectoral monitoring plans of the participating institutions but sought coordination and standardization among them.
- The integrated monitoring program was comprehensive and systematic. For example, the monitoring of bathing

water quality, continuous monitoring at selected sites, poisonous residuals in biota and sediment monitoring were included.

- Standards for data quality control were prepared and implemented. The monitoring work is under the supervision of the network, therefore data quality can be assured across the network.
- The program has taken the experiences and results from previous monitoring work. Pollution sources and hot spots, pollutant characteristics and monitoring results have been fully considered in the program.

Compilation of Technical Standards for Marine Pollution Monitoring

A set of technical standards for monitoring marine pollution in Xiamen has been compiled to meet the requirements of monitoring techniques and data quality control. The standards include general monitoring protocols on sampling, sample storage, transportation and management, monitoring technique, data recording, calculation and quality control. Compared to national marine monitoring standards, the Xiamen standards are more practical.

Seawater Quality Standards in Xiamen

A basic principle that was adhered to when developing seawater quality standards in Xiamen (local standards) was that the local standard must be compatible with the national standard. Experiences from domestic and foreign standards were adopted and combined, taking into account environmental and socioeconomic conditions and the environmental management plan of Xiamen.

Local Standards and National Standards

Scope of application. The local standards define water quality management targets for various functional zones.

Water quality parameters. Eighteen parameters were chosen from the 34 parameters in the national standards. The selection was based on the Xiamen conditions and water use.

Standard values. Almost all the water quality standards adopted in Xiamen were the same as the national standards. However, maximum values for suspended particle material (SPM) and temperature were added.

Monitoring seawater quality. Details about monitoring parameters, sampling station, sampling type, sampling frequency and layers for each monitoring project (including routine monitoring, functional zone monitoring and emergency monitoring) were defined. Methods of sample collection, storage, transportation, analytical methods and data processing were detailed.

Capacity Building Activities

Interlaboratory Analytical Calibration in the Monitoring Network

An interlaboratory analytical calibration was conducted among the network members for the first time in Xiamen before carrying out the monitoring program. Samples included standards and real samples, e.g., water, sediment and organisms. The monitoring parameters included nutrients, petroleum and heavy trace metals. The results of the calibration were significant. Many laboratories accurately analyzed most items. However, it was also learned that a few laboratories need to improve their analytical techniques.

Workshops in Marine Environmental Monitoring at Xiamen Demonstration Site

Workshops in marine environmental monitoring were held to increase awareness of the monitoring results. The workshops addressed the following topics:

- the effective use of marine environmental monitoring in managing seas areas;
- the design and illustration of the integrated marine monitoring program;
- the compilation and introduction of marine monitoring standards;
- quality control and assurance; and
- data management and reporting.

Monitoring to Address Management Needs

The following approaches were adopted for the assessment.

Pollution Index

If the pollution index (the value of analytical results divided by the standard value of water quality) is less than or equal to 1, the parameter meets the requirement of water quality; otherwise the parameter does not meet the requirement of water quality.

The results of the Xiamen Sea water quality assessment showed that the concentrations of phosphorus (P) and non-ion ammonium are less than standard values, but the total nitrogen

(N) concentrations are apparently beyond the standard values.

Determining the Ratio of N to P

In Xiamen Sea water, the ratio of N to P is higher than 16:1, especially in spring. Therefore, to avoid eutrophication, the concentration of P is a control element and an important monitoring parameter. The high ratio of N to P may change the composition of plankton communities and enhance the possibility of red tide occurrence.

Monitoring the Effectiveness of Management Interventions

From 1980 to 1996, the GNP of Xiamen increased 20 times and the population doubled. However, these have not led to a corresponding level of deterioration in marine environmental quality due to effective management interventions.

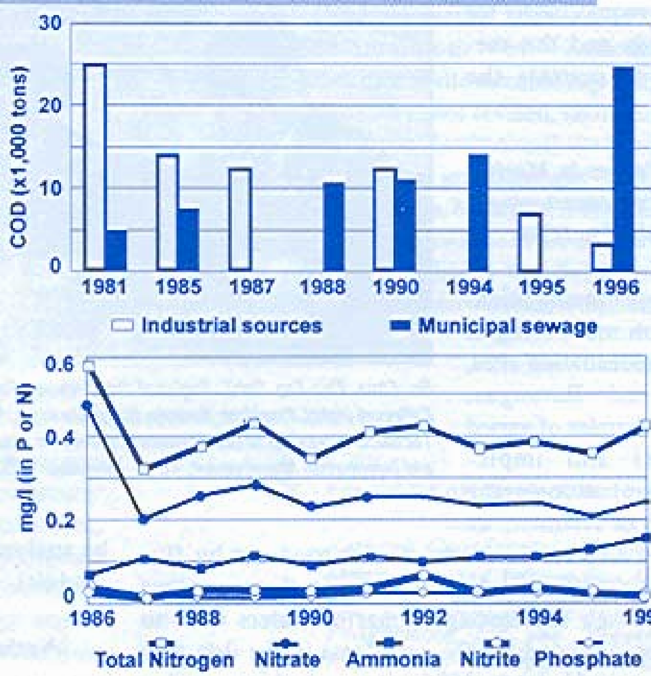
The levelling off of nutrients is believed to be a direct result of pollution management interventions. From 1981 to 1996, the total amount of chemical oxygen demand (COD) discharges from industrial sources into Xiamen coastal waters was reduced from 25,100 tons to 3,200 tons. Nevertheless, the amount of COD from municipal sewage discharges increased from 4,900 tons to 25,000 tons. The cumulative effect was that the total amount of COD remained at the same level (see ***Figure 1***).

Within the Western Sea area of Xiamen, variations in average concentrations of nutrients have occurred over the past ten years. The average levels of nitrogen and phosphate, which are believed to trigger red tide occurrence, were 0.100 mg/l and 0.015 mg/l, respectively. Average concentrations of total nitrogen, nitrate and phosphate in 1996, although beyond the red tide thresholds, were lower than those in 1986. On balance, nutrient concentrations levelled off during the past ten years, except for a slight upward trend for ammonia which merits attention (see ***Figure 2***). Red tide events were observed in the Western Sea of Xiamen in 1986 and 1987, but not after 1990.

***Xu Kuncan**, Professor, Third Institute of Oceanography, State Oceanic Administration and **Hong Lijuan**, Vice Director, Environment Monitoring Station of Xiamen Port Authority*

Figure 1: COD Discharges in Xiamen Coastal Waters, 1981-1996.

Figure 2: Average Nutrient Levels in Western Coastal Waters of Xiamen, 1986-1996.



THE SECOND TECHNICAL WORKSHOP OF THE REGIONAL NETWORK FOR MARINE POLLUTION MONITORING AND INFORMATION MANAGEMENT

The Second Technical Workshop of the Regional Network for Marine Pollution Monitoring and Information Management was held on 10-11 November 1997 in Burapha University, Bangsaen, Chonburi, Thailand.

The meeting was intended to follow through the first workshop of the MPMIM Network held in 1996 and to enable participants from various countries in the region to share experiences on marine pollution monitoring as applied to ICM and related sites. The workshop discussed the strategies and mechanisms used to develop, initiate and sustain marine pollution monitoring programs at ICM sites and the problems encountered while going through the process. The forum discussed two documents, one on land-based sources of pollution and the other on the state of the marine environment in the East Asian Seas region. The two-day meeting discussed the purposes and benefits of the Marine Pollution Monitoring and Information Management Network, the types of and the requirements for membership and the mechanisms to operate the Network.

Dr. Chua Thia-Eng (left), Regional Programme Manager and Dr. Phasook Kullavanij (right), President, Burapha University during the opening of the Second Technical Workshop of the Regional Network for Marine Pollution Monitoring and Information Management, 10-11 November 1997, Chonburi, Thailand.

Experiences in Marine Pollution Monitoring as Applied to ICM

The paper presentations on pollution monitoring at the two demonstration sites, Xiamen and Batangas, provided examples of varied approaches and implementation of monitoring programs. In Xiamen, an operational monitoring program is carried out by five government institutions and a state university that at one time went about their monitoring of marine waters with no coordination or regard for the usefulness of the data they were generating. Under the ICM framework, this group has rationalized their monitoring tasks and optimized the sampling and monitoring program so that now their efforts complement rather than duplicate. Results of intercomparison exercises among the participating organizations have shown that, except for a few parameters, the laboratories are able to obtain accurate and comparable results for the parameters being monitored. The data acquired are now being assessed and will be packaged to provide guidance to the local government.

The monitoring program being initiated in Batangas, on the other hand, seeks to bring together the resources of the local government, national line agencies and the private sector in implementing environmental monitoring of the bay. One factor that has helped bring about the cooperation of the private sector to this monitoring effort is the prior existence of an organization of industries operating around Batangas Bay that has expressed and shown its commitment to protect the environment. Moreover, the strategy adopted for the monitoring program, whose principal facilitator is the newly-created Environment and Natural Resources Office of the provincial government of Batangas, was to focus on environmental (receiving waters) rather than compliance (end-of-pipe) monitoring.

Discussions ensued about the applicability of these two monitoring approaches to other sites and countries, the necessity of coupling the monitoring effort to specific sites and the ICM framework, and other ways by which data could be analyzed and processed (e.g., the utility of numerical models).

National Profiles of Marine Pollution

The presentation on national profiles of marine pollution described the continuing efforts to produce profiles on land-based sources of pollution in the region to update the IMO global waste survey conducted several years ago. At present, the documents from the different countries are at varying stages of completion. An effort was made during the discussion to identify the institutions or individuals tasked to complete the country documents and the required action from the Programme to facilitate the submission of the documents by the end of the year.

State of the Marine Environment in the East Asian Seas

The document on the state of the marine environment in the East Asian Seas region referred to the effort in the late 1980s to assess the status of the marine environment in the region which resulted in the GESAMP report published in 1990. The major environment issues recognized then were summarized and compared with what is perceived to be the major issues in the region today. Many of the problems have remained, albeit, increasing in severity. These include: nutrient enrichment and eutrophication; harmful algal blooms; wastes from agriculture, aquaculture and mariculture; wastes from industries particularly trace metals; and, oil and petroleum hydrocarbons. Plastics and endocrine-disrupting chemicals in the marine environment were cited as emerging issues that should be given attention in the region. The meeting discussed the need to consider scaling down of monitoring efforts on trace elements in seawater in response to the assessment made that of the dozen or so trace metals routinely monitored, only two or three elements appear to be environmentally critical. Various regional initiatives to address marine pollution were also summarized and the need for better coordination and complementation of these efforts. Finally, the paper discussed the future and the effort to address site-specific marine pollution issues through the ICM framework.

Lessons Learned from Monitoring Activities

A discussion was undertaken on the experiences and lessons learned vis-à-vis monitoring (e.g., quality assurance/quality control, the choices of parameters to be monitored, and packaging of data and information). The meeting agreed to continue to adopt "Category 1" parameters proposed by the HOTO/GOOS panel which are of medium or high impact but are relatively easy to measure. These parameters include nutrients, human pathogens, dissolved oxygen, suspended particulates, phytoplankton pigments, litter/plastics and petroleum (oil).

MPMIM Network

A presentation was made on the MPMIM Network—its objectives, benefits and obligations of members. The discussion that followed amplified on the advantages in joining the Network to institutions and ICM sites. Benefits derived by Network members of pollution monitoring data were also highlighted. The meeting recognized the difficulties of some countries to share pollution monitoring data but agreed that processed information, instead of raw data, could be shared. Initially no fixed format would be required to be used by network members in the provision of data but rather members could choose from among the various formats that pollution information are packaged. Where available, members would be encouraged to establish their own Web pages on the Internet to allow them greater flexibility in determining the data that they are able to share. The meeting also recognized the need to have not only institutional membership but also personal membership to the Network. All participants to the meeting would automatically be subscribed to the electronic mailing list of the Network and, at the very least, members would derive benefits by obtaining greater access to information and advice from members. However, institutional members of the Network would obtain other benefits such as a free standard reference materials for relevant matrices and parameters, subscription to marine pollution research titles, and technical assistance for monitoring, as needed.

... agreed that processed information, instead of raw data, could be shared...

The meeting considered a draft Memorandum of Agreement for institutional/site membership to the Network which was later revised, taking into account the comments of the group. Institutional site/membership is assured for Xiamen (China) and Batangas (Philippines); is likely in the case of Cambodia, Malaysia, Indonesia, Republic of Korea and Vietnam; and possible in the case of Singapore. Participants promised to bring the document to their respective authorities for their consideration and possible favorable action.

For details on the workshop and the paper presentations, please contact ***Dr. Gil Jacinto****, Network Coordinator, Marine Pollution Monitoring and Information Management Network, GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, P.O. Box 2502, Quezon City 1165, Manila, Philippines.*

ECOLOGICAL AND SOCIOECONOMIC IMPACT ASSESSMENT OF COASTAL ECONOMIC DEVELOPMENT IN XIAMEN, CHINA

Xiamen is known for its beautiful subtropical scenery and is one of the earliest international ports (formerly known as Amoy) in China after the Opium War (1840). Located in the southeast coast of China, Xiamen has a coastline of 134 km and a sea area of 334 km². Its economy is highly dependent on the sea as evidenced by the construction of ports, coastal infrastructure, tourism, aquaculture, industry and development. Xiamen is one of the five special economic zones of China.

Because of rapid socioeconomic growth and the expanding use of coastal resources, Xiamen is now under increasing environmental pressure. Xiamen's population has increased rapidly due to a high demand in manpower needed for the growing economy. Already more than half of the mangrove resources have been destroyed. Sea reclamation has reduced tideland and accelerated sedimentation, while sewage and other forms of wastes are being discharged into the sea, thus increasing eutrophication.

To ensure Xiamen's sustainable development, the environmental problems have to be identified and solved. For this to happen, an integrated impact assessment of the economic development along the coastal zone was needed.

Impact Assessment for Management Improvement

In March 1996, the municipal government of Xiamen appointed a Scientific Expert Committee made up of top scientists and experts. This put into place the infrastructure which made scientific inputs into management possible. Management-oriented research was organized. The results were readily usable for environmental impact assessment and provided a basis for the development of the Marine Functional Zonation Scheme and the Marine Economic Development Programme.

Methodological Framework

In the conduct of impact assessment, a methodological framework was developed integrating ecological and socioeconomic assessment (see ***Figure 1***). For ecological impacts, various indicators were used as shown in ***Table 1***. The social and economic impacts were assessed in terms of population patterns, human health, food security, employment and equity.

The framework looks into the nature and extent of impacts on the ecosystem by coastal economic activities, quantifies economic loss associated with the adverse ecosystem changes, and defines direction and measures for improving management. A multi-disciplinary team was organized; sharing of ideas occurred among various team members through meetings held during the implementation of the project to work out the linkages and improve understanding of the results from the disciplinary studies. Primary and secondary data on various environmental and socioeconomic aspects of coastal activities in Xiamen were consolidated as baseline information.

Figure 1. Methodological Framework for Integrated Ecological and Socioeconomic Impact Assessment.

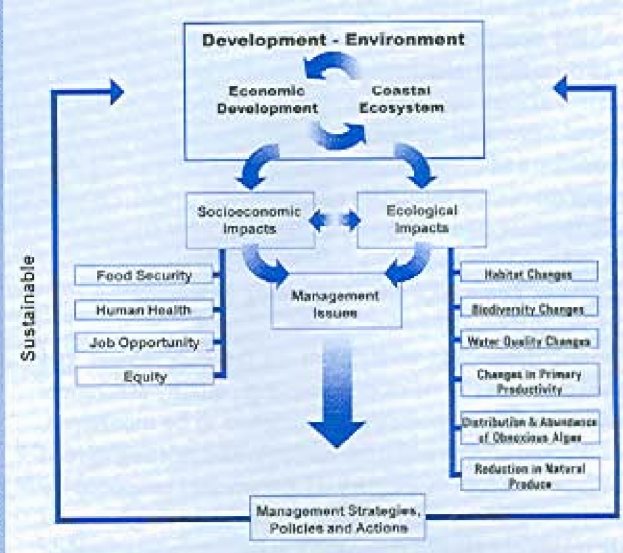


Table 1: Ecological Evaluation Index Factors for Xiamen.

National Index Factors	Special Index Factors
Chemical factors (water quality, sediment, organism)	Chinese white dolphin (*Sousa chinensis*)
Vegetation	Egret
Benthic fauna	Lancelet
Phytoplankton	Mangrove

Ecosystem Impacts

The assessment framework was applied to three representative areas in Xiamen, which brought to light numerous problems that threaten the Xiamen coastal zone.

The Western Sea

Results showed that coastal construction projects and long-term pollutant discharges were having cumulative impacts in the Western Sea water and sediment.

The direct impacts were the change in geomorphology and the reduction of water surface area. For instance, to meet the requirements for transportation and land use, several dikes were constructed from 1950 to the 1970s and large area reclamation was carried out. Thus, tidal flushing in the Western Sea was reduced by 69.4%.

Changes also occurred in the hydrological circulation pattern and siltation velocity. As the tidal influx volume was reduced, the tidal flushing capacity weakened and sedimentation accelerated. Dredging activities increased just to maintain an acceptable depth for navigation. These activities consumed resources that could have been used for the development of the port and shipping industry in Xiamen.

The Western Sea is the recipient of about 80% of all land-based wastes in this highly industrialized and populated area. Only 40% of the wastes are treated before being discharged into the sea. With tidal flushing reduced, the deterioration of water quality accelerated. The average chemical oxygen demand (COD) increased twofold in five years and nitrogen levels exceeded the State Marine Water Quality Standards by 100%.

The effects were enormous. Fishing grounds were destroyed and sightings of the Chinese white dolphin (*Sousa chinensis*) decreased. Polychaete dominated 50% of the bottom species, indicating contamination of the sediments.

Tong'an Bay

Tong'an Bay is earmarked as an aquaculture area for Xiamen City. Presently, aquaculture comprises 44 km^2 or 51% of the total suitable aquaculture area. The cultured species are mainly oyster and shrimp with a multi-structure culture pattern being used.

Culture waters and tidal prism of the bay have been reduced due to a large area reclamation project. This has resulted in significant deterioration of the hydrodynamic conditions and water exchange capacity of the bay, serious depositions and a decrease in carrying capacity.

In recent years, industrial areas along Tongji Highway and near Tong'an town have rapidly developed and wastewater from these areas discharge into the western and northwestern inner bay of Tong'an Bay with only partial treatment.

It is predicted that by the year 2000, Tong'an Bay will be unsuitable for aquaculture. The water quality prediction for the next five years indicates incremental COD increases of 0.25 mg/l (mean), providing an early warning of the organic pollution problems of Tong'an Bay.

Eastern Coastline

The eastern coastline (from Xiamen University in the south to Wutong in the north) is the longest and widest white sand beach and fishing area in Xiamen Island. Regarded as the best tourist spot in Xiamen, there has been an increase in tourist visits. This has resulted in degradation of the coastal area, including destruction of trees, wastewater discharging directly through the beach and beach litter.

Environmental Cost

Estimates of environmental cost associated with coastal development have been calculated (see ***Table 2***)

Table 2: Environmental Cost Estimates of Adverse Ecosystem Changes.

Issues	Cost (million yuan/year)
Aquaculture loss from pollution accidents	0.66
Fishery loss from inappropriate fishing methods such as the use of explosives, poisons, electricity	0.25
Cost of removing sea floating refuse	1.00
Cost of dredging navigation/port area	1.72
Cost of Yuandang Lagoon treatment	35.00
Cost of establishing/maintaining Egret Nature Conservation Zone	0.20
Cost of establishing/maintaining *Branchiostoma belcheri* Gray Nature Conservation Zone	0.10
Economic loss from sand beach erosion	>0.30
Economic loss from coastal bank erosion	16.00
Ecological loss from oil spills/discharges	difficult to count

Due to information limitation and uncertainties, experts believed that the numbers given in the table could be underestimates, as most of the values used in the analysis are direct and tangible economic losses, and the costs of chronic and cumulative effects were not considered. The economic analysis provides the basis for a benefit-cost appraisal of proposed management interventions.

Mitigative Measures

Models of the Western Sea suggest that opening the Maluan Dam will increase tidal influxes, thus accelerating the rate of flow of the whole Western Sea. The increased flow rate would reduce marine siltation in navigation channels which would in turn benefit the shipping industry.

A project on preliminary treatment of Xiamen University Beach, conducted in 1995, enhanced control over direct sewage discharges, strengthened the cleaning and management of the beach area. As a result, Xiamen University Beach has been restored and has become a beautiful public recreation site once again.

The government has paid much attention to the advice provided by the Scientific Expert Committee. The management-oriented research is addressing existing and potential conflicts between future development and the ecosystem of the Xiamen Sea.

***Hong Huasheng and Xue Xiongzhi**, The Research Laboratory of SEDC of Marine Ecological Environment, College of Oceanography and Environmental Science, Xiamen University, Xiamen, People's Republic of China*

Newsbriefs

The Global Environment Facility (GEF) /United Nations Development Programme (UNDP)/ International Maritime Organization (IMO) Regional Programme for Marine Pollution Prevention and Management in the East Asian Seas (MPP-EAS) is now on its fourth year of implementation. The Programme is participated in by Brunei Darussalam, Cambodia, China, DPR Korea, Indonesia, Malaysia, Philippines, Republic of Korea, Singapore, Thailand and Vietnam. This section highlights recent activities of the Programme from August to December 1997.

REGIONAL PROGRAMME

Fourth Programme Steering Committee Endorses New Project Proposal

The Government of Vietnam hosted the Fourth Programme Steering Committee (PSC) Meeting from 15 to18 December 1997 in Hanoi. It was attended by delegates from the 11 participating countries.

Among the observers to the meeting were representatives from the Government of Japan, United Nations Industrial Development Organization (UNIDO), the Intergovernmental Oceanographic Commission/ Subcommission for the Western Pacific (IOC/WESTPAC), the Malacca Strait Council, the Japanese Association of Marine Safety (JAMS), the World Conservation Union (IUCN) Hanoi, the World Wildlife Fund (WWF), the Swedish International Cooperation Development Agency (Sida) and the Coastal Management Center (CMC).

The PSC meeting comprises a technical session and a Tripartite Review session. The participation in the latter session is limited to participating countries, UNDP and IMO.

Technical Session. In the technical session, the meeting concluded that the Programme has made significant progress particularly in the development and testing of working models for ICM, risk assessment/risk management and innovative approaches to sustainable financing. The meeting noted the positive assessment of the Regional Programme's performance by the external mid-term review.

Unanimous support was expressed for a new GEF project proposal "Building Partnerships for the Environmental Protection and Management of the East Asian Seas". The meeting considered that the project proposal provided opportunities to: a) develop ICM demonstration sites to address various environmental concerns which were not yet tested in the GEF pilot phase; b) adopt the innovative approach and methodologies developed during the pilot phase in the planning and management of coastal areas throughout the region; c) enable the region to deal with coastal and transboundary problems especially at the local and subregional levels; and d) strengthen regional commitment through a sustainable regional mechanism.

The participants of the session recommended that the Programme be extended to 30 June 1999 at no additional cost to GEF to enable the conduct of an international conference on the Programme outputs, the completion of technical reports and the dissemination of scientific and technical information to all participating countries.

Tripartite Review. At the Tripartite Review, the meeting expressed general satisfaction with the Project Performance Evaluation Report (PPER) of the Regional Programme. The conclusions and recommendations of the Technical Session of the Fourth PSC meeting were adopted as Tripartite Review actions including the revised Programme activities, the 1998 workplan and budget, and the 1999 Programme extension workplan and budget.

Regional Workshop on Partnerships in the Application of Integrated Coastal Management

A Regional Workshop on Partnerships in the Application of Integrated Coastal Management (ICM) was held in Burapha University, Bangsaen, Chonburi, Thailand on 12-14 November 1997. It was organized by the Regional Programme in collaboration with Burapha University and co-hosted by eight local government agencies and local institutions. The workshop extended the experiences gained and lessons learned from the ICM demonstration projects in Batangas Bay, Philippines and Xiamen, People's Republic of China; promoted regional networking of local governments operating ICM programs; and fostered partnerships among organizations implementing ICM programs.

The meeting was attended by about 120 participants and observers from the East Asian Seas region including Japan, consisting primarily of government

Newsbriefs

The Regional Workshop on Partnerships in the Application of Integrated Coastal Management was attended by around 120 participants and observers from the East Asian Seas region, some of whom are shown in this photo at the Institute of Marine Science in Burapha University, Chonburi, Thailand.

officials, university professors and individuals from the private sector. There were also representatives from the Wetlands International Asia-Pacific, IUCN, IOC/WESTPAC, Food and Agriculture Organization, and from Coastal Resources Management Projects in Indonesia, Malaysia and the Philippines.

Thirty-five papers were presented in nine sessions which cover policy and institutional arrangements, marine pollution monitoring, financing waste management, scientific support systems, capacity building, national ICM initiatives, partnership and networking. Drs. Chua Thia-Eng, Huming Yu, Gil Jacinto, Mario Delos Reyes and Mr. Adrian Ross of the Regional Programme presented papers.

The ultimate goal of the event was to establish a regional network of ICM sites, to serve as a "self-help" mechanism for local governments that are currently involved in planning to develop this innovative approach to managing their coastal areas.

BATANGAS BAY DEMONSTRATION PROJECT

Preparation of a Water Use Zonation Scheme

A two-phase validation workshop was conducted on 20 August and 10 September 1997, with the objective to verify and possibly resolve major issues raised in the initial draft report on functional zonation in Batangas Bay. The workshop focused on actual or potential conflicts between and among stakeholders claiming the right to use part or the whole of the bay. The workshop was attended by representatives from local government units, the Municipal Planning and Development Office of the coastal municipalities and city, the Provincial Planning and Development Office, the Programme Development and Management Office and the Environment and Natural Resources Office of the Provincial Government of Batangas, Philippines.

Workshop on the Implementation of the Local Government Code in Relation to Integrated Coastal Management in the Batangas Bay Region

The workshop, held on 19-20 November 1997, developed an action plan to identify approaches, options, strategies and mechanisms for improving the implementation of the Local Government Code as well as to draft provincial and municipal model ordinances for integrated environmental management system in the Batangas Bay Region.

The action plan and draft ordinances address issues on jurisdiction, monitoring and assessment within the ICM program framework; coordination and administration among government agencies and levels of government; and sustainable financing of marine pollution and ICM programs.

The workshop was organized by the Department of Environment and Natural Resources and the Regional

Programme in collaboration with the Environment and Natural Resources Office of the Provincial Government of Batangas. Twenty-six representatives from the local government, national agencies and industries participated in the workshop.

MALACCA STRAITS DEMONSTRATION PROJECT

Workshop on the Development of Methodology for Resource Valuation and Cost-Benefit Analysis in the Straits of Malacca

The Regional Programme convened scientists and experts involved in the Malacca Straits Demonstration Project at Genting Highlands, Malaysia on 18-21 September 1997. The purpose of the workshop was to get a consensus among participating institutions on the development of a framework for resource valuation and cost-benefit analysis in the Straits.

Twenty-five experts from various academic and government institutions from the three littoral States (Malaysia, Singapore and Indonesia) attended the workshop to discuss the methodologies to be used and information needs. Participants approved the use of an Economic Valuation Framework for the Straits which involves the identification of direct and indirect uses of coastal resources.

The analysis will be included in the risk assessment and risk management framework for the Straits of Malacca.

INTERNATIONAL CONVENTIONS

International Conventions: A Report Card on Awareness Building

Within a span of four years, the number of international conventions ratified by the eleven participating countries in the Regional Programme increased from 34 in 1994 to 64 in 1997, with Malaysia and the Republic of Korea leading the way, with a combined total of 12 accessions.

The International Convention for the Prevention of Pollution from Ships, or MARPOL 73/78, will soon attain universality in the region. The remaining non-members of the convention, the Philippines and Thailand, are well on their way to the ratification, with the Regional Programme providing technical and legal support to the effort in the Philippines.

The year 1997 was particularly busy, as it saw the first three adherents of the 1992 CLC and FUND Protocols in the region—the Republic of Korea, the Philippines and Singapore—and the first for OPRC, Malaysia. Malaysia also ratified MARPOL Annexes 1, 2 and 5.

The major reason for this turnout is the enhanced awareness on the benefits of global instruments. The Regional Programme has contributed to such enhancement through the various workshops, establishment of a legal information database and a regional network of interested legal practitioners.

CAPACITY BUILDING

Third Regional ICM Training Course

A training course on the Application of Integrated Coastal Management (ICM) System in Marine Pollution Prevention and Management was held on 6 to 26 October 1997 in the Philippines, People's Republic of China and Singapore. The course aimed to strengthen the abilities of the participants on ICM strategic management planning with emphasis on marine pollution prevention and management.

One of the participants, H.E. Ambassador Fernando Gonzales Guyer of Uruguay commented that "The training course contributed to confirming many of my convictions, intuitions and 'suspicions' about the essence of ICM programs, helped me understand the functioning of useful ICM instruments and techniques that were only known to me by reference (e.g., GIS), and changed also profoundly my perceptions with regard to several aspects of the ICM process, for example, the inter-relations between research and management."

Twenty-two participants from Cambodia, China, Indonesia, Kenya, Malaysia, the Philippines, Sri Lanka, Thailand, Uruguay and Vietnam, Thirty-five experts/specialists served as resource persons for the course.

The training course was co-sponsored by the Regional Programme, Coastal Management Center (CMC), Swedish International Development Cooperation Agency (Sida) and the International Development Research Centre (IDRC). Co-organizers of the course included the Marine Science Institute of the University of the Philippines, Office of the Xiamen Demonstration Project and School of Biological Sciences of the National University of Singapore.

ICM Training Course Participants in Singapore.

Integrated Environmental Impact Assessment (IEIA) for Coastal and Marine Areas Training Workshop

An IEIA training workshop was held on 2-7 December 1997 at the City University of Hongkong hosted by the Centre for Environmental Science and Technology (CEST). It was sponsored by the Swedish Agency for Research Cooperation in Developing Countries (Sida) and organized by the Coastal Management Center (CMC), the CEST of the University of Hongkong, and the Regional Programme. The gathering aimed to train officials and administrators handling EIA, coastal planners, academicians and other individuals, the concept, scope, methodology, multidisciplinary approach, implementation and benefits of IEIA to encourage them to incorporate IEIA in the development of planning scheme in their countries.

Twenty-one representatives from the government and nongovernment agencies from nine participating countries in the region attended the workshop.

OPRC Training Courses Held

The Regional Programme organized two Oil Pollution Preparedness Response and Cooperation (OPRC) training courses in Bangkok, Thailand and Bandan Seri Begawan, Brunei Darussalam on 15-20 and 22-27 June 1997, respectively.

The training course was designed for the littoral countries of the southern South China Sea namely, Brunei Darussalam, Malaysia, the Philippines and Vietnam. It targeted government and industry personnel who have a role or responsibility within their organization for on-site response to oil spills, and staff having duties involving on-site logistics and equipment deployment and use, marine operations, health safety and environmental monitoring. Twenty-four participants from Thailand, Malaysia, Cambodia and Vietnam attended the course in Thailand while 20 participants from Brunei, Malaysia, Vietnam and the Philippines attended the course held in Brunei Darussalam. The participants consisted mainly of staff from government ministries (i.e., marine, environment and defence) and petroleum companies.

Fifth Asian Fisheries Forum

The Fifth Asian Fisheries Forum will be held on 11-14 November 1998 at the Lotus Hotel, Pang Suan Kaew, Chiangmai, Thailand. This will be sponsored by the Asian Fisheries Society and the Aquatic Resources Research Institute of Chulalongkorn University. The Technical Programme Committee encourages the submission of technical papers and posters for presentation. For details, contact:

Dr. Padermsak Jarayabhand
Aquatic Resources Research Institute
9th Floor, Institute Bld. No. 3
Chulalongkorn University
Bangkok 10330, Thailand
Telephone: (662) 2188160-3
Fax: (662) 2544259
Email: ardic@chulkn.car.chula.ac.th

New Short Courses at AIT

A four-week course on Coastal Planning and Management for Aquaculture Development will be offered on 10 August to 4 September 1998 at the Asian Institute of Technology, Thailand.

Other short courses scheduled for 1998 include Aquatic Farm Management; Pond Water Quality Management for Commercial Fish and Shrimp Production; Post-Harvest Processing and Technology; Sustainable Aquatic Systems: Fish Farming for the Future; Catfish Production Strategies: The Thai Experience; Fish Nutrition; The Nile Tilapia: Techniques for Mass Fry Production and Grow-out; Hapa Spawning Techniques; and Training of Trainers. Capacity Building for Effective Skills Transfer. For more details, contact:

Training and Consultancy Unit
Agricultural and Aquatic Systems Program/
School of Environment, Resources and Development
Asian Institute of Technology
P.O. Box 4 Klong Luang
Pathumthani 12120, Thailand
Telephone: (66) 2-524-5219
Fax: (66) 2-524-5484
Telefax: 84276 TH
Email: tcuaasp@ait.ac.th

Master of Marine Management Degree at Dalhousie

The Marine Affairs Program of the Dalhousie University is now accepting applications for the Master of Marine Management degree. The deadline for applications is 31 March 1998. For details, contact:

Marine Affairs Program
1234 Seymour St., Halifax, Nova Scotia
Canada B3H 3J5
Telephone: (902) 494-3555
Fax: (902) 494-1001
Email: Patricia.Roberts@Dal.Ca

URI Summer Institute in Coastal Management

This bi-annual Summer Institute of the Coastal Resource Center (CRC) will be held on 1 to 26 June 1998 at CRC, University of Rhode Island, Narragansett, USA. For more information, contact:

The Training Manager
Coastal Resource Center
Narragansett Bay Campus
The University of Rhode Island
Narragansett, RI 02882, USA
Telephone: 401-874-6212
Fax: 401-789-4670
Email: mjwood@gsosun1.gso.uri.edu

IMO International Maritime Law Institute

IMLI was established by a statute promulgated by the International Maritime Organization and under an agreement concluded between the IMO and the Government of Malta. It is located on the University of Malta campus and began operation in October 1989.

The purpose of the Institute is to train lawyers from developing countries to become specialists in maritime law. The course is open to law graduates already working in a maritime field or in a legal department or law office dealing with maritime matters. It consists of postgraduate training in international maritime law for one academic year leading to the degree of Master of Laws, covering shipping law and law of the sea as well as drafting of maritime legislation. All selected students must be nominated and supported by their governments. It is envisaged that graduates of the Institute will provide the expertise required for the implementation of IMO and other maritime conventions into their respective national legal systems.

The number of admissions is limited due to the intensive nature of the course. In line with the IMO strategy for integration of women into maritime activities, up to 50% of admissions are reserved for women. To date, the Institute has produced over 145 graduates.

Law graduates who wish to pursue their careers in the field of maritime law, whether in the public or private sectors, in law practice, administration or in academe and would like to benefit from this unique opportunity, are invited to write to:

The Director, IMO IMLI
P.O. Box 31, Msida MSD 01, Malta
Fax No. (356) 343092
E-mail: imli@maltanet.net
Please quote Ref. No. TrpCsts. 10/97

International Conference on Education and Training in ICM

The International Conference on "Education and Training in Integrated Coastal Area Management: The Mediterranean Prospect" will be held on 25-29 May 1998 in Genoa, Italy. It is organized by the International Centre for Coastal and Ocean Policy Studies (ICCOPS) jointly with the International Geographical Union (IGU). For further information, contact:

The Secretariat, ICCOPS
c/o University of Genoa
Department Polis
Stradone di S. Agostino 37
16123 Genoa, Italy
Telefax: (10) 2095840
Email: iccops@polis.unige.it
Homepage: http://www.polis.unige.it/1998education

capacity building/ training activities 1998

- **Training on Marine Pollution Monitoring Techniques—15 March to 15 April (Xiamen, PR China); 1 to 30 April (Dalian, PR China)**

  A training course for chemists covering marine pollution monitoring procedures and techniques in accordance with GOOS and other international protocols.

- **Training Seminar for Administrators and Senior Managers on Oil Pollution Preparedness, Response and Cooperation—23-25 June (Dalian, PR China)**

  A course which provides awareness of the roles and responsibilities of senior personnel in the management of oil spills of national significance.

- **Regional Training Course on the Application of Integrated Coastal Management System in Marine Pollution Prevention and Management—7 to 26 September (Manila and Batangas, Philippines; Xiamen, PR China; Singapore)**

  A training course for resource managers, planning officers, administrators and technical staff in the application of integrated coastal management in marine pollution prevention and management.

- **Training Workshop on Integrated Environmental Impact Assessment for Coastal and Marine Areas—16-21 November (National University of Singapore, Singapore)**

  A six-day training for officials/administrators handling EIA, coastal planners and academicians on the concept, scope, methodology, multidisciplinary approach, implementation and benefits of EIA.

- **Regional Training Workshop on National Implementation of International Conventions on Marine Pollution—20-25 September (Thailand).**

  A training workshop that consolidates national experiences and practices on legislation relating to marine pollution, and an avenue for the formulation of national and regional guidelines for the implementation of international conventions.

- **Training Course on Marine Water Sampling and Field Measurements—April (Vietnam); June (Cambodia); August (DPR Korea)**

  A training course that enhances capabilities of and provides participants with practical knowledge and appropriate techniques of seawater sampling and field measurements through field and laboratory exercises.

- **Study Tour: Batangas Demonstration Project—27 to 31 May; 14 to 18 October (Batangas City, Philippines)**

  An activity that exposes participants to the Batangas demonstration site and enables them to appreciate, learn and experience the actual implementation of integrated coastal management (ICM) as a planning and management approach to marine and coastal environmental issues and problems.

- **Study Tour: Xiamen Demonstration Project—4 to 8 March; 31 to 4 June; 18 to 22 October (Xiamen, PR China)**

  An activity that exposes participants to the Xiamen demonstration site and enables them to appreciate, learn and experience the actual implementation of integrated coastal management (ICM) as a planning and management approach to marine and coastal environmental issues and problems.

- **Internship Program—Every six months (Programme Development and Management Office)**

  An important component of capacity building activity that provides participants with skills training on specific areas in marine pollution prevention and management programs and expertise in actual program development, implementation and management.

upcoming activities

1998

January

13-15 National Workshop on the Implementation of MARPOL: Cost Effective Shore Reception Facilities (Indonesia)

19-24 International Workshop on the Rehabilitation of Degraded Coastal Systems (Thailand)

27 Batangas Bay Council for Integrated Coastal Management Meeting (Philippines)

February

12 Batangas Demonstration Project Progress Monitoring (Philippines)

15-21 Policy Workshop on the Malacca Straits (Singapore/Jakarta)

16-20 Malacca Straits Demonstration Project Progress Review (Singapore)

24-26 STAP Expert Group Workshop on Emerging Technologies in International Waters and Their Application to GEF Projects (Philippines)

March

4-8 Batangas Delegation to Xiamen on Integrated Waste Management (Xiamen)

3-7 World Bank/APCEL Seminar on Coastal Marine Environmental Management (Singapore)

15-20 Sustainable Financing Workshop (Columbia)

16-17 Leading Edge Information Technologies and Systems in Marine Environment Workshop (Canada)

21-29 URI Meeting on ICM Indicators and the Development of Medium-Term Projects (Rhode Island)

29-31 National Workshop on Marine Environment (Vietnam)

April

1-4 IMO/UNEP Workshop on Waste Management and Marine Pollution in Southern and Eastern Africa (Cape Town)

2-5 UNDP/MOSTE Meeting on Baseline Cost Estimates (Vietnam)

May

6-8 Level 3 Training Course on Oil Pollution Preparedness and Response Cooperation (Dalian, PR China)

June

9-15 International Conference on Marine Pollution and Ecotoxicology (Hongkong)

22-27 Sampling and Field Measurement Training Workshop (Cambodia)

July

1-3 Xiamen Demonstration Project Workshop (Xiamen)

13-17 Legal Drafting Workshop on CLC and Fund Convention (Vietnam)

15-17 ICM Training for Batangas (Philippines)

For further information contact the:

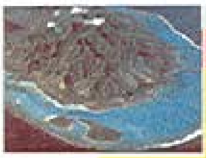
GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas
P.O. Box 2502, Quezon City 1165
Metro Manila, Philippines
Telefax: (632) 9269712
Email:
imo@klink.com.ph; imo@skyinet.net
URL:
http://www.skyinet.net/users/imo

ERRATUM

In the July 1997 issue of Tropical Coasts, back cover, on the map "Convention on Biological Diversity: Ratification Status", we failed to include China as one of those countries which ratified the Convention. In fact, China ratified the Convention in 1993. Our deepest apologies for this omission.

-Editors-

Modified Version of Sensitivity Ranking for Coastal Ecosystems and Habitats (Malacca Straits Environmental Profile, 1997).



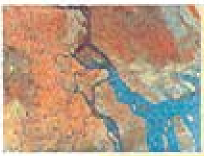
1 Coral Reef

Delicate coral-algal symbiosis and diverse associated reef flora and fauna; recovery of coral from severe oiling may take up to 5-10 years for reestablishment of complete reef ecosystem; sensitive to dispersants.

2 Mangrove

Important nursery areas for commercial shrimp species and supports detritus-based food chain; protects shoreline from erosion; oil may persist in mangrove habitat, especially where tidal flushing is reduced; recovery may take several years; sensitive to dispersants.

1 is the most sensitive, 8 the least sensitive; this is a qualitative order and not based on quantitative criteria



3 Estuaries

Important productive habitat for aquatic organisms; high socioeconomic importance for large estuaries; difficult to adequately mitigate oil spills in estuaries.

4 Tidal Flats

Productive biological habitat; high organic matter content of sediment will increase persistence; natural clean-up recommended.

5 Seagrass Beds

Productive habitat and diverse associated fauna and flora; usually located in subtidal and not affected directly; contaminated bottom sediments may cause most damage; recovery may take several years; sensitive to dispersants

6 Upwelling Zones

Upwelling zones nutrient-rich waters support concentrations of pelagic and benthic organisms; sensitive to dispersants.

7 Sandy Shores

Shores impacts vary according to substrate type, etc.

8 Rocky Shores

Shores wave action and tidal flushing reduce the impacts associated with oil spills

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> Our grand business is not to see what lies dimly at a distance, but to do what lies clearly at hand.
>
> **Thomas Carlyle**
> *Historian and Philosopher*

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