

# Inf mapper

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**Coastal and Marine Resources Management**



## EDITORIAL

President Fidel V. Ramos recently launched the Bantay Dagat Movement designed for the protection of our marine resources. An innovative feature of the movement is the creation of corps of volunteers composed of citizens who will be deputized to act as guardians of the country's seas and coastal waters.

As the President proudly noted, the nationwide establishment of corps of volunteers is people empowerment in practice, which will have a positive effect on the government's environmental program.

The Bantay Dagat Movement is just one of the many initiatives taken by the present administration towards the judicious management of our natural resources. Late last year, the National Maritime Policy was signed, signalling the shift from a land-based to an archipelagic orientation in the country's development thrust.

The policy aims to identify and address maritime issues such as the total extent of our national territory, protection of marine economy and technology, and maritime security. Although the protection of marine resources is just a component of this program, the shift in the development thrust recognizes the need to take a closer look at our marine and coastal resources. Like the dwindling forests, the country's coastal resources are fast diminishing. Mangrove areas, which were about

400,000 hectares seventy years ago, are now only about 120,000 hectares. Coral reefs which boast of the world's finest and most diverse species, have been severely damaged and only about 5% remains in excellent condition.

These figures show an alarming rate of depletion which, if left unchecked, will lead to a total destruction of what remains of our marine and coastal wealth. This trend is doubly significant for a country such as the Philippines whose extensive coastline and productive inland waters have been lucrative sources of food and means of livelihood for a large segment of the population.

It is heartening to note, however, that there has been an increase in public awareness and concern of the country's coastal and marine resources. The sustained information drive of the DENR has encouraged non-government organizations, foundations and private environment groups to participate more actively in the worldwide effort to conserve our natural resources and preserve the environment.

To further emphasize the need to raise environmental consciousness and to stress the importance of environmental conservation through sustainable development, the President has proclaimed 1995 to 2005 as "Philippine Environment Decade."

Through this move, the current administration hopes to leave a legacy of environmental commitment and sustainable development to the Philippines, alongside its goal of attaining full economic growth in the 21st century.

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## NEW PRODUCTS

The following topographic maps at scale 1:50,000 were revised:

- One sheet covering Asturias, Cebu, map sheet # 3722-III
- One sheet covering Clarin, Bohol, map sheet # 3820-IV
- One sheet covering Dimiao, Bohol, map sheet # 3820-III
- One sheet covering Calape, Bohol, map sheet # 3720-I
- One sheet covering Tagbilaran City, Bohol, map sheet # 3720-II

Topographic maps at scale 1:10,000 of portions of Metro Manila were also revised. These covered the following areas:

- One sheet covering Bagumbayan, map sheet #3229-IV-2

- One sheet covering Las Piñas, map sheet #3129-I-5
- One sheet covering Baclaran, map sheet #3130-II-25
- One sheet covering Sun Valley, map sheet #3229-IV-1
- One sheet covering Malibay, map sheet #3220-III-21

Revised regional maps at scale 1:300,000 cover the following:  
Region II  
Region IX  
Region XII

The administrative map of the province of Sarangani at scale 1:50,000 was also revised.

Tide and Current Tables for 1995 were printed.

Fifteen new colored nautical charts were published:

- Chart No. 4333 - Puerto Princesa Harbor
- No. 4316 - Northwestern Palawan
- No. 4214 - Verde Island Passage
- No. 4512 - Smales Group
- No. 4624 - Northern Part of Davao Gulf
- No. 4411 - Sibuyan and Romblon
- No. 4446 - Cebu Harbor
- No. 4213 - Port of Olongapo
- No. 4305 - Mindoro and vicinity
- No. 4343 - Paluan Bay
- No. 4424 - Southern Coast of Leyte
- No. 4426 - Ormoc Bay to Maasim
- No. 4629 - Hinatuan Passage
- No. 4666 - Lianga Bay
- No. 4351 - Coron Bay

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### Editorial Assistant:

Rhea C. Nicolas  
Published by the Media Production Division, Information Management Department, National Mapping and Resource Information Authority (NAMRIA)  
Office: Fort A. Bonifacio  
Makati, Metro Manila  
Tel. No.: 810-48-31 to 44  
Fax No.: 810-54-68/810-28-81  
Telex No.: 14607 CARTCE PS



# NAMRIA 's Support to the Coastal Environment Program

by Rosita A. Fabian

**C**oastal environments encompass different ecosystems which include shoreland mangroves, seagrass beds and coral reefs. These are among the most productive and biologically diverse landscapes in the coastal zone.

Majority of the families living along the coast depend on its diverse marine resources for their living. Poverty, however, remains to be a problem for these coastal families as fish production has levelled off, unable to catch up with rapid population growth. The reduction in fish catch as well as the use of destructive fishing methods have greatly contributed to poverty among many coastal communities.

To provide production and livelihood opportunities to marginal coastal families in the country, the Coastal Environment Program (CEP) was implemented under DENR Administrative Order No. 19 and Memorandum Circular No. 28, series of 1993. The main objectives of the CEP are the following:

1. Coordinate DENR activities on resource and environmental management of coastal ecosystems in the Philippines to minimize overlaps and improve the efficiency and effectiveness of the implementation of these activities
2. Integrate the strategies, thrusts and directions of DENR activities in coastal environments by way of:
  - 2.1 Using community organizing as a primary means of intervention to protect and improve the level of sustainable use of coastal resources
  - 2.2 Involving communities and immediate stockholders of coastal resources as principal partners of the DENR to protect and manage coastal ecosystems
  - 2.3 Mobilizing as many of the other coastal activities of the Department and their associated financial and administrative resources to support program thrusts in different localities in the country
  - 2.4 Utilizing the total systems approach to identify resource issues, institutional problems and local opportunities for human welfare in each coastal activity of the DENR
3. Attain higher levels of productivity, biodiversity, sustainability, stability and ecological integrity of coastal resource systems through the promotion of environment friendly technologies
4. Improve cultural, socio-economic and generational equity in access to and use of coastal resources, mainly by expanding livelihood opportunities and democratizing control of ecological support systems in coastal environments
5. Expand sectoral participation in protecting and managing coastal environments
6. Upgrade the capability of Department per-



*Enlarged aerial photograph of CEP model site at Prieto Diaz, Sorsogon (scale 1:10,000)*

- sonnel in both field and support offices, to undertake community-based protection and management of coastal environments and resources systems
7. Develop and implement policies to augment community participation and control of access to and use of coastal resource systems and to promote and improve the productivity, biodiversity, sustainability and equity of human benefits and utilization of coastal environments and ecosystems

The CEP involves three general phases of work:

- PHASE I. Information, education and communication (IEC)
- PHASE II. Introduction of intended interventions for eventual adoption by partner communities and sectors
- PHASE III. Monitoring and evaluation of the activity to seek options and opportunities for follow-up and institutionalization

There are also five categories comprising the organic components of the CEP: (1) Coastal habitats and biodiversity, (2) Endangered species, (3) Coastal industries and pollution, (4) Resource inventory and assessment, and (5) Research and specialized projects.

As a support unit in the CEP general functional chart, the NAMRIA assists the Coastal Environment Program Coordinating Office (CEPCO) in providing technical expertise in the assessment of projects, specifically in remote sensing, GIS, mapping and resource inventory surveys, aside from its usual function of providing hydrographic and oceanographic data for the coastal and marine sectors.

For CY 1994, the NAMRIA through its regular fund allocation proposed and imple-

mented a regular project entitled "Mangrove Inventory, Assessment and Mapping of CEP Areas in the Philippines."

The target areas of the project are the identified priority model sites in the following regions:

- Region 1 - Lingayen Gulf, Pangasinan
  - Region 3 - Palauig, Masinloc, Candilaria and Sta. Cruz, Zambales
  - Region 4 - Ulugan Bay, Puerto Princesa
  - Region 5 - Prieto Diaz, Sorsogon
  - Region 6 - Sapijan Bay, Capi
  - Region 7 - Mahanay Island, Bohol
  - Region 8 - Guiuan, Eastern Samar
  - Region 9 - Sibutad, Zamboanga Del Norte and Tuburan, Basilan
  - Region 10 - Baliangao, Plaridel and Lopez Jaena, Misamis Occidental
  - Region 11 - Baganga, Davao Oriental
  - Region 12 - Lebak, Sultan Kudarat
- There is no identified site in Region 2

From these identified sites, the model site at DENR Region 8 located at Guiuan Eastern Samar and the model site at DENR Region 5 located at Prieto Diaz, Sorsogon were surveyed, assessed and mapped. These two sites were selected because these contain the most extensive mangrove areas among the identified sites.

The final CEP map showing the location of surveyed and inventoried mangrove forest in Guiuan, Eastern Samar is shown. Aside from mangrove forest inventory, perimeter survey was conducted and control points were established using the global positioning system (GPS) receivers. These control points are in accordance with the Philippine Reference System (PRS 92), particularly the points established by the NAMRIA in the air strip of Guiuan in 1990.

*(Cont. on page 4)*



## NAMRIA's Support... from page 3

All final maps to be prepared by the NAMRIA will serve as base maps for future developmental and supplementary projects related to the CEP. These maps will also be used in the digital mapping and GIS activities to be undertaken later.

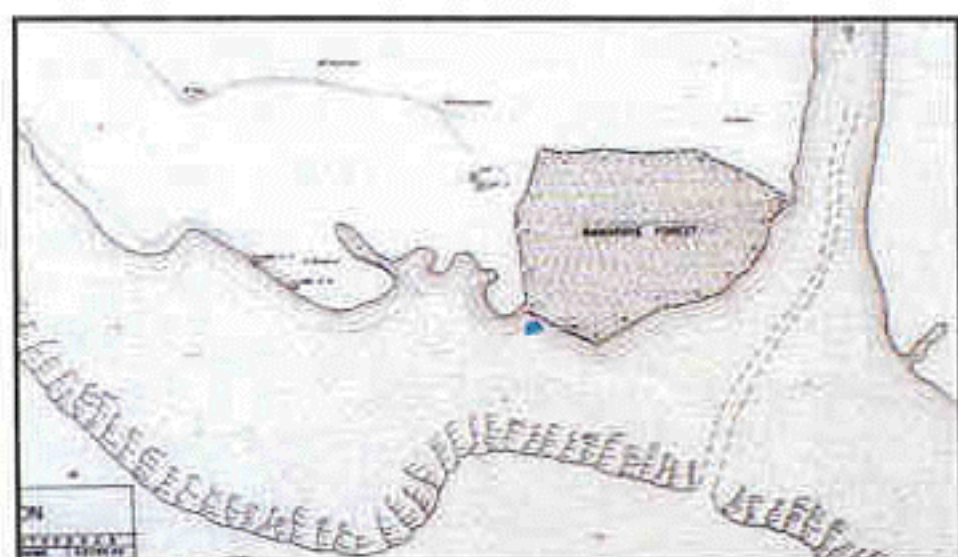
The CEP activities at the model site in Prieto Diaz, which is considered as one of the most successful CEP sites, were fully supported by the NAMRIA through the survey and mapping component of the project. Enlarged aerial photographs and satellite images were used to pinpoint on reconnaissance view the locations of mangrove forest, seagrasses and coral reefs. Developed fishponds were also seen prominently in the photos. The existence of these fishponds is one critical issue which the top management should look into in order to provide policy directions in the rehabilitation of the CEP site. Several CEP control points were also established in strategic locations (about eight monumented points) where the perimeter surveys had been tied. All mangrove forest blocks were mapped, including the extent of seagrasses and coral reefs.

Another major support to CEP from the NAMRIA is the "Thematic Mapping and Assessment of Twelve Critical Bays." The project will be implemented under a Memorandum of Agreement with the DENR- Fisheries Sector Program (FSP) for a total cost of two million pesos (P2,000,000.00).

In the agreement, the NAMRIA shall provide expertise, manpower and facilities to produce the following expected outputs:

1. Twelve updated Land Resource Maps of the critical bays with the following features:
  - 1.1 Administrative map showing political boundaries down to the barangay level
  - 1.2 Land-use map showing classification of the remaining mangrove level forest
  - 1.3 River system and drainage pattern map
  - 1.4 Land classification map
  - 1.5 Coastal/Water resources map showing the extent of corals and seagrasses
  - 1.6 DFX files\* of all maps.
2. Map of areas under Proclamation Nos. 2151 and 2152
3. Training on the application of remote sensing technologies for coastal resources assessment, monitoring and mapping.

The CEP is one of the flagship projects of DENR Secretary Angel C. Alcala as a contribution of the Department to the Philippines 2000 program of President Fidel V. Ramos.



Portion of the final CEP map showing the location of surveyed and inventoried mangrove forest in Guiuan, Eastern Samar.

# Threats and Hazards to the Philippine Coastal/Marine Zone

by Charmaine Rowena C. Aviquivil  
Macario A. Del Rosario  
Maria Romina B. dR.-Pe Benito

**G**eography books and other reference materials have taught us that the Philippines is an island-nation composed of 7,107 islands. The country has a total coastline of about 18,000 kilometers (km), with 80% of its provinces and two-thirds of its municipalities sharing this extensive coastline. Approximately 55% of its population live in some 10,000 coastal barangays, and majority of these people depend on fishing as their major source of livelihood.

In view of this reality, it becomes important for us to know the current state of our coastal and marine resources. Like the other ecosystems, the coastal and marine zones have increasingly been strained by the pressures of industrialization and development. This article focuses on the various hazards posed by man and nature to these resources.

## MANGROVES: A DWINDLING RESOURCE

**Mangrove\*** swamps are among the richest and most productive ecosystems of the coastal zone. The strong correlation between productive coastal fishing grounds and their proximity to mangrove swamps is generally accepted. In fact, mangroves are a good source of fry and fish upon which coastal dwellers depend for their living. Mangroves can be converted to fishponds, and are good sources of forest products such as firewood, charcoal, and other domestic needs of coastal families.

### Ecological Importance of Mangroves

It must be emphasized, however, that the greater importance of mangroves lies not merely in the economic benefits they provide but more so in their ecological significance. For one, mangroves provide a nursery, breeding, and feeding ground for many forms of marine life. They export nutrients to the sea and serve as fertilizers to phytoplankton which form the food base for many marine organisms. Their root systems help protect the soil and prevent shoreline erosion. They help maintain and improve water quality by absorbing suspended materials and acting as a pollution sink. They serve as a barrier for storm surges and strong winds. Finally, mangroves are the habitat for many unusual flora and fauna which could be studied for scientific and other purposes.

### Current State of Philippine Mangrove Stands

It is said that in the 1920s, 400,290 hectares of mangroves existed. According to the Forest Management Bureau, the area has dwindled to only 123,400 hectares as of 1993. This loss is attributed to various factors such as the conversion to fishponds; reclamation for residential and industrial purposes; overharvesting of

mangrove trees for charcoal or fuelwood production; lack of reforestation; and physical expansion of coastal communities.

New **mangrove stands\*** may suffer from natural agents such as barnacles and oysters which attach themselves to the young seedlings; untethered pigs, goats and other animals which may destroy the newly planted seedlings; and damage from monsoon winds and storm. In the Visayas, it was found that polluted coastal waters cause an abnormal growth of an organism called *Diopatra cuprea*, which feeds on the leaves and roots of mangroves.

### Halting the Threats to Mangrove Resources

In 1978, the former Natural Resources Management Center (NRMC) conducted a national mangrove inventory using both low-altitude aerial photography and satellite data. It updated information on the areal extent, geographical distribution, and ecological conditions of mangrove forests in the country. This led to the issuance of Presidential Proclamations 2151 and 2152, setting aside 78,594 hectares as permanent mangrove forests. Since these projects were done in the late '70s, similar studies should be made today to obtain current information on the state of mangrove resources.

A World Bank country study (Philippines: Environment and Natural Resources Management Study, 1989) recommended that the current prohibition of mangrove conversion into fishponds should continue and that its enforcement be improved. It further recommended that a general program be developed for restricted titling or long-term leasing of both partially degraded and entirely denuded mangrove areas for reforestation and sustained production as sources of firewood.

## THE COUNTRY'S ENDANGERED FISHERY RESOURCES

The Department of Agriculture's Bureau of Fisheries and Aquatic Resources (BFAR) recently reported that the Philippines ranks 11th among the top fishing nations of the world as of the early part of this decade. That the country is still able to enjoy a favorable fisheries production is truly miraculous, considering the prevailing threat to its marine resources as a result of human abuse.

Dynamite, cyanide, and muro-ami fishing are illegal fishing methods which are highly destructive since they cause the devastation of these resources.

### Dynamite Fishing

Dynamite or blast fishing is a fishing technique with the use of explosives. In an article of an eminent Filipino fishery biologist (Ronquillo, 1964), it is said that dynamite

\* Terms in bold type and marked with asterisks are defined in the Glossary of Terms on page 16



fishing "has been practiced in this country as early as could be remembered." Through the years, there has been widespread use in the country of explosives in fishing, despite existing laws making the practice illegal and the acquisition of dynamite difficult.

Dynamite fishing is a wasteful and destructive way of catching fish since it kills both the young and mature fish. Other species of marine life are destroyed as well. There is also the danger involved for fishermen who handle explosives.

Dynamite fishing is also cited in a World Bank study as one of the major causes of "direct damage" to Philippine corals\*. Coral structures are blasted to pieces by dynamite fishing. Just like the mangroves, coral reefs serve as breeding, spawning, and nursery grounds as well as habitat for marine life forms in the tropics. Fringing coral reefs\* also effectively serve as a protective barrier of the land against the unending pounding of the waves.

### Cyanide Fishing

Another fishing method greatly contributing to the destruction of coral reefs and the alarming reduction of fish supply is cyanide fishing.

Cyanide fishing involves the widespread spraying into the water of sodium cyanide, a most lethal substance. Since its first reported use in the country in 1962, the use of sodium cyanide is said to have spread throughout the Philippines with the expansion of business firms dealing with the tropical fish trade.

To fishermen, especially live fish collectors, cyanide fishing is efficient since it makes fish-catching easier. However, the poison is imbibed by the fish and those which do not die instantly pass the poison on to the people who consume them. Reports have indicated that the technique has also been used in catching fish for consumption. Just this year, according to a daily newspaper, "there have been reports of deaths in some areas in Pangasinan attributed to eating fish caught through cyanide fishing." Owing to their low quality, the credibility, especially of the country's food and aquarium fish in the international market is also adversely affected.

Coral reefs serving as the protective habitat of most aquarium fish also die as a result of exposure to the chemical. As recently mentioned in a daily newspaper, the number of "hard-core" cyanide users among the country's fishermen is about 4,000.

### Muro-ami Fishing

"Muro-ami" is a Japanese term which means "drive-in net," a fishing gear used in reef fishing. Muro-ami fishing basically involves the "scaring," by a group of swimmers, of reef fish towards a **bag net**\*. Corals are damaged by stones or pieces of lead or iron chains serving as weights and tied to the **scarelines**\* held vertically by the swimmers.

Prior to the banning in 1986 by the DA of the operation of muro-ami in Philippine territorial waters, this fishing method proved destructive to the country's coral reefs and dangerous to the divers or swimmers, some of

whom were even children. There were also muro-ami operators who were found to be poorly taking care of the welfare of their fishing crew.

In muro-ami fishing, the size of the catch is considerably large. However, fish-catching is non-selective and overfishing of coral reefs can result.

Prohibited with "muro-ami" is its local, smaller version called "kayakas" which uses different materials like bamboo as scaring devices.

Thousands of fishermen and their families who were greatly dependent on muro-ami fishing as their means of livelihood suffered "economic dislocation" when it was prohibited. Recognizing their plight, the government, through the DA/BFAR, came up with a modified version of the muro-ami fishing gear in the "pa-aling." Unlike in muro-ami fishing, the pa-aling fishing method is not destructive to coral reefs. Without the use of destructive scarelines, the fish are driven towards the net by means of air bubbles produced by compressors.

### Saving the Country's Fishery Resources

For a country greatly dependent on its fishing resources for food and work for its people, the conservation and protection of its vast fishery resources is a matter of great concern for the government.

Presently spearheading the Philippine government's efforts not only to save the country's marine resources but also to improve the living condition of its fishermen is the foreign funded Fisheries Sector Program (FSP). This is being implemented by the DA, with the assistance of other agencies. This project aims for the rehabilitation of the ecological condition of coastal zones, alleviation of widespread indigence among the fisherfolk and improvement of the productivity of the fishing sector.

Considered as the "core resource and rehabilitation thrust" of the FSP is the Coastal Resource Management (CRM) aspect which primarily deals with coastal degradation problems caused by illegal fishing methods and overfishing. So far, under the CRM, fishermen have been organized, trained, and reoriented for resource enhancement meas-



**Mangroves are among the most productive ecosystems in the coastal zone**  
DENR

ures which include the construction of artificial reefs and the creation of fish sanctuaries and marine reserves.

Assisting the government in its decades-old war against illegal fishing are concerned environmental organizations in the private sector. Groups like the Haribon Foundation and the International Marinelife Alliance (IMA) are promoting alternative fishing techniques like the use of nets instead of cyanide. With the help of IMA-Philippines, the government is maintaining cyanide detection test laboratories in the country—one at the Ninoy Aquino International Airport and the other in Puerto Princesa, Palawan.

## THE RED TIDE THREAT

A phenomenon that occurs persistently year after year is red tide. It has been a bane to many coastal communities in the country for several years now, causing losses in fishermen's catch and aquaculture harvest, and depriving many people of their main source of livelihood. Worse than the loss of fish catch is the loss of human lives it has also caused.

### Dinoflagellates — The Red Tide Culprit

Red tide is caused by single-celled organisms called *dinoflagellates*. When these multiply or bloom in sufficient numbers during warm seasons, they usually cause a reddish coloration of the waters they infest, hence the term "red tide".

Dinoflagellates are minute organisms which usually stay in waters with high temperature and salinity. These microscopic organisms have about 2,000 varieties, 30 of which carry poisonous substances. Of these, the culprit is the *Pyrodinium bahamense* var. *compressum* or *Pbc* which causes red tide.

Red tide results from a combination of factors such as the water temperature and an oversupply of nutrients. It occurs between the end of summer and the onset of the rainy season, during which surface water runs off from the land to the sea. Nutrients increase in the sea and this causes the proliferation of the dinoflagellates. Solar heat which increases

(Cont. on page 6)



surface water temperature creates a conducive atmosphere for the growth and multiplication of these organisms.

### Man-made Causes of Red Tide

Although thought of as a natural phenomenon, red tide is also exacerbated by man-made activities such as pollution. Apparently, pollution worsens red tide because it increases the nitrogen and phosphorous content of the water. When the rains flush industrial and domestic wastes from the land out into the sea, dinoflagellates that thrive on these wastes multiply and cause red tide.

Red tide affects fish, squid, shrimps, and crabs that feed on the dinoflagellates. However, these can still be safe for human consumption because the toxic substance is ingested into their guts or intestines which are usually removed before cooking. Bivalves and other shellfish like oysters (talaba), mussels (tahong), clams (halaan) pose the greatest danger because they are filter feeders and absorb more toxins than fish, which have sieve-like gills. Moreover, shellfish do not have their guts or gills removed before cooking.

### Occurrence Patterns

Red tide is a global phenomenon which has appeared practically everywhere, from Australia down south, to Canada and the United States in the north. It was first seen in Philippine waters in 1908. This was in Bataan where it affected many coastal areas. It was not experienced again until 1983, when it was reported in Maqueda bay, Villareal Bay and

Samar Sea, poisoning the fish and shellfish in the area. From 1987 onwards it has manifested itself in Zambales, Leyte, Bataan, Cavite, Misamis Oriental, Negros Occidental, Cebu and parts of Manila Bay.

This year, despite heavy rains and winds which are believed to flush out the harmful organisms, red tide struck again in Manila Bay. This prompted the President to declare a state of calamity in the coastal areas of Metro Manila, Bataan, Bulacan and Cavite. A ban on the gathering, harvesting, transporting and selling of shellfish was effected in these areas.

Since 1983, the BFAR has already documented a total of 1,537 cases of paralytic shellfish poisoning (PSP). PSP occurs in humans who have eaten shellfish that have ingested red tide toxins. Symptoms, which are usually felt 30 minutes after eating infected shellfish, include the following: abnormal feeling in the lips, mouth, and extremities; numbness and tingling of the face; vomiting, nausea, and dizziness; diarrhea; difficulty in breathing, speaking, and swallowing; a feeling of lightness; paralysis of the body, especially the respiratory organs; quickening of pulsebeats; lack of balance; and muscle weakness. Respiratory paralysis can lead to death within 12 hours.

There is no known antidote to red tide poisoning. However, toxins can be removed from the stomach by gastric lavage or inducing vomiting. In some cases, artificial respiration may be applied.

By and large, the best prevention is to

avoid eating shellfish from known contaminated areas during red tide outbreaks. Fish, squid, shrimps and crabs must be carefully cleaned and their guts entirely removed to prevent poisoning.

### Combating Red Tide

What is being done regarding the red tide problem in the country? The government provides relief services and alternative means of livelihood to the people in the affected communities. In fact, the recent infestation has prompted the release by the President of P1.625 million in livelihood assistance from the calamity fund for the affected towns. Further, the government has, through the Red Tide Task Force and other agencies comprising the Inter-Agency Committee on Environmental Health, instituted a red tide monitoring and warning system. This is a nationwide network of testing centers which keeps track of red tide occurrences and recommends the declaration and lifting of shellfish bans.

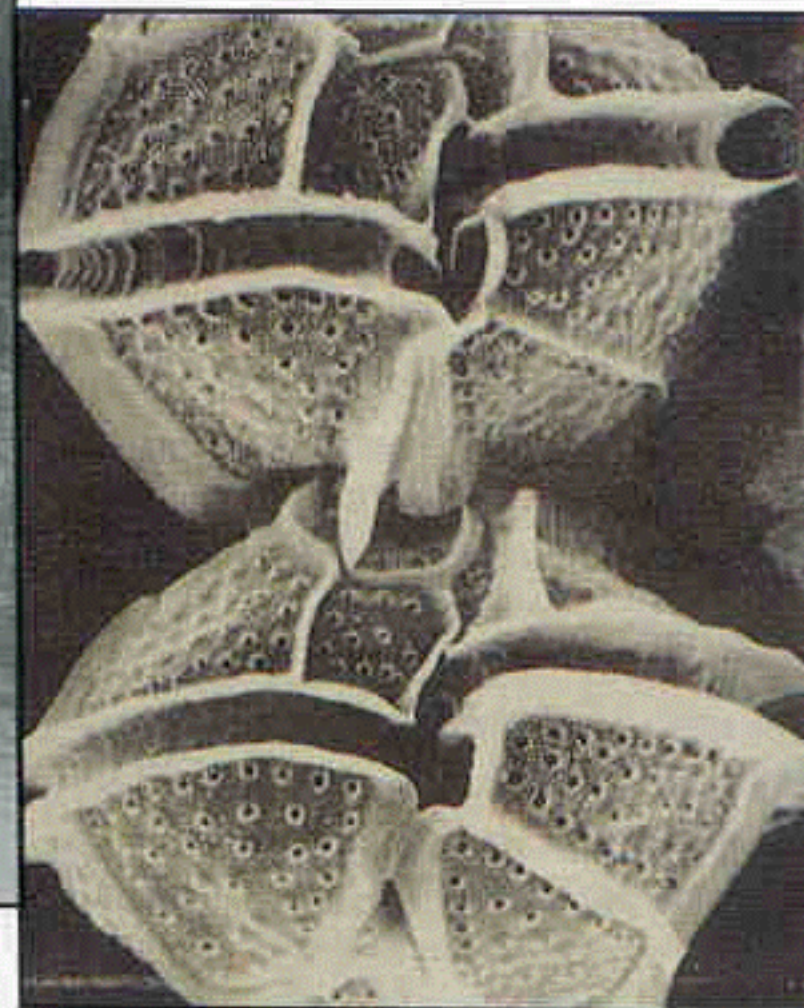
A Red Tide Research and Development Program was implemented recently to study this phenomenon and develop possible solutions. Involved in this program are BFAR, the University of the Philippines Marine Science Institute (UP-MSI) and UP Los Baños, coordinated by the Philippine Council for Aquatic and Marine Research and Development with the support of the Department of Science and Technology and the ASEAN-Canada Cooperative Marine Science project. Studies have been made on this phenomenon. For instance, the UP-MSI has made a headway in the study of red tide by successfully isolating and culturing the organism *Pbc* in the laboratory. This will enable scientists to understand the organism better and may pave the way for its control. The UP-MSI is also studying the possibility of using *carageenan* to cushion the deadly effects of the red tide toxin.

It is believed that red tide can be minimized, if not eliminated, by using less chemical fertilizers and pesticides, and avoiding the dumping of wastes from industries and homes into our water bodies. Finally, what must be instituted is an all-out program to rid the Philippine coastlines of possible sources of



Seeding of giant clams in Alaminos, Pangasinan by DENR Secretary Angel C. Alcala as part of a DENR coastal resources improvement program

DENR



Electron micrograph of *Pyrodinium bahamense* var. *compressum* (taken by Dr. Gustaaf M. Hallegraeff, CSIRO Marine Laboratories, Australia)

BFAR





*Toxic pollutants emanating from factories*

BFAR

nutrients which cause the microorganisms to multiply.

## **WATER POLLUTION - AN ECOLOGICAL PROBLEM**

The dwindling of the country's coastal and marine resources is not the only problem we are facing today. Another concern is their degradation caused by pollution.

According to the International Maritime Organization, 60-70% of the marine pollution comes from land-based sources such as industrial effluents, raw sewage discharges, oil, hazardous and agricultural wastes, and sedimentation due to deforestation. Pollution from sea-based activities can be traced to offshore hydrocarbon exploration and production, as well as oil spills and discharges from sea vessels.

### **Water Contaminants**

Waters can be contaminated by mechanical, biological, chemical and thermal pollution. Mechanical pollution damages aquatic life through its various forms such as erosion, turbidity, siltation and sedimentation. Biological pollutants, on the other hand, include organic compounds present in domestic sewage, and slaughterhouse and food processing discharges. These serve as food for bacteria which reduce the concentration of dissolved oxygen in the water, thereby killing fish, algae and other organisms.

Chemical pollutants include synthetic organic compounds found in fuel, fibers, solvents, detergents, paints, ink, dyes, pesticides, food additives, drugs, as well as inorganic compounds such as nitrogen and phosphorus, acids, mercury and lead. Radioactive pollutants may come from **mine tailings\***, ore processing mills, or nuclear reactor leakages. And finally, heat from factories and nuclear plants may also be a pollutant in that it decreases the amount of oxygen in the water which results in the death of marine organisms and causes changes in their biological patterns.

### **Reviving the Pasig River**

Inland waters are particularly vulnerable to pollution. A DENR assessment of the quality of the country's surface water systems show that 50 major river systems are polluted. A classic case is the Pasig River which has been seriously degraded during the past decades.

According to the River Rehabilitation Secretariat report, the Pasig River is one of the dirtiest in Asia, with 327 tons of pollutants dumped into it daily. Of the total wastes in the river, liquid domestic wastes comprise 46%; industrial wastes, 44%; and solid wastes, 10%. Major sources of pollution of the Pasig River could largely be attributed to the residents of some 367 barangays in the vicinity, the 70,000 squatters living along the sides of the river, and the 820 companies surrounding the river, 320 of which are known polluters.

Over the years, various programs have been conducted by the government to rehabilitate the Pasig River. The most recent of these include the Pasig River Rehabilitation Program (PRRP) spearheaded by the DENR and the *Sagip Pasig Movement* led by First Lady Amelita Ramos. These efforts are tapping the business sector and NGOs to help in

reviving the river. Already, more than 20 firms have expressed their commitment to participate in these programs. Among the specific projects of the PRRP are the conversion of industrial wastes in the river into biogas; more effective garbage collection in the surrounding areas; removal of the wastes floating in the river by deploying 100 river aides; relocation of squatters and educating them on environmental protection; and others.

Apart from the PRRP, the DENR also has River Revival Program which aims to resurrect dead rivers and institute steps to prevent the further degradation of already heavily polluted rivers.

## **OIL SPILLS - MAJOR CONTRIBUTOR TO COASTAL/MARINE POLLUTION**

Marine oil pollution can be generally divided into accidental and operational types. Accidental oil pollution involves stranding and collisions. The more common accidental source, however, is the stranding or running aground of vessels because of faulty navigations. This may in turn be the result of negligence, inadequate training of navigators, defective navigational and communication equipment and the lack of reliable and updated nautical charts. One of the most unforgettable accidental oil spills of great magnitude was the case of the 987-foot tanker Exxon Valdez carrying 1.25 million barrels of oil which ran aground at Bligh Reef in Alaska's Prince William Sound in March 1989.

There are other chronic low level oil pollution incidents that get less attention than catastrophic spills and blow outs but are considered as major contributors to marine and coastal pollution. Most of these are categorized under operational pollution, and include spillages resulting from shipboard operations, offshore drilling and production, leakages from industries, leaks at marine terminals, municipal and industrial wastes drained to the seas and urban oil waste runoff that eventually reaches the rivers and bays.

Spillages also include operational discharges from tankers during tank cleaning, loading, discharging, transferring, bunkering and **bilge\*** discharges. This type of spill often results from deliberate human action or inaction, carelessness, ignorance of the effects to

*(Cont. on page 13)*



*Solid domestic wastes polluting the Tullahan river*

DENR



## PHOTO ESSAY

**C**oral reefs are said to cover some 600,000 square kilometers (km<sup>2</sup>) or 17 percent of the earth's surface. The world's coral reefs are inhabited by numerous organisms, both animals and plants, which contribute to their formation. The major contributor, however, to the formation of reefs are millions of tiny animals called **coral polyps**.\*

The most well-known members of *Phylum Coelenterata*, under which coral polyps are categorized, are stony corals. These are coral polyps whose skeleton is made up of lime (calcium carbonate). They usually inhabit the lighted zone which is generally not deeper than the range of SCUBA divers. Stony corals are described as "hermatypic" or reef building. These corals are the colonial animals (together

with mollusks and calcareous algae) which form the coral reefs of tropical seas.

Also in existence are soft corals whose skeletons are composed of minute particles embedded in the flesh, and are soft and leathery in texture; as well as horny corals often used in making fancy jewelry.

While coral polyps abound in all oceans in the world, these form reefs only within the tropics. The Philippines being a tropical country contains some of the richest and most diverse coral reefs in the world. In fact, more than 27,000 km<sup>2</sup> of the country's coastal areas are composed of coral reefs.

Coral reefs are important to the country not only for their great beauty and decorative value, but more significantly for ecological

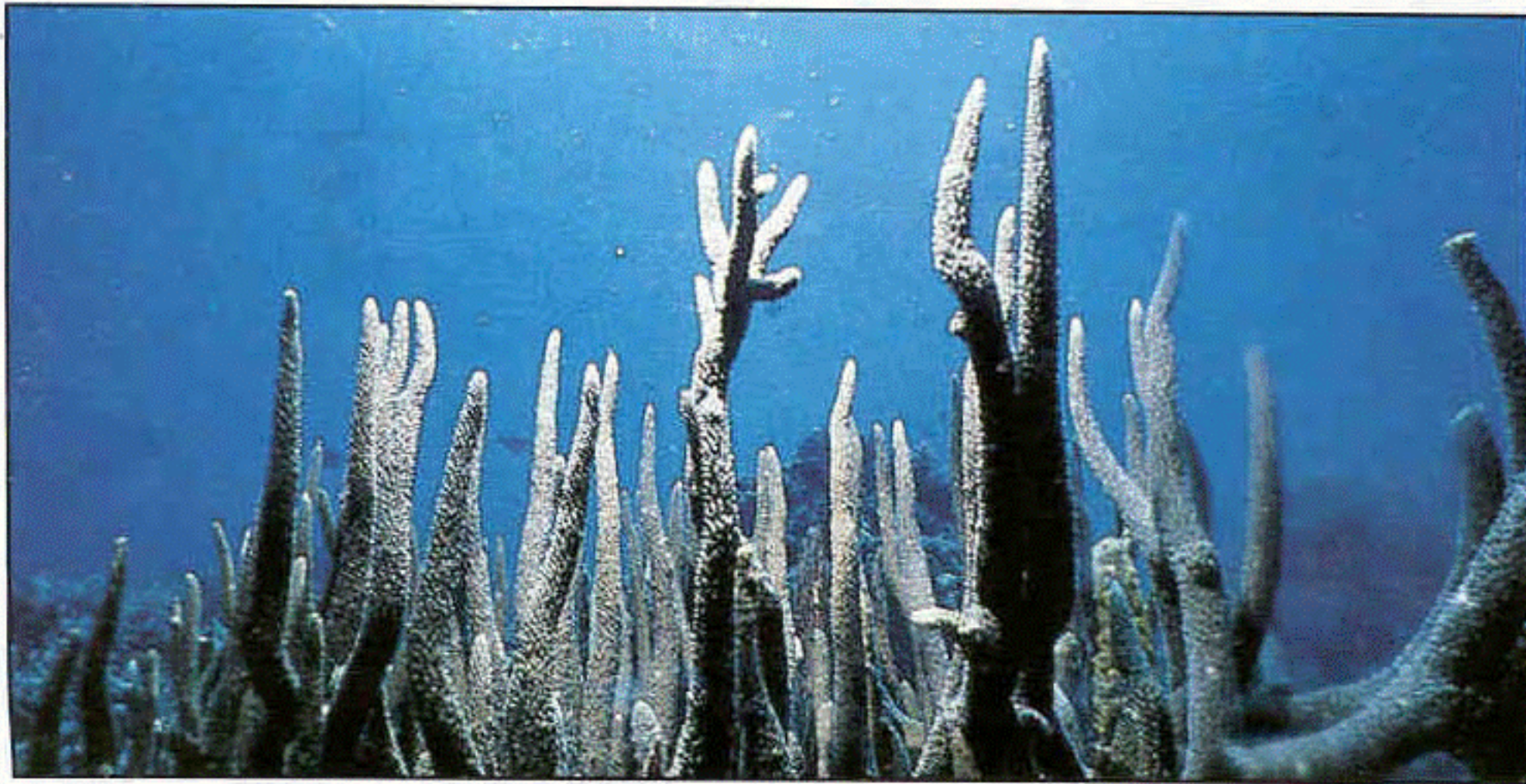
and environmental reasons. As a major component of the tropical marine ecosystem, coral reefs serve as habitat as well as spawning, breeding and nursery grounds for a multitude of marine organisms. Coral reefs are therefore closely linked with fishery production and play a vital role in sustaining marine food production. Coral reefs which fringe the coastal areas also serve as natural seawalls, protecting the shoreline against storm surges and preventing beach erosion.

This issue's spread showcases various corals, both stony and soft, which can be found in Philippine waters.

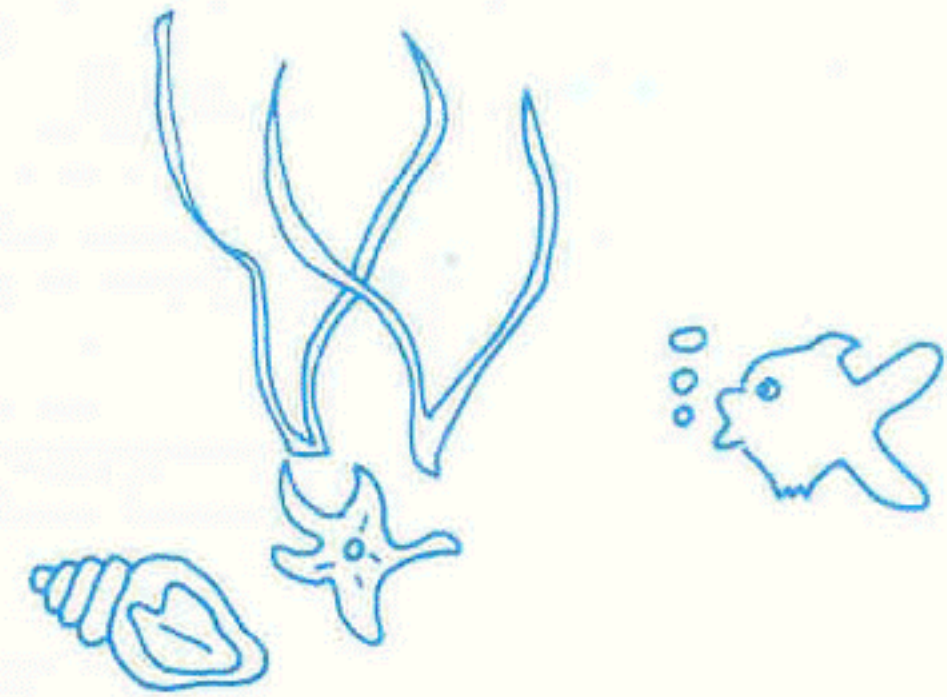
Researched by Celeste Barile

### Sources

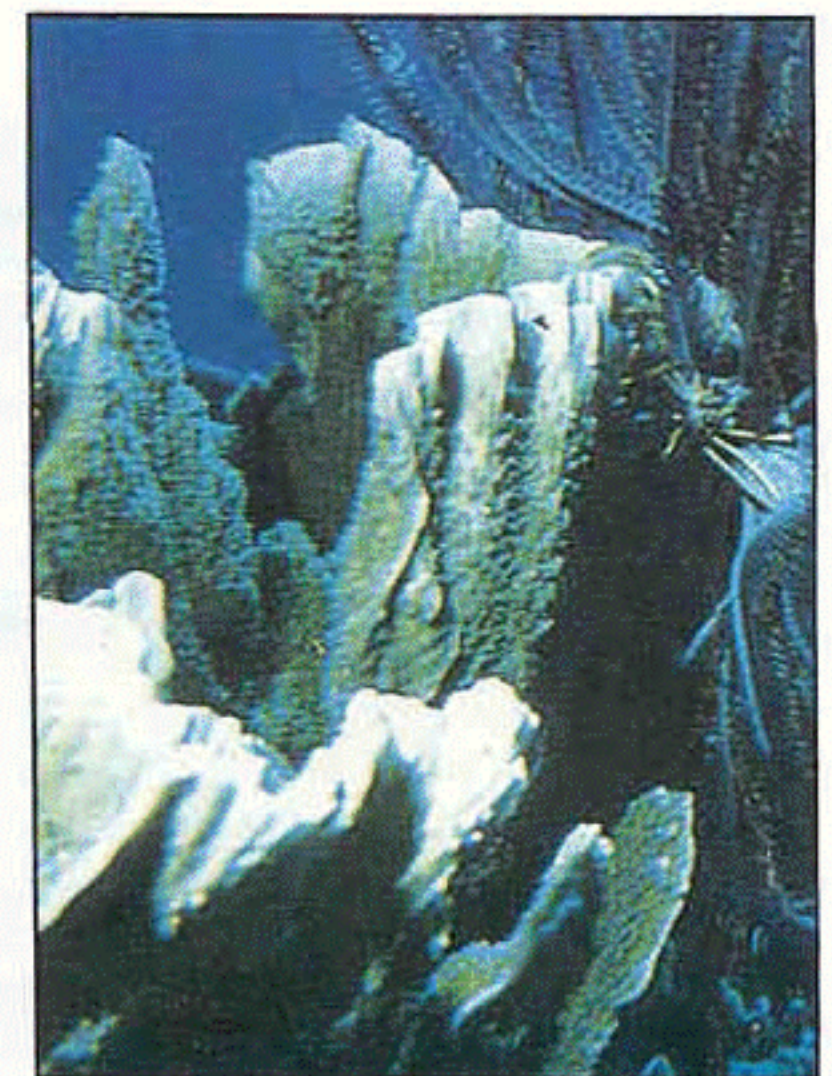
Crossland, C.J.; Hatches O.G.; and Smith, S.V. "Role of Coral Reefs in Global Ocean Production." *Coral Reefs* 10 (1991):55.  
Natural Resources Management Center (NRMC)/University of the Philippines Natural Science Research Center. *Guide to Philippine Flora and Fauna*. Quezon City: NRMC (Ministry of Natural Resources), 1981. Vol. II: Philippine Corals, by Francisco Nemenzo.  
NRMC. "Philippine Corals: Issues on Conservation and Management." *Likas Yaman*, Vol. I No. 9.



*Acropora Sp. Scleractinian Form (Hard Coral)*

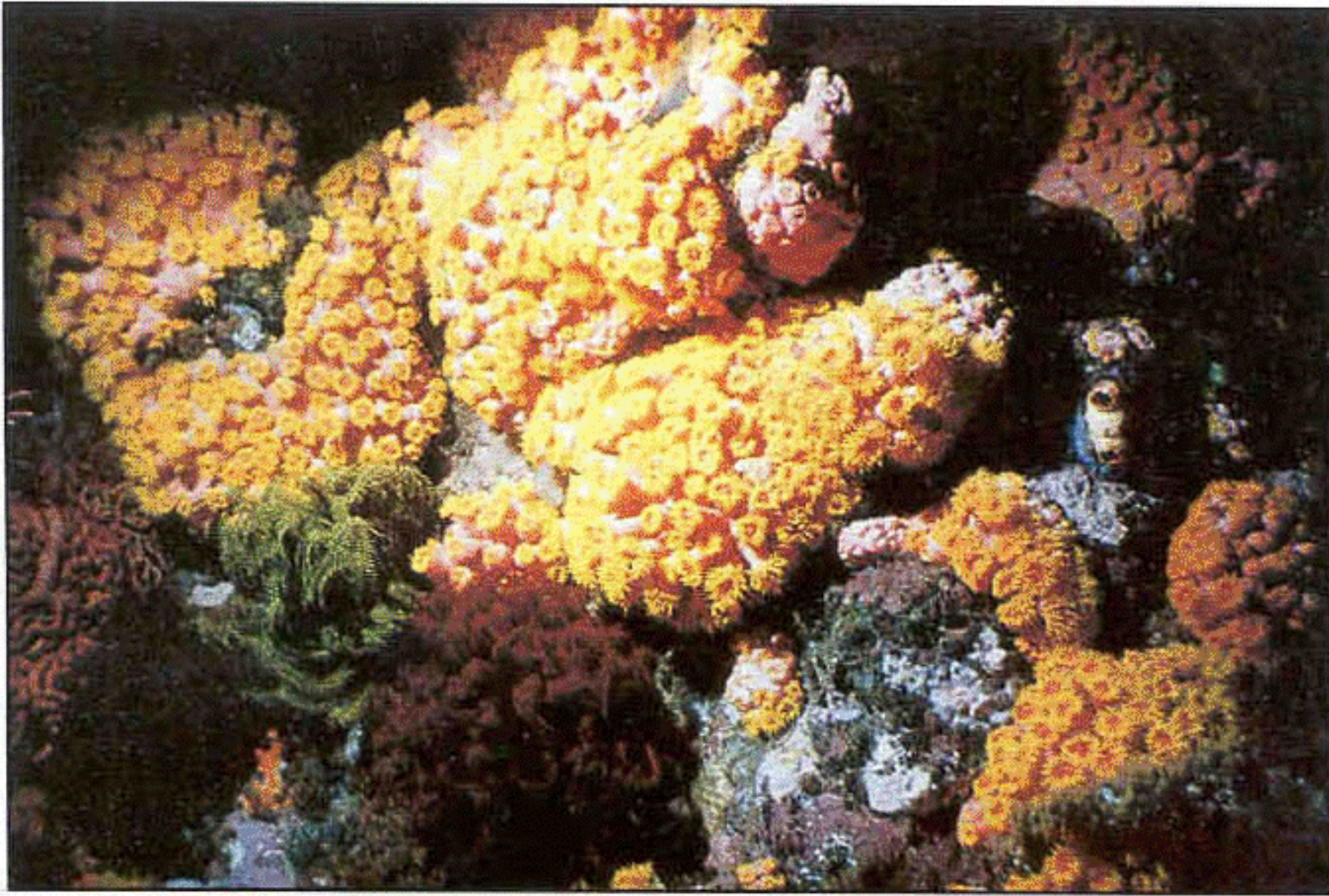


*Acropora (Isopora) Sp. Branching Form (Hard Coral)*

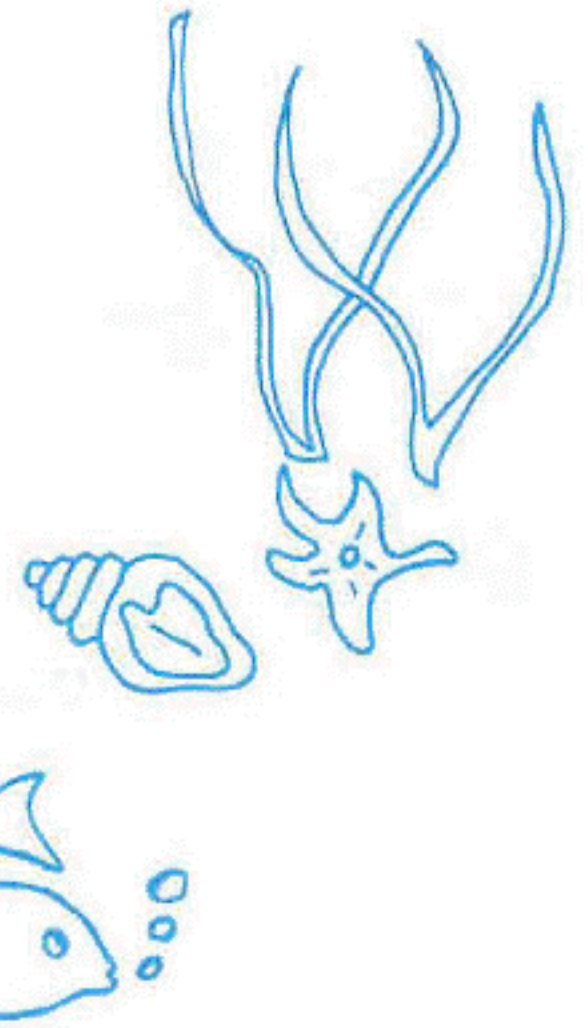


*Montipora Sp. Foliose Form (Hard Coral)*

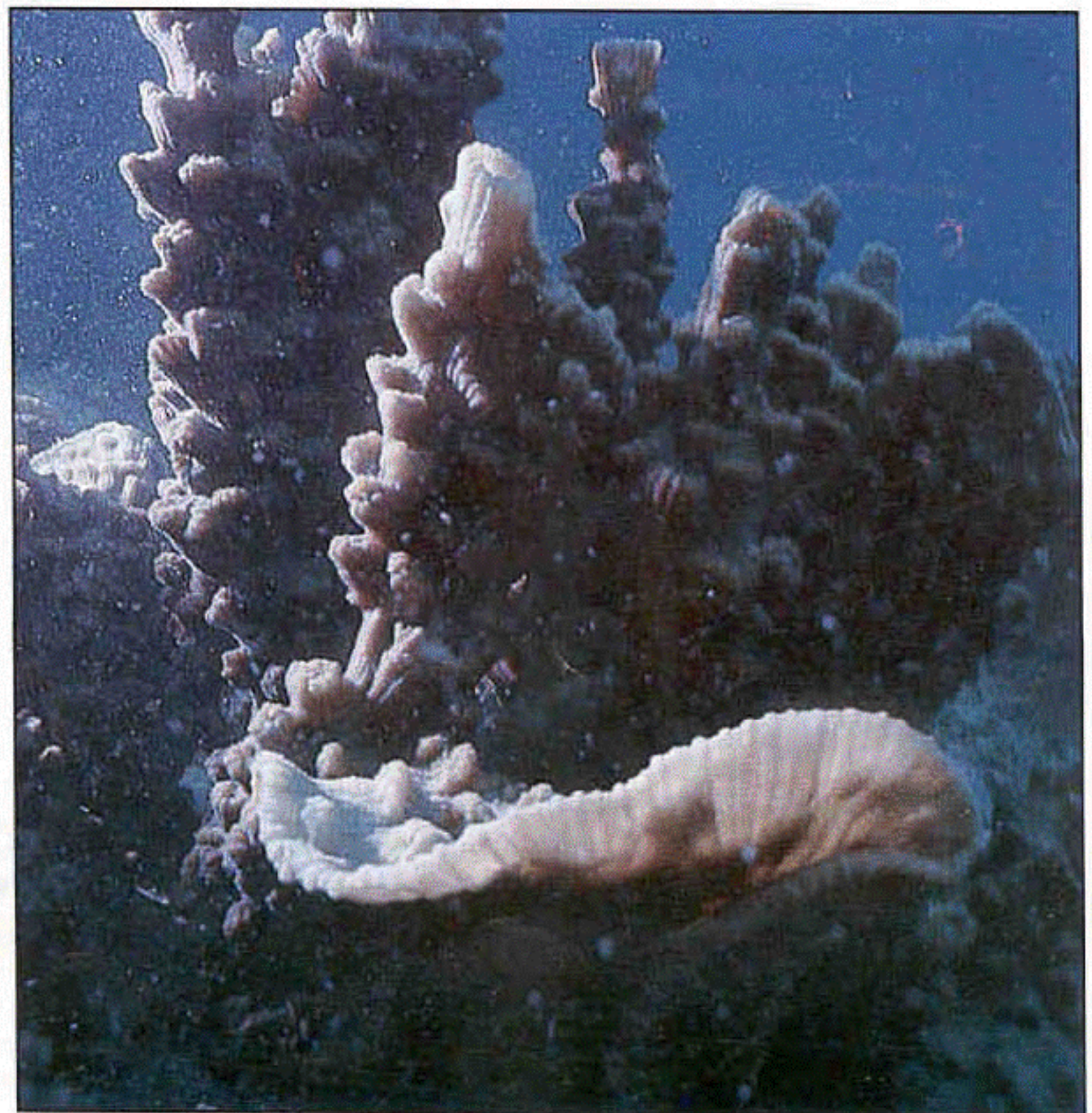




*Tubastrea Sp. Non-Scleractinian Form (Soft Coral)*



*Acropora Sp. Tabulate Form (Hard Coral)*



*Mycedium Sp. Foliose Form (Hard Coral)*

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- Michael Atrigenio, UP-MSI



NEWS NEWS NEWS NEWS NEWS NEWS NEWS NEWS



*Administrator Solis presents President Ramos with a SPOT image of Pangasinan, as DENR Secretary Alcala looks on.*

## President Ramos visits NAMRIA

**H**is Excellency President Fidel V. Ramos attended the NAMRIA's 7th year anniversary celebration held in Fort A. Bonifacio, Makati, Metro Manila last July 5, 1994.

The President was welcomed by NAMRIA Administrator Jose G. Solis together with DENR Secretary Angel C. Alcala, Undersecretary Ricardo M. Umali, and other DENR and NAMRIA officials and employees.

Administrator Solis briefed the President on NAMRIA's functions, outputs, facilities, capabilities and the state-of-the-art technologies it utilizes such as the GPS, GIS, remote sensing and digital photogrammetric techniques.

He likewise mentioned some of NAMRIA's significant projects, activities and services undertaken for the past years which have direct bearing on the welfare of the Filipinos like the tax mapping and zoning information system for Muntinlupa, hydrographic and topographic surveys of major river systems and coastal areas around Mt. Pinatubo, assessment of agricultural resources through photo-tax mapping, production of provincial Environment and Natural Resources or ENR Atlas, and the various base mapping projects which update the topographic maps covering the whole Philippines, among others.

President Ramos, in turn, urged NAMRIA officials and employees to maximize the use of the agency's modern technologies to help ensure greater productivity and improve the

socio-economic conditions of the people. He also emphasized that all NAMRIA personnel play a vital role in achieving the government's vision of "Philippines 2000." President Ramos further stressed the need for the utilization of information being developed in the institution.

During this visit, the President launched the NAMRIA ENR Regional Atlas of Tarlac and Zambales and opened the map technology exhibit showing NAMRIA products and services. In appreciation of the President's visit, Administrator Solis presented him with a NOAA image of the Philippines and a SPOT image of Pangasinan.

Another highlight of the day was the holding of NAMRIA's 7th Technical Forum entitled "NAMRIA in Support to DENR." The forum aimed to assess the capabilities of the NAMRIA to support the present needs of the ENR sector. It highlighted the latest technologies in spatial information using GIS, remote sensing, digital mapping and GPS. The forum was initiated in response to the NAMRIA Governing Board's suggestion to hold promotional campaigns for DENR.

Representatives from the different units of DENR, its attached bureaus and regional offices, as well as from NEDA and other private firms attended the event.

Questions/issues raised during the open forum included the following: access to information available at the NAMRIA, specifically digital data, accuracy and quality of such information and accuracy of GPS.

## NAMRIA - DMA conduct joint GPS survey

**T**he NAMRIA and the Defense Mapping Agency (DMA) of the United States Department of Defense recently conducted a GPS survey to establish eight **fundamental absolute stations\*** in the country that will link the national geodetic system, the Philippine Reference System 92 (PRS 92) to a high accuracy **geocentric\*** terrestrial reference system. In effect, the link-up will improve the technical definition and accuracy of the PRS 92.

PRS 92 is a first order geodetic control network which was recently established in the country using the GPS. PRS 92 is being adopted by geodetic engineers and surveyors as the standard reference in all their surveying and mapping activities in the country as embodied in Executive Order No. 45 signed by the President on January 5, 1993, and implemented through Administrative Order No. 22 of the DENR.

The joint survey is under a memorandum of agreement between NAMRIA and the DMA concerning mapping, charting and geodesy cooperation which was signed on 9 September 1991. The MOA specifies that both agencies shall participate in the development of areas for technical cooperation to complement relevant programs in topographic mapping, hydrographic charting, related digital data, geodetic surveys, geodetic computations and adjustment, geophysical surveys and other geographic-related activities as may be mutually determined.

The agreement also includes exchange of information such as maps, charts, gazettes and other related geographic materials and geodetic and geophysical data.

The NAMRIA-DMA cooperative survey includes the sending of a CGSD technical personnel to the DMA at Missouri, USA to assist in the data processing, adjustment and correction of some old US C&GS triangulation network and the new stations under PRS 92. DMA agreed to provide a new software to NAMRIA after the training of the CGSD staff.



## Ferry for Manila-Bicol-Masbate-Cebu Planned

**A**n Inter-agency Committee that will study the feasibility of providing ferry service for the Manila-Bicol-Masbate-Cebu route has been created under Administrative Order No. 143 signed by the President on August 25, 1994. It is chaired by Senior Deputy Executive Secretary Leonardo A. Quisumbing, and co-chaired by Mr. Paciencia Balbon, general manager of the Maritime Industry Authority (MARINA). Administrator Jose G. Solis was appointed member together with the Undersecretary for Technical Services of the Department of Public Works & Highways (DPWH), the general manager of the Philippine Ports Authority (PPA), a representative of the Presidential Committee on Flagship Programs and Projects, and a representative of the Masbate Economic Development Council.

The feasibility study is in response to Executive Order No. 185 dated June 1994 which seeks the opening of all sea routes in the areas mentioned and encourages ship owners to enter into developmental routes. The issuance of the EO is in line with the objective of the transport sector under the Medium-Term Philippine Development Plan (MTPDP) which is to strengthen the interregional and urban-rural linkages to ensure people's mobility and continuous flow of goods and services by promoting a multi-modal transport system.

The feasibility study for the Manila-Bicol-Masbate-Cebu route was prioritized because Bicol has been identified as being left out of the maritime commercial network in regions with flourishing economies. Presently, there is

no direct commercial sea traffic between Manila-Bicol and Bicol-Cebu to support the region's industry and agriculture including its tourism industry which is one of the flagship projects identified by the President.

The short term plan of the project will cover three areas: Lucena (Quezon)-Masbate (Masbate)-Cataingan (Masbate)- Hagnaya (Cebu) Cebu City; Bulan - Masbate - Cataingan - Carmen; and Masbate - Cebu City - Maasin (Leyte) - Surigao City; Lucena City - Balanacan (Marinduque) - Cajidiocan (Sibuyan) - Mandaon (Masbate). Under this plan, existing facilities in the area will be utilized as jump off point of the project.

The medium term plan will cover the areas of Lucena (Quezon) - Masbate (Masbate) - Uson (Masbate) - Cataingan - Carmen (Cebu); and Mandaon (Masbate) - Roxas City. Ship-owners will be enjoined to work on the infrastructure under this plan.

The long term plan will cover Manila/Batangas/Lucena - Pasacao (Camarines Sur) - Pantao (Albay) - San Pascual (Burias) - San Fernando (Ticao) - Cataingan (Masbate) - Carmen (Cebu) - Cebu City. The plan will require the construction of permanent reinforced concrete piers with ramps for roll-on-roll-off vessels in areas that are safe.

The NAMRIA will undertake the hydrographic surveys of these sea routes.

The committee has also identified NGOs and private agencies from the water, land and air transport sector which will be involved in the development of the priority sea routes.

## Ifugao Province to be mapped

**T**he NAMRIA recently signed a Memorandum of Agreement with the Province of Ifugao represented by Governor Albert Pawingia and the DENR Cordillera Administrative Region (CAR) to conduct thematic mapping of the province.

Under the agreement, NAMRIA will undertake the acquisition, interpretation and data analysis of photo and satellite images of the project area. It will dispatch teams to conduct survey, assessment and field validation of the data.

DENR-CAR will provide additional technical manpower, act as liaison between NAMRIA and local government units and make available basic references and other data.

The project will produce maps for Ifugao province at scale 1:50,000 such as land suitability, land use, land classification, slope, geology, drainage and administrative maps. A mosaic map at scale 1:100,000 and a tax map at scale 1:10,000 will also be produced.

The project aims to support the province's vision to ensure its continuous development and the improvement of the social and economic welfare of its people. The outputs will provide the province with accurate data and information on its natural resources and the status of their environment.

## NAMRIA participates in tropical forest management project

**T**he NAMRIA is currently involved in the Information System Development Project for the Management of Tropical Forest (ISDP-MTF) with the DENR as the lead agency. The project aims to provide basic data relevant for the Forest Management Plan through the analysis of forest distribution, contents of forest and the conditions of logged over areas and land use, among others, using remote sensing technology.

The Philippines is among the recipients of the project which was launched by the Forestry Agency of the Japanese Ministry of Agriculture, Forestry and Fisheries in the tropical countries of Asia, particularly the ASEAN region. The assistance is part of Japan's long-standing international cooperation efforts.

The project has three phases: a) Wide Area Tropical Forest Resources Survey, b) Development of Tropical Forest Management Planning Information Service System, and c) Development of Tropical Forest Resources Analysis Technology.

The first phase intends to analyze the land use, forest distribution, forest type, felling and

disaster (such as flood) conditions of a tropical area. Using the information and analyzed data obtained in phase I, a forest management data and disk system will be developed in phase II. The data can be visually presented on a monitor screen in terms of an area or information category such as forest distribution and forest type, among others. A data disk containing analyzed data will be provided by Japan to recipient countries. In phase III, an information analysis technology combining satellite data and ground truth data, such as data on topographic maps, will be developed to promote wider utilization of remote sensing data in the tropics for the identification of potential disaster areas and classification of forest suitability.

The activities of the project such as selection, pre-processing of image data, preliminary analysis and field study are being done by the Remote Sensing and Resource Data Analysis Department of the NAMRIA.



**DENR Sec. Angel C. Alcala pinpoints the target area for the second field study of the ISDP-MTF. Coverage of the Landsat TM scenes being presented are: Regions I, II, CAR and portions of Region III**

The project has already completed study area I covering Palawan and Mindoro with a total area of 2.4 million hectares. It is currently doing its study area II covering CAR, Region II and portions of Regions 1, 3 and 4. It will eventually move on to study area III with the area of coverage to be determined near the completion of study area II.

The project will provide the DENR with false color images at scale 1:250,000; land-use and forest type images at scale 1:250,000; and land-use and forest type maps at scale 1:100,000.



## NAMRIA intensifies public awareness program

**T**he Information Management Department of NAMRIA has intensified its public awareness program through regional information campaigns, accommodations for briefing and tour of its facilities, conduct of technical forum, participation in product and technology exhibits and media releases.

Linkages with the various information, education and communication units of government and the private sectors have also been strengthened.

Information campaigns were conducted this year in the cities of Baguio, Mandaluyong, and Puerto Princesa, and in Rizal province. In the campaigns, the NAMRIA's products and services were presented to participants composed of local government officials, planning officers, representatives from other government agencies, NGOs, academe and private entities. Information on the latest technologies which can be applied in their respective areas of developmental activities was also presented.

The agency has also been gaining recognition from the other sectors of the society as indicated in the numerous requests for briefing of its functions, and tour of its facilities. As of November, the agency has already accommodated 60 requests. Aside from the ENR sector, most of the requests came from universities, local government units, other government agencies and foreign institutions.

The NAMRIA also participated in 24 photo and map exhibits set up in various offices and schools in Metro Manila and at the information campaign sites.

One technical forum was held in July with the theme, "NAMRIA in Support to DENR."

### CONTRIBUTIONS

The Infomapper is accepting contributions for its forthcoming issues. Manuscript should be typed, double-spaced, and must indicate the author's name, position, and office/home address. Photographs and illustrations with captions are also welcome.

The Editors reserve the right to edit materials submitted.

## TRAININGS/CONFERENCES/SEMINARS



*Engr. Chiquito Molina of RSRDAD explains to his co-participants the accuracy of the measured reflectivity of the radar images of Mt. Pinatubo during a SAR-Geology Workshop held at NAMRIA*

**T**he Coast and Geodetic Surveys Department (CGSD) of the NAMRIA and the Japan International Cooperation Agency (JICA) conducted a Seminar on Notices to Mariners and Navigational Warnings on November 15 - 21, 1994 at the CGSD Office in Barraca Street, San Nicolas, Manila.

The seminar presented the status of Notices to Mariners, Navigational Warnings and Hydrographic Publication Services in the Philippines, Japan and the rest of the international maritime community. It also served as a venue for the sharing of information and discussion of issues such as problems in gathering Maritime Safety Information (MSI) from the local maritime community, the means of improving maritime and navigational services, and the identification of areas for cooperation between government agencies and private marine organizations, among others.

The creation of an Inter-Agency Committee on Navigational Safety was the culminating activity of the seminar. Through the Committee, agencies with related functions will coordinate and work on the following: 1) study/review of the system and policies on Notices to Mariners in the Philippines; 2) lobby Congress for the funding and maintenance of lighthouses; 3) conduct information campaigns and seminar on the importance and uses of Notices to Mariners; 4) work for the inclusion of related subjects on navigational safety in the curriculum; and 5) request assistance from JICA to enable Filipinos and other nationalities to pursue diploma courses at the Japan Maritime Safety Agency.

The participants were technical staff from the CGSD-NAMRIA, MARINA, DOTC, PPA, Philippine Coast Guard, and the Philippine National Police/Maritime Command.

A training course on Synthetic Aperture Radar (SAR) - Geology sponsored by the Intera Information Technologies Corporation under the North West Luzon Geohazard Mapping Project was also conducted at the NAMRIA on October 24-28, 1994.

The workshop aimed to familiarize participants with radar technology specifically on the usefulness and suitability of active microwave capabilities for tropical areas like the Philippines.

The advantage of SAR over other remote sensing technologies being applied in the tropical regions is its all-weather capability. Imagery can be obtained any time of the day regardless of cloud cover. This makes radar imagery a very reliable source of geographic information for developing countries.

The participants went to the Mt. Pinatubo area where they had actual field study and application of what they have learned during the discussions. They verified the accuracy of the reflectivity measurements of the radar images of Mt. Pinatubo in relation to the extent and location of lahar deposits and their damages to nearby areas.

Twelve participants comprising mostly of geologists, engineers and remote sensing technologists from the Mines and Geo-Sciences Bureau, DPWH, CERTEZA, Phivolcs and the NAMRIA attended the workshop.



## Threats & Hazards . . . from page 7

the environment or poor operational procedures. If we are going to consider the more than 400 million-ton world fleet of today and that oil spills contribute to about 10% of marine pollution, operational discharges from tankers can be considered as a major cause of marine and coastal pollution. The recent oil spill in Laguna de Bay was allegedly caused by an unattended faulty drain valve from one of the oil storage tanks of NAPOCOR at the Malaya Thermal Plant in Rizal.

### Effects on Tourism

The contamination of coastal areas is a common feature of most marine oil spills. These lead to a major disruption of the recreational activities in beaches and coastal areas such as swimming, boating, fishing and diving, resulting in a major setback in the hotel, resort, and generally the tourism industry.

### Effects on Industry

Major industries including power plants often rely on a continuous supply of clean water for their normal operations, particularly for cooling purposes. So while power plants and other industries are major sources and causes of spills, these industries could also be operationally affected by the amount of oil in their water intake which reduces their efficiency.

### Aesthetic and Physical Effects

Naturally, a fraction of the oil evaporates rapidly to the atmosphere and the remaining components weather or degrade more slowly. This degraded oil poses less danger to marine life except for sedentary animals like barnacles. As days pass, spilled oil becomes more viscous, transforming to a tar-like residue deposited in the shorelines. When mixed with fine-grained sediments such as sand and gravel, it forms a hard **tar-mat** similar to asphalt. This gives the shorelines (particularly the upper **intertidal zone**\*) a black and sticky appearance that would require a great amount of resources, and time and effort to clean. The churning of the waves causes the water to mix with the oil and form an emulsion or a **mousse** (70% water). Both the tar-mat and mousse weather more slowly until completely dispersed, biodegraded or consumed by natural processes.

### Effects on Marine Life

The coastal areas more than the open seas are the most adversely affected by oil spills. Spilt oil can evaporate or emulsify, but most of the time it is carried by the waves to the bays and coastal areas. So wherever there are any of the three major coastal ecosystems — coral reefs, **seagrasses**\* and mangroves — the effect of oil spills are not limited only to aesthetic and physico-chemical changes, but also encompass biological changes.

Some marine mammals such as seals and

some reptiles such as turtles are vulnerable to the adverse effects of oil contamination because of their need to surface for breathing. Most of the oil damage to marine flora and fauna result from coating, asphyxiation and poisoning through direct contact or ingestion. Adult fish living in nearshore waters are also at risk from exposure to dispersed or dissolved oil. When their gills get clogged with oil, they are unable to breathe and they die.

There are evidences to show that oil kills coral reef fishes and has detrimental effects on the reproduction, growth rate, colonization capacities and feeding and behavioral responses of corals (Alcala et. al. 1987).

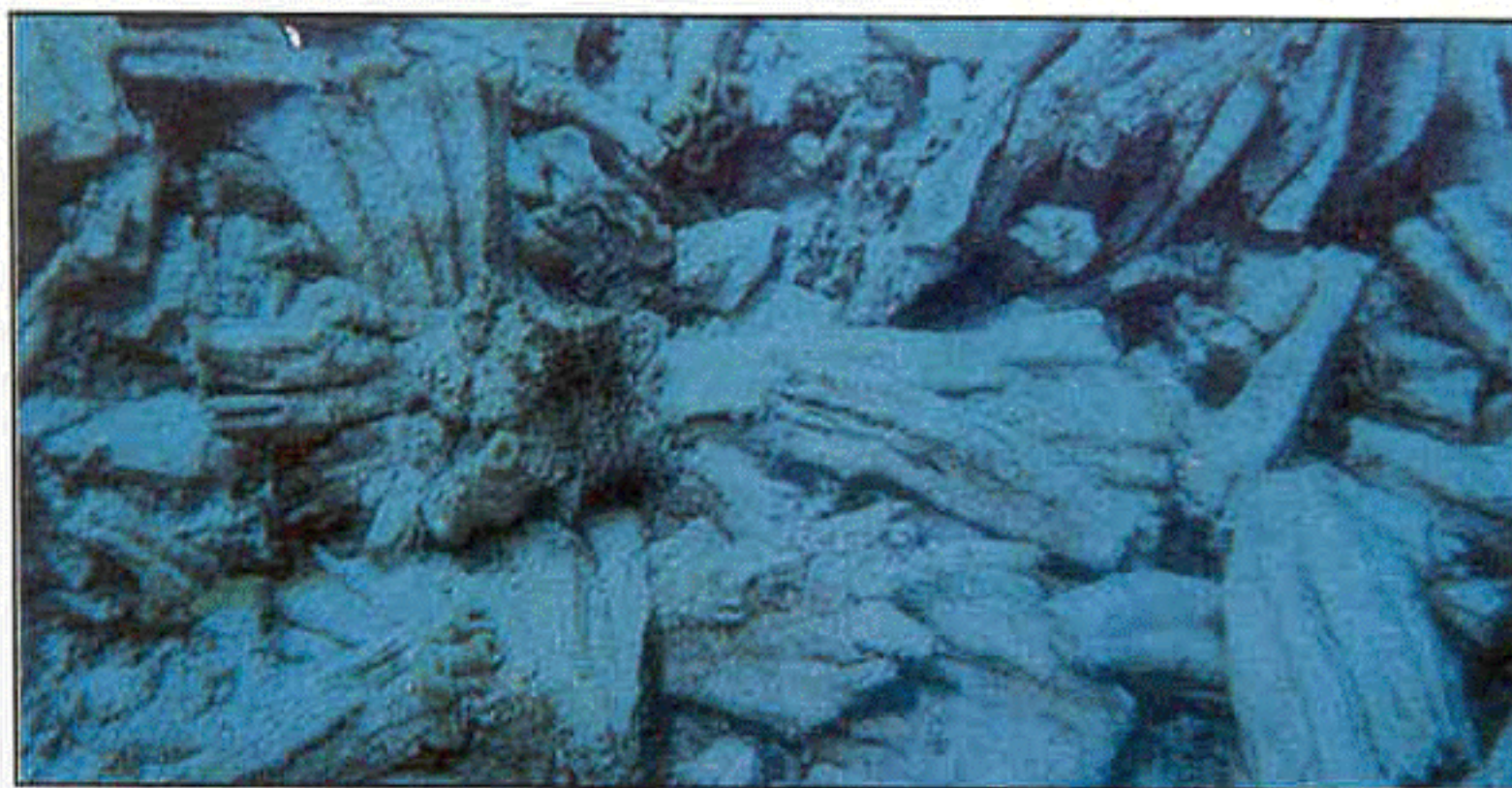
Certain species of seagrasses have developed resistance to pollutants and some are proven to be good sinks or absorbers of heavy metals, but oil may have a tremendous impact on their productivity.

As the spawning and breeding grounds of fish and a major source of nutrients to the dependent ecosystems, mangroves may not live up to their role as a safe sanctuary to juvenile fishes. This may affect the quality and growth of eggs and fry, and hamper the transport of nutrients to other ecosystems.

As the oil is dispersed in the coastal areas, the transparency of the water is lessened, thus reducing or blocking the amount of the sunlight energy that enters the water and affecting the productivity of the ecosystem.

### Cleaning Up Oil Spills

The best method of reducing the effects



Corals broken to rubble as a result of dynamite fishing

and incidence of oil pollution is through prevention. This is done through proper staff training and encouraging appreciation of a clean environment. Cleanup operations can be carried out in different manners depending on the size of the spill, the geographical location and the kind of resource threatened.

Developed countries use remote sensing and aerial surveying and photography on a periodic basis to delineate and monitor the location and movement of spills. Aircraft and sea vessels are also employed to lay out **booms**\* and spray chemical dispersants on the affected area. In some cases, GIS technology is used in the mapping and analysis of the area of coverage.

Cleaning up the shorelines requires repeated cold water deluge, cold water washing,

warm water washing and bioremediation which involves the application of nutrients (nitrogen and phosphorus) to accelerate the natural biodegradation of oil. During the washing, which involves the pumping of sea water, the oil is flushed down the waterline where it is trapped by booms and recovered by **skimmers**.\*

There are also natural processes that assist the breakdown of oil. One is biodegradation (biological oxidation) in which microorganisms break down oil molecules. In the Laguna Lake spill, cleansing was hastened by the presence of continuous rains and presence of water hyacinth which is a good oil absorber.

The country's coastal and marine resources are indeed in a precarious state. Nevertheless, with the efforts of the government and the vigilance of ordinary citizens, there may still be hope of saving these resources for future generations.

### Sources

- Abadilla, Domingo C. *The Environmental Crisis*. Manila: Philippine Education, 1982.
- Alcala, Angel C. "Harnessing the Living Freshwater and Marine Resources of Southeast Asia." *Silliman Journal* 36 (First Quarter, 1992): 87-102.
- Alcala, A.C., E.D. Gomez and H.T. Yap. 1987. "Philippine Coral Reefs: Status and Human Responses to Change." *Resource Management Optimization* 4 (1987): 297-340.
- "Amidst Red Tide." *Manila Chronicle*, 29 May 1994, p. 8.
- Cabrera, Tracy. "Cyanide Fishing Threatens to Destroy RP's Coral Reefs." *The Philippine Journal*, 01 November 1994, p. 5.
- Carlos, Maricris C. "Land-based Pollution Threatens Marine Life." *Businessworld*, 06 June 1994, pp. 1, 6.
- . "20 Firms Vow to Minimize Dumping of Waste in Pasig." *Businessworld*, 29 November 1993, p. 16.
- Contreras, Volt. "Everyone's in the Same Boat." *Philippine Daily Inquirer*, 16 October 1994, pp. B10-29.
- "Cyanide Fishing Fast Depleting Coral Reefs." *The Philippine Journal*, 26 November 1994, p. 15.
- Del Rosario, Macario A. "The Significance of Mangroves for Conservation." Unpublished paper submitted to Miriam College, 1994.
- Department of Agriculture/Bureau of Fisheries and Aquatic Resources. "Final Report on Muro-Ami Fishing Operations by the Task Force," 1988.
- Domanay, Jose S. "Guides for the Determination of Fishes Caught by Explosives." Bureau of Fisheries, 1973.
- . "Despite Heavy Rains, Red Tide Still Spreading." *Philippine Star*, 01 August 1994, p. 13.
- Fernandez, Rudy A. "Breakthrough in Red Tide Research Chalked Up." *Philippine Star*, 27 February 1994, p. 1, 7.
- . "Oil Spills and Discharges: Bane to Tropical Ecosystems." *Philippine Star*, 21 September, 1994, p. 20.
- "Government Effort to Save RP Marine Resources in Full Swing." *Philippine Daily Inquirer*, 16 October 1994, pp. B10, 29.
- Hall, Howard. "Sea Urchins." *Asia Magazine*, June 1986, pp. 22-27.
- Lopez-Deo, Cynthia. "Red Tide Calamity Declared in MM, Three Provinces." *Manila Chronicle*, 13 July 1994, p. 8.
- Martinez, Kit. "Philippine Environmental Problem: an Urgent Call." *Manila Times*, 06, 07 July 1992.
- Mitra, Ramon V., Jr. Philippine Ministry of Agriculture and Food. "Prohibiting the Operation of 'Muro-ami' and 'Kayakas' in all Philippine Waters." *Fisheries Administrative Order*, No. 163, s. 1986.
- Morales, Dante D.; Tupasi, Thelma E. and Co, Vilma M. "Questions Most Often Asked About Red Tide." *The Sunday Chronicle*, 21 August 1994, p. 16.
- Natural Resources Management Center (NRMC)/University of the Philippines Natural Science Research Center. *Guide to Philippine Flora and Fauna*. Quezon City: NRMC (Ministry of Natural Resources), 1981.
- Vol. II: Philippine Corals, by Francisco Nemenzo.
- Orig, Thor S. "Can 'Red Tide' Be Licked?" *Manila Bulletin*, 04 April 1994, p. S-17.
- . "Red Tide Task Force Develops Warning Systems." *Manila Bulletin*, 05 September 1994, p. S-9.
- PAJ News Services. "Cyanide Fishing In, Dynamite Fishing Out." *The Philippine Star*, 10 July 1994, p. 19.
- "Polluted Coastal Waters Killing Mangrove Forests." *Businessworld*, 02 March 1992, p. 10.
- "Red Tide Menace: Man-made Form of Environmental Damage." *The Sunday Chronicle*, 31 July 1994, p. 3.
- "Red Tide Phenomenon Now Worldwide." *Manila Chronicle*, 29 August 1994, p. 7.
- Ronquillo, Inocencio A. "Destructive Effects of Dynamite Fishing." Philippine Fisheries Commission (Fisheries Information Division), reprinted, 1964.
- Sebastian, Roberto S. Philippine Department of Agriculture. "Regulations Governing Pa-Aling Fishing Operation in Philippine Waters." *Fisheries Administrative Order*, No. 190, s. 1994.
- Son, Johanna. "Cyanide Harmful to Fishing Industry—and Your Health." *The Manila Chronicle*, 06 June 1988, pp. 1, 7.
- . "It's Difficult to Detect Poisoned Fish." *The Manila Chronicle*, 07 June 1988, pp. 1, 7.
- . "Fish Nets as Alternative to Cyanide." *The Manila Chronicle*, 08 June 1988, pp. 1, 7.
- Tacadena, Jose. "Pagsagip sa Ilog Pasig." *Filipino Magazine*, 14 February 1994, p. 6.
- "The Lessons of Exxon Valdez." *Exploration and Production Technology International*, 1993, pp. 235-239.
- Water Health. Quezon City: UP Institute for Science and Mathematics Education Development, 1984.
- "When Oil Spills." *Sandiwala, PNOC*, October 1993, pp. 4-5.
- World Bank. *Philippines: Environment and Natural Resources Management Study*. Washington, D.C.: World Bank, 1989.



## TECHNICAL REPORT

### I. INTRODUCTION

Ecologically important and socio-economically valuable coastal resources such as mangroves have dwindled to less than one third of its original area over the past seven decades. A need to develop a better approach to mangrove forest inventory and assessment is therefore needed to prevent further losses in the country's mangrove forests.

**Optical sensor\*** data from SPOT and Landsat Multispectral Scanner (MSS) and Thematic Mapper (TM) have been increasingly utilized over the years for the monitoring and mapping of coastal areas. In tropical areas, however, the optimal use of these data could be hampered by persistent cloud cover. Providing a welcome alternative to other remote sensing data is the advent of **radar sensors\***, which can penetrate cloud cover, such as Synthetic Aperture Radar (SAR) data.

SAR data are obtained by imaging a swath to one side of an aircraft while flying at about 9,000 meters above sea level. This is called the side-looking mode. These data are recorded on board the aircraft in digital form using High Density Digital Tapes. Simultaneously, these data are displayed in real time on dry silver paper.

Due to the complexity of factors to be considered in using and interpreting SAR data, as well as the different parameters being measured by SAR and by optical sensors, the usual image processing techniques for manipulating optical sensor data cannot simply be applied on SAR data. This study, therefore, attempts to determine which **filters\*** and processing methods would result in the optimal use of SAR data, particularly for mapping coastal areas.

### II. PROJECT OBJECTIVES

The general objective of the study is to assess the viability of SAR data for land cover mapping. Specifically, it aims to compare the enhancement level of available filtering methods and to analyze the level of information that can be extracted from SAR data for delineating coastal resources like mangroves from the near-coastal land features.

### III. REVIEW OF LITERATURE

Available literature on SAR and its problems and potentials for mapping applications were reviewed. Among the important points gathered were: the development of imaging radar systems such as Side-Looking airborne Radars (SLAR) and SAR; the presence of **speckle\*** which limits the general interpretability of SAR data; speckle suppression methods which are used to improve and prepare the SAR image for interpretation; the various kinds of filters; the advantage of using **adaptive filters\***; and the need to consider not only despeckling in the processing of SAR

## Filter Selection and Digital Processing Methods for Synthetic Aperture Radar (SAR) for use in Coastal Land Cover Mapping<sup>1</sup>

by Ma. Consuelo D. Garcia

(Condensed for publication by Charmaine C. Aviquivil)



Median 7 x 7 density-sliced SAR image of Pagbilao, Quezon

data for subsequent interpretation, but also its tone and texture characteristics.

Several studies on the use of SAR for general land use and coastal mapping were also cited.

### IV. METHODOLOGY

The data utilized for the study included the following: 1987 SPOT High Resolution Visible (HRV) data of Pagbilao, Quezon, as well as 1991 STAR-1 SAR data and maps of the above study area. Software used included the following: ERDAS, MERIDIAN, EARTHVIEW, and ERMapper software packages.

#### A. Selection and Description of Study Area

The selection of the study area was limited by the available Philippine coverage of the SAR data in the NAMRIA Archives during the project duration. Since only Luzon was covered, the area selected was Pagbilao, Quezon because it had a sizeable mangrove stand remaining. SPOT HRV digital data of the area that showed the least cloud cover was selected. The corresponding STAR-1 SAR data of the study area taken in April 1991 was likewise selected from the Archives.

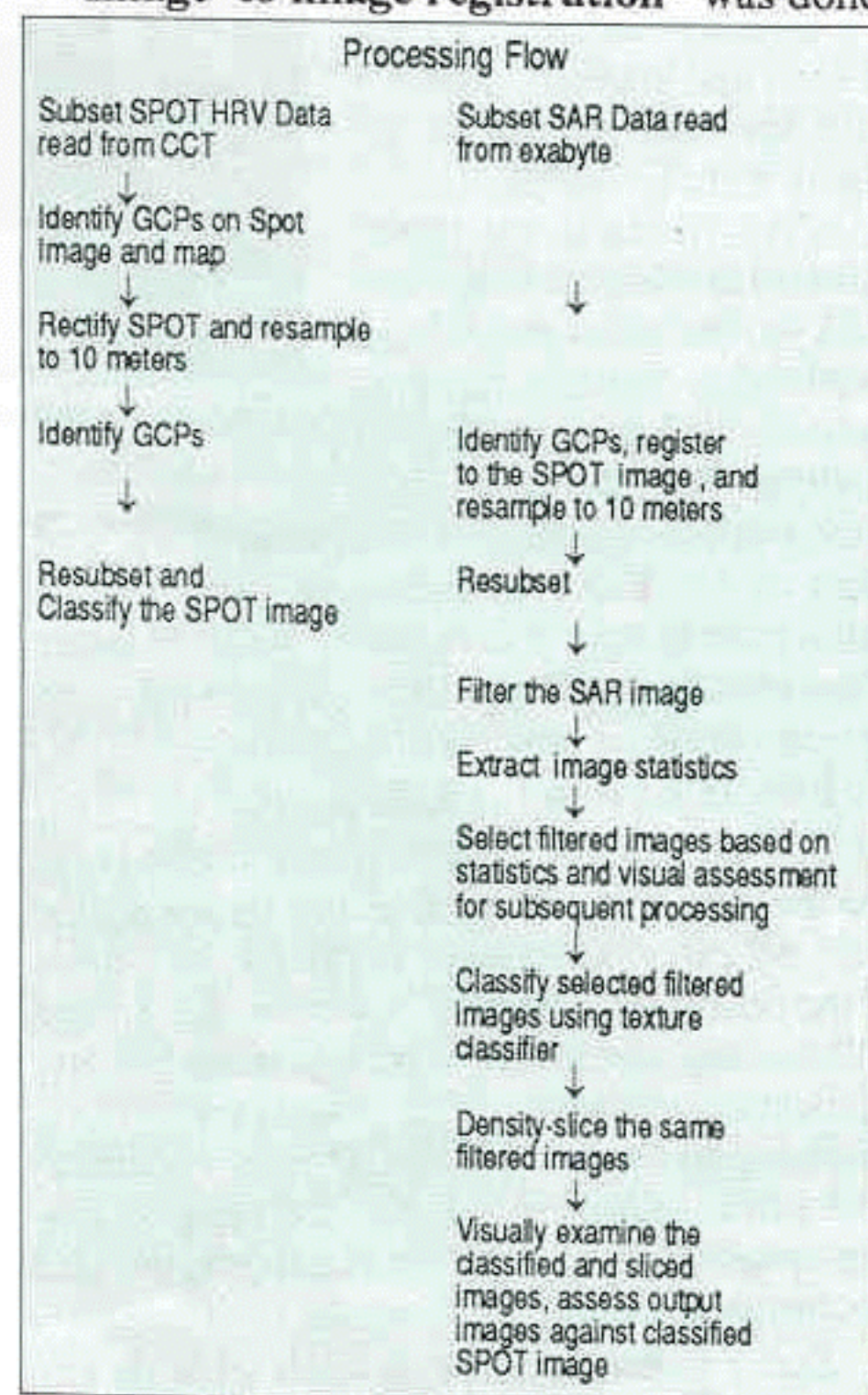
Pagbilao, Quezon is located east of Manila at 119°53' central longitude and 16°23' central latitude. The site, characterized by secondary mangrove growth lying on a delta formed by a river and its tributaries is one of the few areas in the country where sizeable stands of mangroves can still be found.

The mangrove forest found in Pagbilao has been subjected to land use conversion, particularly to fishponds, and utilization of mangrove trees for charcoal making, firewood

production and other purposes which have greatly contributed to the rapid depletion of the mangrove forest stand. To date, the only remaining mangrove stand along this area is the DENR mangrove reserve, bordered by the Palsabangon and Pinagbayan rivers. The rest of the stands are thin and serve only as a buffer zone between the fishponds and coastline to inhibit erosion.

#### B. Image Registration

**Image to image registration\*** was done



<sup>1</sup>This technical report is a condensed version of the project report submitted by the author to the School of Geography, University of New South Wales, Australia in partial fulfillment of the requirements for the degree of Master of Applied Science in Remote Sensing.



to enable the comparison of the processed radar files to the classified SPOT file that served as the ground truth data. A total of 24 well-distributed GCPs were identified on both SAR and SPOT images. A transformation matrix was then computed and tested and an output grid file was created using the ERDAS software's COORDN and LRECTIFY image processing algorithms, respectively.

### C. Filtering of the SAR Image

As mentioned in Part III of this report, SAR images have to be filtered to remove speckle. The filter used, however, should not only do away with noise, but should also be able to bring out the inherent tone and texture of the image while maintaining the curvilinear features.

Different filters were used in this study: **low pass and high pass filters\*** found in the DCONV algorithm of ERDAS, the filters found in the ERDAS LANSCAN algorithm, and a new adaptive filter known as the LEE filter which is found in the EARTHVIEW package.

### D. Texture Transformation

The available texture transformation algorithms in the MERIDIAN system such as variance, range, and skewness were applied on the SAR image using varying **kernel\*** sizes. The texture functions show the statistical measures of coarseness, smoothness and regularity over a kernel of pixels independent of the positions of the pixels within.

### E. Statistical Analysis

After filtering the SAR image, the output filtered images were visually examined. Those that showed the most information were selected for subsequent processing. Statistical data on the selected filtered images, as well as data on the windows of known cover features for each of the images were generated using the GETINFO command in the EARTHVIEW package. These statistical data included the maximum and minimum data values, mean value and standard deviation.

### F. Image Classification, Texture Classification and Density Slicing

The SPOT image was classified using a hybrid classification method in ERDAS, which resulted in a more accurate transformation of information classes to corresponding land cover features.

Texture classification of the filtered SAR images, on the other hand, was done in two phases using the EARTHVIEW package. Initially, a training **session\*** was done under the TCLASTRN algorithm of the package, after which the actual classification was undertaken under the TCLASIFY algorithm.

The same filtered SAR images were also **density-sliced\*** in the ERMMapper package using the feature window statistics generated from the EARTHVIEW processing. Each sin-

gle-band filtered SAR image was assigned to three bands corresponding to the **RGB guns\***. Each of the bands were then sliced using the same range of intensity values. The three-band assignment was undertaken to better delineate the range of statistical values for each of the known cover features, based on the color resulting from the slicing in the RGB guns.

### G. Output Assessment

Due to time limitation, digital comparison to assess the accuracy of the processed SAR images and the classified SPOT image was not undertaken. Instead, qualitative comparison of the processed SAR and classified SPOT files was done visually. A portion of the classified SPOT files was transferred to a transparency and was overlaid over the processed SAR images.

## V. RESULTS AND DISCUSSION

### A. Image to Image Registration

Out of the 24 GCPs identified for the image to image registration between the SPOT and SAR data, only ten GCPs were accepted after the iterative registration using a second order transformation. Although a number of GCPs could be identified on the SAR data, identification of the corresponding GCPs on the SPOT image was made difficult by the extensive cloud cover.

Coastlines are dynamic areas of the coastal zone and are subject to physical change across time. Thus, using the coastline for identifying GCPs posed an additional difficulty, considering the temporal difference of four years

between the two images.

### B. Classification of SPOT HRV Image

Four general cover classes resulted from the classification of the SPOT image: water, mangroves, coconut, and open/grassland areas. Despite repeated and careful updating of the **signature file\***, its use still resulted in noticeable errors in the classified SPOT image. For instance, the cover class color denoting mangroves appeared in small patches in places known as coconut areas. Segregation of these two classes was accomplished by careful **thresholding\*** of their spectral values and spatial pixel distance.

### C. Filtering of STAR-1 SAR Image

Filtered images initially selected based on their having retained substantial information included the low-pass filtered images (3x3, 5x5, and 7x7), variance transformed image (3x3), minimum-maximum LANSCAN filtered image (3x3), median filtered images (3x3, 5x5, and 7x7), and LEE-filtered images (3x3, 5x5 and 7x7). The LANSCAN and variance-transformed images were then eliminated due to extreme overlapping of pixel range values.

Based on image statistics, the median-filtered images showed the least image variability while the LEE-filtered images displayed the highest variability. The 7x7 LEE filter successfully removed the speckle while retaining the general scene texture, as denoted by the high standard deviation compared to the raw SAR image and the rest of the filtered SAR images.

### D. Textural Classification of the Filtered SAR Images

The textural classification of the filtered images did not result in a clear delineation of cover features. Only the median 5x5 and the LEE 3x3 and 5x5 filtered images delineated mangrove areas at the coastline. Further, only the offshore water was correctly classified texturally in all images.

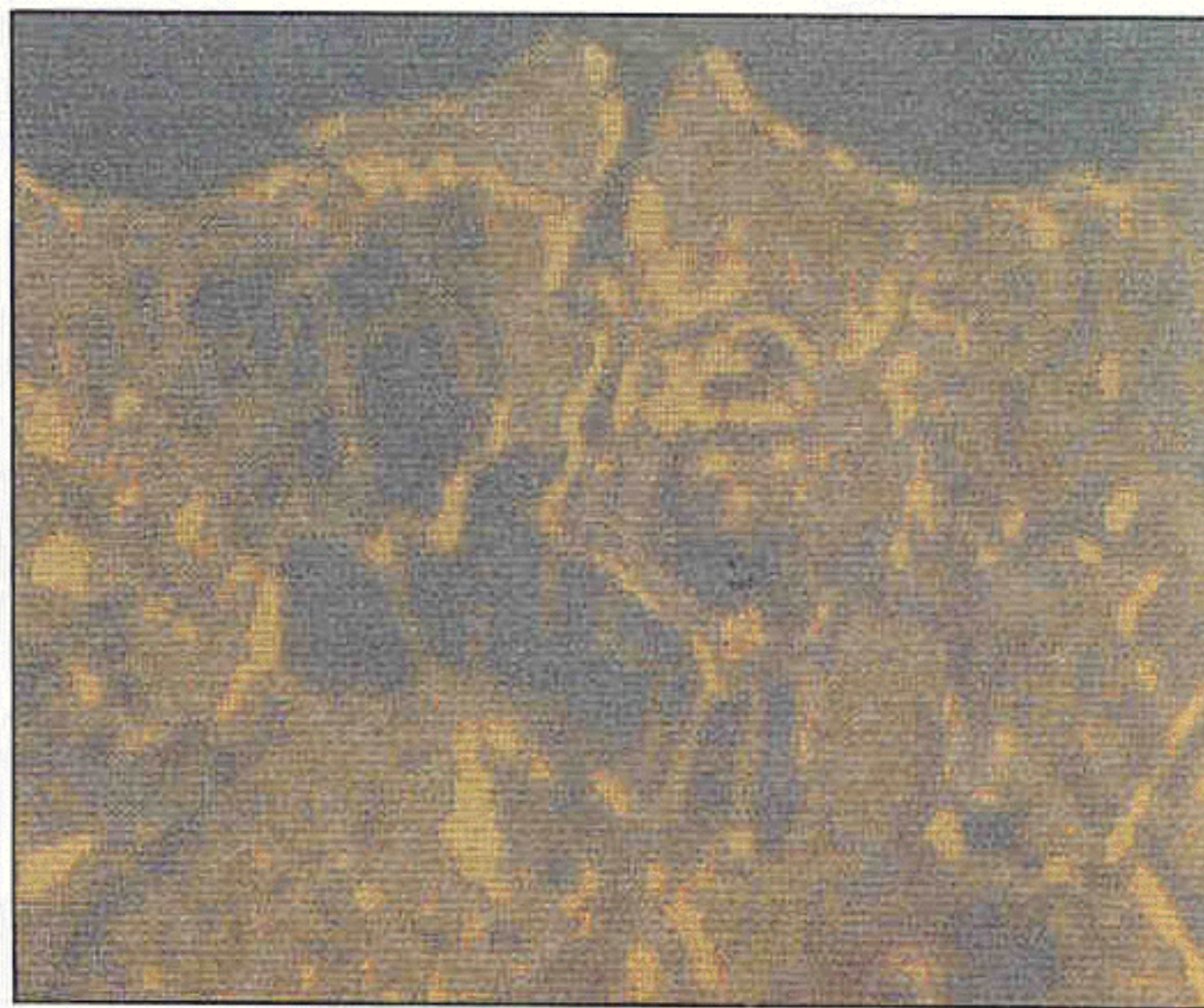
The result of the texture classification points to the similarity or overlap of the **texture signature spectra\*** of mangrove, coconut and open areas. While these areas may be different physically and geometrically, their backscatter and textural qualities could not be distinguished from each other using short radar wavelengths.

### E. Density-Slicing of the Filtered SAR Images

In general, all the filtered images that were density-sliced delineated well the open and fishpond water areas compared to their counterpart texture-classified images. Density slicing, however, did not result in a clear delineation of vegetated areas, specifically the mangroves and coconuts. This may be attributed to the overlap of intensity values of mangroves and coconuts.

## VI. CONCLUSION

The viability of using a single **X-band SAR data\*** for delineating coastal features was assessed against a classified SPOT image. Results showed that vegetation cover with similar and overlapping backscatter response



**LEE 7 x 7 density-sliced SAR image of the study area**  
(Note: Photo Inverted)

between the two images. Other factors which added to the difficulty in using the coastline as a reference point include the following: emerging mangal growth during the interim four-year period; the difference in the way by which optical and radar sensors sense the land and water interface; and the difference in the timing of passes of both images which could have made it harder to identify the actual coastal edge due to the effects of tidal fluctua-



## GLOSSARY

**Adaptive filters** - special filters used to smooth out speckle on radar images by calculating the filter weights for each window position based on the local mean and variance of the grey values on the radar image beneath the kernel window.

**Bag net** - a movable net shaped like a cone with two detachable wings or panels tied to either side which extend out to guide fish to be captured into the mouth or bag portion of the net.

**Bilge** - the rounded, lower part of a ship's hold.

**Boom** - a device that provides a continuous subsurface skirt or flexible screen supported by flotation chambers used to contain oil spills.

**Coral polyps** - refer to tiny organisms belonging to *Phylum Coelenterata*. These organisms whose limy skeleton is known as "coral" inhabit fresh and marine waters and contribute to the formation of coral reefs.

**Coral reefs** - reefs or ridges formed from calcareous plant and animal organisms, among which are coral polyps.

**Corals** - skeletons of sea animals called coral polyps.

**Density-slicing** - the process of converting the continuous gray tone of an image into a series of density intervals or slices, each corresponding to a specific digital range.

**DXF files** - acronym for Data Interchange Format; these refer to standard ASCII text files which can easily be translated to the formats of other software or submitted to other programs for specialized analysis.

**Filter** - an image-enhancing algorithm that either emphasizes or deemphasizes certain groups (or bands) of spatial frequencies or brightness values relative to others in an image; an algorithm that performs spatial-frequency enhancement; an area operation that uses a kernel of an odd array size which is moved through an input image so that the brightness value ( $BV_{ij}$ ) at location  $ij$  in the output image is a function of some weighted average (linear combination) of brightness values located in a particular spatial pattern around the  $ij$  location in the input image; a subarray (box, window, or kernel) of  $N$  by  $M$  pixels that is moved through the larger image array and is usually of an odd integer dimension along each side so that a central pixel exists for DN reassignment based upon the surrounding pixel values.

**Fundamental absolute station** - geodetic station surveyed using GPS to an accuracy of one meter or less relative to WGS

(World Geodetic System) 84.

**Geocentric** - earth-centered.

**High-pass filter** - a spatial filter that enhances high spatial frequencies on an image.

**Image to image registration** - the translation and rotation alignment process by which two images of like geometries and of the same set of objects are positioned coincident with respect to one another so that corresponding elements of the same ground area appear in the same place on the registered image.

**Intertidal zone** - part of the beach that is within the high and the low tide tide water lines.

**Kernel** - a pixel array used for digital image filtering; also called window.

**Low-pass filter** - a spatial filter that deemphasizes the high frequency detail on an image.

**Mangrove** - term applied to the type of forest occurring on tidal flats along the sea coast, extending along the stream where the water is brackish.

**Mangrove stand** - refers to a mangrove resource specifically of trees.

**Mine tailings** - waste materials from metallurgical processes.

**Optical sensor** - any device that gathers the electromagnetic energy (EMR) reflected by an object within the visible light and infrared region, converts such energy into a signal, and presents them into a form useful for obtaining information about the environment.

**Radar sensor** - an active remote sensing sensor which propagates its own microwave radiation to the surface and detects the reflected component called echo or backscatter.

**RGB guns** - red, green and blue color guns that create the image on the color Cathode Ray Tube (CRT) screen.

**Scarelines** - devices for scaring fish which are made up of ropes to which are attached, aside from weights, materials such as white plastics or coconut leaves, and floats like styrofoam or bamboo. The fish are scared by the noise resulting from the bouncing of the weights along the bottom of the sea, and by the sight of the moving attachments to the ropes.

**Seagrasses** - group of submerged flowering plants in the marine environment that thrives in shallow-water coastal habitats. They possess erect, leafy shoots and creeping stems which are effective for propagation.

**Signature file** - the file containing the statistical characteristic of spectral classes or training areas which is used for classifying the image.

**Skimmer** - a device used to collect spilled oil from the water surface by air suction or rotating disks. Oil is pumped out to a central collection point.

**Speckle** - the peculiar granular pattern or the light and dark pixel mixing on a radar image resulting from the constructive and destructive interference of radar backscatter.

**Texture signature spectra** - the output file of texture classification containing the range of statistical information corresponding to the texture of features on a radar image.

**Thresholding** - the process of delimiting the range of information that will be processed digitally.

**Training session** - the process of informing an image processor which sites to analyze for spectral or textural properties as a prerequisite to supervised classification.

**X-band SAR data** - radar data image within the range of 3 cm wavelength.

### Filter Selection... from page 15

such as mangroves and coconuts cannot be differentiated using a short wavelength single SAR dataset.

Literature shows that mangroves could be delineated from other vegetation by the presence of water beneath the canopy. In this study, however, water beneath the canopy could not be recognized on the raw and processed SAR images due to the low penetration capability of the X-band SAR pulses. And since response from the X-band radar was mainly due to surface scattering, the canopy surfaces of mangroves and coconuts (both being rough surfaces) could appear similar.

Among the filters used, the LEE filter removed the speckle well while maintaining the curvilinear features. The textural classifier was unable to discriminate among the three major coastal features such as mangroves, coconuts and open areas. Density-slicing, however, resulted in the delineation of water, open areas and general vegetation.

To fully assess the applicability of SAR data for coastal mapping purposes, further investigation of the automatic delineation of inherently variable coastal areas using multi-band SAR data needs to be undertaken. Experiments on multi-band imagery and the use of adaptive filters over large areas showing high scene variability, like the coastal zone, should also be pursued to determine the filters' robustness in averaging real heterogeneous areas while maintaining curvilinear features. Finally, considerable work in the field of automatic classification adapted for multi-band SAR data may have to be done in order to optimize the use of SAR data for coastal land cover mapping. This should take into consideration the varying coastal features and target responses to the different microwave bands.

<sup>2</sup> Editor's note: Due to space constraints, we cannot publish the list of references consulted for this project report. Those interested in consulting the references can avail of the list from the author or from the editors of this publication.

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