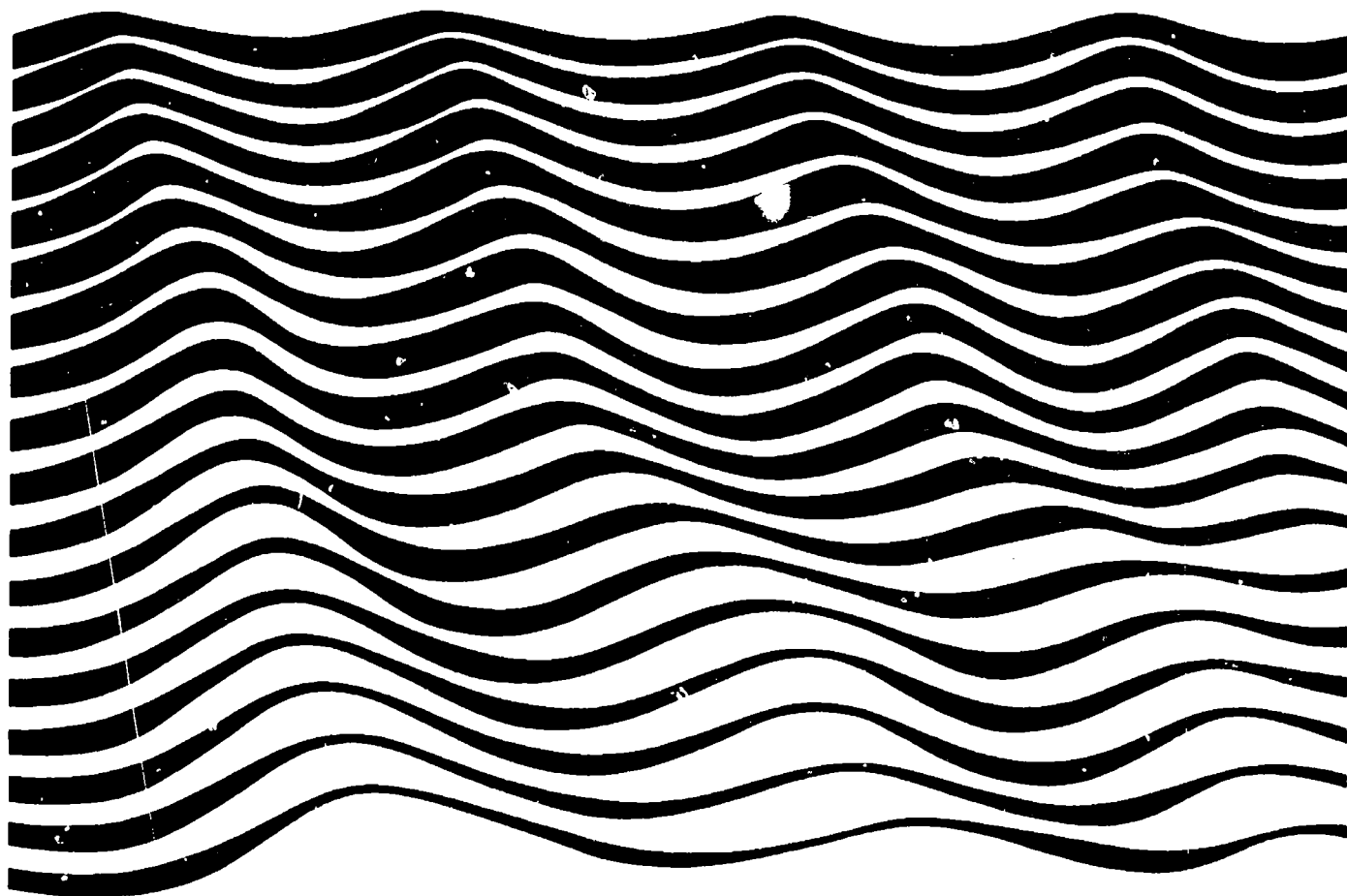


# Coastal Ecosystems of Latin America and the Caribbean

Objectives, priorities and activities  
of Unesco's COMAR project for  
the Latin American and  
Caribbean region

Caracas, Venezuela, 15-19 November 1982



Unesco, 1983

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9 The mangrove ecosystem: scientific aspects and human impact Report of the seminar organized by Unesco at Cali, Colombia, 27 November-1 December 1978 Available in English and Spanish	1979	22 Guidelines for marine biological reference collections Prepared in response to a recommendation by a meeting of experts from the Mediterranean Arab countries Available in English, French and Arabic	1983
10 Development of marine science and technology in Africa Working Group of Experts sponsored by ECA and Unesco, Addis Ababa, 5-9 May 1980 Available in English and French	1980	23 Coral reefs, seagrass beds and mangroves: their interaction in the coastal zones of the Caribbean Report of a workshop held at West Indies Laboratory, St. Croix, U.S. Virgin Islands, May, 1982 English only	1983
11 Programa de Plancton para el Pacífico Oriental Informe final del Seminario-Taller realizado en el Instituto del Mar del Perú, El Callao, Perú, 8-11 de septiembre de 1980 Spanish only	1981		
12 Geología y geoquímica del margen continental del Atlántico Sudoccidental Informe final del Taller de Trabajo organizado por la Unesco en Montevideo, Uruguay, 2-4 de diciembre de 1980 Spanish only	1981		
13 Seminario Latinoamericano sobre Enseñanza de la Oceanografía Informe final del Seminario organizado por la Unesco en São Paulo, Brasil, 17-20 de noviembre de 1978 Spanish only	1981		

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## PREFACE

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## SUMMARY

A review meeting on the third version of the draft 'Regional project for research and training on coastal ecosystems of Latin America and the Caribbean, and their relations with the continental shelf' (COSALC), which constitutes a regional component of COMAR, was held from 15 to 19 November 1982 at the Venezuelan Institute for Scientific Research (IVIC) in Caracas, Venezuela.

Twenty-three scientists from twenty-one countries took part in the meeting together with the Intergovernmental Oceanographic Commission for the Caribbean and Adjacent Regions (IOCARIBE), a representative of the Unesco Division of Marine Sciences (SC/OCE) and a representative of the Regional Office for Science and Technology for Latin America and the Caribbean (ROSTLAC/UNESCO).

The plenary sessions were devoted on the one hand to stating the general problems (examples, strategies and methods of study related to coastal systems as well as to presenting the activities conducted by IOCARIBE and explaining the significance of the interregional COMAR project and, on the other hand, to the presentation by each participant of a report on the situation in regard to the coastal zones in his own country. Light was thus thrown on the socio-economic importance of the zones, the available infrastructure and manpower, the research and training programmes and the prospects of developing rational exploitation of coastal zone resources.

Three working groups were set up with a view to analysing the programmes required in each country in the region and subregions which may be involved in the COSALC action plan:

The Research and Training Working Group (RTG).

The Management and Training Working Group (MTG).

The Project Organization Working Group (POG).

In the light of the considerations discussed in plenary session on the basis of the analyses made by these working groups, it was recommended:

- (1) that the specific and more general recommendations contained in the different working group reports and concerning the various actions which need to be undertaken in the short- and medium-term, be implemented by Unesco;
- (2) that governments, Unesco and the various international agencies participating in the project make the necessary arrangements and promote co-operative agreements as required for the project to be implemented, and therefore contribute to a reinforcement of national mechanisms and of international co-operation for research and training and the management of coastal zone resources.

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## 1. INTRODUCTION

### 1.1 Background and justifications

Today, two-thirds of the world population lives in coastal areas. This high density of human settlement together with the urgent need for socio-economic development, is a factor that puts pressure on the environment through overexploitation of natural resources and through the adverse effects of pollution with industrial, domestic and agricultural residues and wastes.

This pressure, added to the numerous and complex natural interactions at work in coastal systems, makes coastal areas more vulnerable to variations in the environmental factors that govern the equilibrium between interrelated ecosystems.

As early as its nineteenth session, Unesco's General Conference emphasized the importance of coastal zones and stressed the need to assist Member States in acquiring a better knowledge of the scientific aspects of the various coastal ecosystems and of man's impact on them, as a basis for a good and efficient coastal management policy.

With a view to furthering knowledge of the resources of coastal ecosystems and of the general lines along which they function, Unesco implemented a 'Major Interregional Project on Research and Training Leading to the Integrated Management of Coastal Systems' (COMAR). This project has four fundamental characteristics:

- (i) close co-operation among the international scientific community;
- (ii) adaptation of each of the regional components of the project to the specific features of each region, notwithstanding the fact that it is conceived as an interregional project;
- (iii) the establishment of practical and effective co-operation between scientists and managers;
- (iv) the promotion of a better knowledge of the traditional practices in the coastal ecosystems and their utilization as a new mode of development.

Likewise, a proposed regional co-operation programme has been launched under the title of 'Regional Project for Research and Training on Coastal Ecosystems of Latin America and the Caribbean, and their Relations with the Continental Shelf' (COSALC), it is under the technical guidance of Unesco as part of its marine sciences programme in co-ordination with other Unesco activities carried out by the IOC,(1) the MAB programme,(2) and the Earth Sciences and Hydrological programmes.

### 1.2 Major characteristics of COSALC

This proposed co-operation is an experimental training and research programme of a regional, interdisciplinary and integrated nature which is to be put

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(1) IOC: Intergovernmental Oceanographic Commission

(2) MAB programme: Intergovernmental Programme on Man and the Biosphere



into effect by means of a co-operative network of research institutions in the different countries of the region.

### 1.3 Objectives of COSALC

#### 1.3.1 Development objectives

- (i) To establish a regional framework for co-operative post-graduate research and training activities, with a view to increasing the number and competence of scientists and administrators engaged in study and management of the various ecological systems characteristic of the coastal zones, their relations with the ocean, and related resources.
- (ii) To lay down guidelines for carrying out good and efficient management with a view to obtaining the best possible economic benefit from the marine and coastal environment.

#### 1.3.2 Immediate objectives

- (i) To summarize the present state of knowledge and propose guidelines for future research and management activities in regard to the distribution, structure and functioning of ecosystems in coastal areas and the adjacent marine environment, the potential resources and their utilization, and the impact of human activities.
- (ii) To undertake studies on the size, distribution and state of conservation or deterioration of the different coastal ecosystems and to inventory the data and information material and the potential manpower for socio-economic development that exist in the various countries in Latin America and the Caribbean.
- (iii) To promote the establishment of a regional institutional network as a basic means of putting co-operation into practical effect with a view to improving training and research activities concerned with the coastal areas and the marine environment.
- (iv) To design and carry out an integrated training programme involving the multidisciplinary aspects of coastal areas and the marine environment, starting from a general descriptive and ecological standpoint, with a view to gradually introducing more specialized postgraduate research activities, bearing in mind the methods applicable to management and scientific research policies utilized by Unesco in co-operation with the international scientific community and concerning mangrove swamps, coastal lagoons, estuaries and coral reefs.
- (v) To organize working meetings, seminars and experimental projects on specialized subjects with a view to determining priorities in research and training, increasing the number of participants in the region and encouraging reflection in order to improve research and training activities, taking into consideration the specific requirements of the research and management policies of the participating countries.
- (vi) Compile information and make it available to the public.

#### 1.4 Objectives of the meeting

With a view to carrying out a definitive review of the proposed project, Unesco organized a meeting of scientific experts from twenty-one countries in Latin America and the Caribbean.

The meeting was held from 15 to 19 November 1982 at the Venezuelan Institute for Scientific Research (IVIC) in Caracas, Venezuela.

Its detailed objectives were:

- (i) to allow each participating country to define and select the activities and components to which it attaches priority;
- (ii) to review the objectives of COSALC in keeping with the priorities established by the participating countries;
- (iii) to review the structure of COSALC;
- (iv) to discuss courses of action and means of finance, including co-ordination matters.

In particular, the purpose of the meeting was to establish a basis for carrying out pilot training and research projects on coastal ecosystems in the region.

#### 1.5 Preparatory regional activities

Through its Division of Marine Sciences (SC/OCE) and the Regional Office for Science and Technology for Latin America and the Caribbean (ROSTLAC), Unesco circularized a first draft of the COSALC project in 1980, and a second revised version in 1981.

In 1982, a workshop on the 'Interaction between Mangroves, Sea-grass Beds and Coral Reefs' was held in St. Croix, U.S.A. Virgin Islands from 24 to 30 May 1982 under the auspices of Unesco, the West Indies Laboratory of the Fairleigh Dickinson University and IOCARIBE.

This workshop was attended by some thirty scientific experts from fifteen countries in the Caribbean as well as by experts from the United States of America and Canada. Its objectives was to establish, by means of reports, discussions and field demonstrations, the real extent of these interactions.

On this occasion, recommendations were formulated which were used in the Caracas meeting as a framework for the Caribbean.

#### 1.6 Subsequent regional activities

Following the Caracas meeting, Unesco participated in organizing and financing the following undertakings in collaboration with several scientific institutions in Brazil:

- (i) Course on 'Ecological aspects of the benthic fauna in estuaries and on the continental shelf' given by Professor J.M. Peres at the Fundaçao Universidade do Rio Grande (FURG), Rio Grande, Rio Grande do Sul, Brazil from 29 November to 8 December 1982.

- (ii) Course on 'Geology Applied to Coastal Planning and Protection' given by Professor F. Ottmann at the Research Centre for Coastal Geology and Oceanographic Studies (CECO), Porto Alegre, Rio Grande do Sul, Brazil, from 29 November to 18 December 1982 and to which Unesco invited two students from the Facultad de Humanidades y Ciencias de la República (Montevideo, Uruguay);
- (iii) 'International Symposium on the Utilization of Coastal Ecosystems: Planning, Pollution and Productivity', held at FURG (Rio Grande, Rio Grande do Sul, Brazil) from 22 to 27 November 1982. The COMAR project was outlined during a plenary session and then discussed in regard to the priorities of each participating country at a special session.

In 1983, Unesco sponsored a co-operation programme between the Centre for Coastal Geology (Mar del Plata University, Argentina) and the Research Centre for Coastal Geology and Oceanographic Studies (CECO) of the Federal University of Rio Grande do Sul (UFRGS), Porto Alegre, which took place from 11 to 14 April at the University of Mar del Plata (UNMP) with the participation of teachers and students from Brazil, Uruguay and Argentina.

In collaboration with the National Oceanic and Atmospheric Administration (NOAA) of the United States of America, Unesco also sponsored a seminar (26-28 January 1983) and a course (9-20 May 1983) on the application of remote sensing techniques to the study of coastal ecosystems. They were held at the Inter-American Geodetic Survey (IAGS) Cartographic School at Fort Clayton, Panama.

## 2. REVIEW OF THE PROPOSED COSALC REGIONAL PROJECT

### 2.1 Coastal ecosystems: regional problems; strategies, examples and methods of study

During the plenary sessions, lectures were given that threw light on several topics of general interest concerning the coastal ecosystems of Latin America and the Caribbean.

Abstracts of these lectures are presented below:

#### 2.1.1 Coastal zone systems of the Eastern Caribbean - main features and subjects of concern (E. Moore, Barbados)

The islands of the Eastern Caribbean (Lesser Antilles) from St. Christopher-Nevis in the north to Grenada in the south, belong to a chain of volcanic islands of different geological ages.

The physical geography of these islands varies greatly; they are surrounded by a diverse body of tropical water whose currents are influenced by the North Atlantic gyre. Upwelling does not occur in these waters, which are characterized by a noteworthy stratification resulting in relatively poor primary production.

In spite of the foregoing characteristic, some of the most productive ecosystems in the world are to be found in the coastal areas of the Caribbean Sea: namely, coral reefs, sea-grass beds and mangrove areas, these last having relatively low productivity rates in the Eastern Caribbean.

Most of the islands are surrounded by coral reefs. The offshore zone extends from low water mark seawards, and in this extension may be found the sea-grass beds which serve as a culturing ground for numerous benthic species and as a feeding ground and sanctuary for a large number of juveniles and small adult migratory species. They also play an important part in the stabilization of sediments.

On the other hand, beaches are at the centre of land/sea interface processes such as erosion and the action of tides, both of which entail major socio-economic impacts.

As a rule, beaches in the Eastern Caribbean are narrow and steep on the west coasts, whereas the east coasts have wide, sandy beaches backed by sand dunes. Beach sand is derived from three main sources:

- (i) cliff erosion;
- (ii) inland sources and transport to the coast via streams;
- (iii) coral reefs.

The east coasts of the islands are the exposed windward coasts while the west coasts are the sheltered leeward coasts. The south and north coasts experience intermediate conditions resulting from refracted waves.

Beaches are affected by waves through a dynamic process of sand erosion and sediment replacement depending on whether the sea is calm or stormy. Eastern Caribbean islands can also be affected by swell waves coming from afar and generated by cyclones. These swell waves are particularly noticeable on the west coasts and occur most often during the winter. Thus, there is a seasonal pattern in beach changes.

The Eastern Caribbean islands also lie within the hurricane zone. Hurricanes are intense tropical cyclones with wind speeds exceeding 74 mph (119 km/h). They may have devastating effects due to the combined action of strong winds, high waves, heavy rain and flooding and swell waves. There is a rapid rise in the sea level produced by onshore hurricane waves which can be as high as 6.5 ft. (2 m). Thus, a hurricane can generate a wave height of 27 ft. (8.2 m) with a maximum height of 52 ft. (15.8 m).

Such combined forces can cause damage to cliffs, beaches and dunes. In extreme cases, the dunes, which take much more time to build, may never re-form, since the beach may re-establish itself further inland.

Hence, it is clear that the coastal area is one of the most vulnerable elements of the landscape as it is subjected to both meteorological and human pressures.

The rate of erosion, which is established from field data, aerial surveys etc., indicates the number of metres of land lost per year. The following data may be presented to give an example: 0.5 m/yr. for the west coast of Barbados (between 1960 and 1980) and Montserrat (between 1966 and 1981); 0.4 m/yr. for the west coast of Grand Turk Island (between 1906 and 1969). Similar erosion has been observed in St. Vincent, St. Lucia and Nevis.

It should be borne in mind that these are average figures spanning a period of years. Consequently, the erosion rate may differ substantially from such average figures and may even be positive.

The foregoing data indicate that throughout the islands of the Eastern Caribbean there has been an erosion phase in progress since the beginning of the 1960s, although owing to inadequate information, it is difficult to pinpoint the start of the erosion. In addition, this trend is confirmed by the fact that between 1962 and 1975 there has been a 45 per cent increase in the amount of beachrock exposed in Barbados.

The major causes of this erosion are difficult to determine, even though their relation to the incoming wave energy is known.

A preliminary analysis of wind speed in Barbados indicated that the average wind speed was higher between 1969 and 1978 than between 1903 and 1968. Further observations also suggest that the number of winter swells have also increased during recent years.

Moreover, during the past forty years there has been an increase in the rate of sea level rise, attributed to an increased melting of the Antarctic ice sheet. During this same period, global mean sea level has risen to an average rate of 3 mm/yr.; although this is already triple the rate measured during the preceding fifty years, during the past ten years it has attained between 7 and 14 mm/yr. It is estimated that a rise in sea level of 3 mm/yr. on a slope of 1 in 10 would result in a retreat of high tide mark of 1 ft (0.3 m) over a ten-year period.

From a socio-economic viewpoint, the development of coastal areas is essential in ensuring a satisfactory communications system.

In the case of small islands lacking natural resources, beaches in particular constitute a potential source of income thanks to tourism. In turn, the tourist industry considerably increases human pressures affecting the different coast ecosystems.

The utilization of coastal areas for residential purposes has a similar effect.

During the past twenty years, many buildings and tourist complexes have been constructed right on the coast, no allowance being made for possible future coastal erosion.

In Barbados, despite the fact that the press gives information on beach erosion, buildings are usually constructed as close as possible to high-tide mark regardless of the legal provision stipulating that they should be located at least 100 ft (30 m) from it.

In any event, the building line restriction should be of at least 328 ft (100 m) in order to avoid any problems.

In an effort to combat coastal erosion which threatens to ruin the tourist industry potential in several islands in the Eastern Caribbean, artificial barriers are frequently constructed. Unfortunately, such measures have a very limited and sometimes detrimental effect, given that they are implemented without first carrying out studies on the coastal hydrodynamics and stability of beaches and, in most cases, with selfish aims.

One very popular measure consists in building groynes designed to trap the sand transported along the coast by longshore drift mechanisms. Groynes may be either permeable or impermeable to sand, the latter type being the most commonly used.

Material accumulates on the updrift side of an impermeable groyne while the supply of sand on the downdrift side is reduced or cut off completely, causing a retreat of the beach in that area. Beach change at the 'Beach Village Hotel' on the west coast of Barbados is an example of this. Indeed, the beach, which was just 3 m in 1979, is now 35 m wide on the updrift side of the 60 m long impermeable groyne built in 1981. Conversely, for 300 m downdrift there is such a deficit of sand that the highest tides now threaten several buildings.

On the other hand, seawalls and revetments are not designed specifically to build up the beach but to protect the land behind the beach. However, contrary to expectations, they usually result in increased beach erosion.

A properly designed seawall should have a curved seaward face in order to avoid wave scour at the base leading to eventual undermining of the wall. If the wall is shaped so as to guide the water straight upward, the water can reach the shore with great force, thus eroding it. An overhanging recurved surface will reflect waves seawards.

The cost factor has played a decisive role in the choice of revetments as a means of protection. Although they provide some local protection, revetments deflect the eroding forces, which then continue acting upon nearby areas.

Breakwaters are structures designed to deflect, absorb or change the incoming wave energy so as to create a sheltered area behind. They may be fixed or floating. Although breakwaters offer a certain degree of protection, they are most often constructed without full consideration for all the environmental parameters involved and, like the other measures, they aggravate the condition they were intended to remedy.

Apart from coastal erosion, there are other subjects of concern such as the impact of human activities which augments the pressures affecting the coastal areas of the Eastern Caribbean.

Among such activities may be mentioned:

- (1) blast fishing on the coral reefs;
- (2) the removal of coral rock and beach sand for construction purposes;
- (3) the removal of coral rock for land fills, or to provide boat channels or to enhance facilities for aquatic sports;
- (4) the vulnerability of these resources to oil pollution;
- (5) the indiscriminate discharge of industrial and domestic effluents into the nearshore areas. Even where such effluents are put through treatment plants it must be remembered that the cost factor very often dictates the type of treatment used. Furthermore, treatment plants and other large-scale projects are almost invariably financed by external funding sources which, in turn, imply calling upon non-resident expertise. Within this framework, much time is needed before problems can be faced and proper work co-ordination and planning can be arrived at.

2.1.2 Present state of research on coastal ecosystems in Latin America (L.R. Martins, Brazil)

Coastal lagoons and deltas are transition areas of the littoral zone between the ocean and terra firma which are subject to complex physical laws. Each of them constitutes a unique environment as a result, in particular, of the specific nature of its hydrodynamics and sedimentation. They are areas of active accumulation and offer sheltered conditions whose effects can be seen in the geochemical properties and nature of the sediments and in their potentially high biological yield.

Coastal lagoons are among the most fertile of littoral ecosystems.

They are to be found along the banks of estuaries or along the shoreline, in enclosed gulfs and in bays, in cold, temperate and tropical latitudes.

Coastal lagoons shelter numerous local species of economic importance (fish, crustaceans and molluscs) and serve as spawning and breeding grounds for migratory species. In many areas, lagoons offer favourable conditions for developing controlled production of marine organisms.

Lagoon sediments often represent accessible sources of basic materials (salts, peat, diatoms and other products) for industrial use. If deep enough, lagoons can serve as ports and navigable canals. They may thus contribute indirectly to creating new towns and built-up areas. In remote districts, coastal lagoons may constitute ecological sanctuaries or be used for tourism or recreation.

Over the past years, the justified desire to exploit living and non-living resources in such systems intensively, has given rise to many projects for the exploitation of coastal lagoons.

The scientific community has been unanimous in pointing out that such projects may often cause serious and permanent damage to a type of coastal environment that it is indispensable to preserve.

Often, the rational exploitation of these sometimes polluted areas is only possible if conservation measures designed to restore them to their original state are carried out at the same time. For example, the breeding of oysters, mussels and fish cannot be properly developed if the environment is not protected from chemical pollution.

No. 31 of 'Unesco Technical Papers in Marine Sciences' reported the existence of forty-nine programmes in Latin America and the Caribbean (about 27 per cent of all studies carried out on lagoon systems in the world).

The programmes are distributed, by country in the region as follows: Brazil (7), Colombia (5), Costa Rica (2), Ecuador (2), El Salvador (1), Guatemala (1), Honduras (1), Jamaica (2), Mexico (22), Nicaragua (1), Panama (1) and Venezuela (4).

The field of study was divided into ten disciplines and one general research area, which were distributed in the region as follows:

General research: 16.6%	Aquaculture: 13.0%
Geography: 1.4%	Fisheries: 10.3%
Physics: 4.1%	Design of models: 2.28%
Geology: 7.6%	Engineering:
Chemistry: 12.4%	Conservation: 4.8%
Biology: 26.9%	

In Latin America, the mangrove regions extend from the Tropic of Cancer to 3° 30'S in the Pacific (at that point they are halted by the Peru current system) and approximately from 30° N to 25°S (at the level of Florianopolis, Brazil) in the Atlantic.

The danger from the impact of human activities on these coasts has caused concern, given that these regions are used for port and reclamation schemes and for agricultural and tourist purposes, not to mention the exploitation of timber.

The fact that mangrove swamps occur in the tropics in high-temperature zones and harbour various diseases has led man to regard them as unhealthy areas that do not need to be conserved.

Thus, the desire to clear insalubrious areas and to develop them for tourism has endangered many mangrove regions. As a result, their flora as well as their fauna are also in danger of becoming extinct.

Having regard to the facts of the situation outlined above, Unesco, through its Division of Marine Sciences and with the backing of its Regional Office for Science and Technology for Latin America and the Caribbean in Montevideo, decided to organize the 'Latin American Seminar on Scientific Aspects of the Mangrove Environment in Latin America' (Cali, Colombia, 27 November-1 December 1978).

The objectives of the seminar were:

- (a) to review studies on mangroves being carried out in Latin America and the Caribbean;
- (b) to foster contacts between research workers from the countries represented at the seminar;
- (c) to promote awareness of the importance of mangroves from the ecological, cultural, health and socio-economic points of view;
- (d) to lay down guidelines for a regional project for multipurpose research and human resources training.

There is no list of studies carried out or projects being executed by institutions in the region as there is in the case of lagoons.

It may be said that research work is being conducted in practically all countries in the region.



Broadly speaking, studies can be grouped under the following headings:

- (a) an inventory of mangrove areas;
- (b) the structure and dynamics of the mangrove ecosystem;
- (c) natural and artificial stresses on the mangrove environment;
- (d) population, demography and health;
- (e) resources exploitation and economics;
- (f) perception of the mangrove environment and legislation;
- (g) rehabilitation, management and conservation.

As for deltas, estuaries and coral reefs, research work on them is more or less widely distributed.

As a rule, research work on estuaries in the region is very closely connected with research on mangrove swamps and coastal lagoons.

Nevertheless, certain institutions, as in north-east Brazil, are conducting research specifically on estuaries.

Research has also been done on deltas especially by firms connected with the exploitation of fossil fuels, particularly hydrocarbons, with a view to constructing sedimentation models that may be useful for singling out and studying similar and older sequences.

In regard to the continental platform with biogenic calcareous cover, studies have been focused above all on stable continental margins of the Atlantic type.

Finally, stress should be laid on Unesco efforts, particularly through its Division of Marine Sciences and its Regional Office in Montevideo, by fostering in the region an awareness of the importance of coastal ecosystems, to provide through various activities an opportunity of exchanging ideas and making known the research under way as well as promoting the exchange of scientists and scientific literature.

#### 2.1.3 Status of knowledge of Venezuelan coastal ecosystems (F. Pannier, Venezuela)

Along its 3,000 kilometres of coasts Venezuela presents a wide variety of ecosystems, which are under considerable pressure from human activities such as industry, tourism, river works, etc.

Several scientific studies have been conducted in Venezuela with a view to laying the foundations for a proper management policy designed to fight against falls in the productivity of these ecosystems and other changes resulting from human activities.

To this end, as a preliminary, the Venezuelan coast was subdivided into seven sectors in accordance with the teachings of Ellenberg (1978), who takes geomorphological considerations as a basis.

This was followed by a qualitative evaluation of the potential for economic development in each sector, within the limits set by the requirements governing the maintenance of its specific ecological balance. Recourse was therefore had to the descriptive models established by Putney in 1978 for forest environments and then adapted to the coastal environment.

Mr Pannier described to the meeting the nature of the sectors and subsectors distinguished along the Venezuelan coast, together with the ecological problems found in each.

2.1.4      The use of remote sensing in the study of coastal areas  
(A.F. Rock, NOAA, United States of America)

Remote sensing techniques vary according to the transportation (airplanes, satellites...) and data acquisition system (infrared photography, thermal photography or radar...) used. As a rule, data can be procured through pictures obtained by photographic processes (black and white, colour or infrared) or electrical processes (multi-spectral, radar, thermal and micro-wave).

Each type of picture has specific interpretation techniques which are more or less sophisticated. Although visual analysis of pictures obtained is the simplest technique, it is still an essential element in interpretation. One may also mention automatic processing of pictures and automated data analysis: for example, the processing of digital multi-spectral data with a view to establishing automatic classification codes and carrying out temperature mapping.

The scientific and technical applications of remote sensing are numerous (inventories, mapping, data collecting...) and lend themselves to the study of areas of considerable size while offering excellent resolution. They assist in achieving the objectives set by several branches of science (geology, meteorology, agronomy, pedology, oceanography...).

With regard to oceanography, remote sensing constitutes a particularly effective research tool and is perhaps insufficiently exploited. In addition to the above-mentioned advantages, remote sensing offers the possibility of obtaining data produced on very short time-scales, thus storing information which would otherwise have been lost owing to the time delay characteristic of other monitoring systems.

In coastal areas, remote sensing makes it possible, inter alia, to rapidly detect the extent, mobility and, at times, the source of oil slicks. By the same means, data can also be obtained on the mobility of sand banks, dunes, etc. in beach and lagoonal systems, the evolution of deltaic cones, the dispersal of suspended matter from estuaries, cliff structure, the upwelling of deep water, the monitoring of fish resources and so on.

Several of these topics have been discussed in a workshop on the relationships between remote sensing and the study of coastal areas. The workshop was held from 9 to 20 May 1983 in Fort Clayton, Panama (at the Cartographic School of the Inter-American Geodetic Survey, IAGS). Unesco sponsored the event as part of the COMAR project.

2.1.5 Methods used in the coastal areas of the Cayman Islands for mapping mangroves and associated vegetation (M. Giglioli, M.R.C.U., British West Indies)

The Mosquito Research and Control Unit (M.R.C.U.) began studying the extent of mangrove swamps in the Cayman Islands more than ten years ago.

The Unit is concerned essentially with protecting public health by combating diseases transmitted by mosquitoes. In this context, mangrove swamps are considered as areas which must be monitored given that they constitute an important mosquito habitat.

Mangrove mapping began with direct identifications carried out along a grid of pre-established plots throughout the mangrove areas. An analysis of the data accumulated over several years, led to the conclusion that the complexity and spatial variability of the components of mangrove swamps made representative mapping by this method impossible unless an inordinately long time were to be taken over the task.

Consequently, it was decided to combine the use of aerial photogrammetry with direct visual identification by helicopter.

The first technique was adapted so as to fit in with M.R.C.U.'s very small budget. It consisted essentially in mounting a 35 mm camera equipped with an auto-winder and a 28 mm lens on an inertial system of the Cardan type, fitted in an opening in the floor of a light aircraft.

It must be stressed that the use of a helicopter would have been impossible without the experience gained in identification during the years in which inventories were conducted in situ.

As a result of these relatively inexpensive and simple techniques, maps were produced on the extent of mangrove swamps and associated vegetation in the Cayman Islands (Little Cayman, Grand Cayman and Cayman Brac).

2.1.6 Objectives and programmes of IOCARIBE (R. Lankford, IOCARIBE)

The Intergovernmental Oceanographic Commission Association for the Caribbean and Adjacent Regions (IOCARIBE) was created six and a half years ago. During the meeting of the Intergovernmental Oceanographic Commission in Paris in November 1982, it was transformed into a subcommission of IOC for the Caribbean.

IOCARIBE is not a foundation but an intergovernmental organization for promoting co-operation and mutual assistance between the countries of the subregion on the different aspects of marine sciences development.

The organization's activities are based on the financial commitments, equipment, material facilities and manpower available in the member countries.

2.1.7 The major interregional project on research and training leading to the integrated management of coastal ecosystems (COMAR): its context, its objectives and its content (M. Steyaert, SC/OCE, Unesco)

For some years, Unesco has been concentrating on thinking out and analysing the major problems of the world of today. These problems are affected by the complexity and magnitude of interactions between human societies and the natural

environment, the lack or uneven distribution of knowledge, the limited nature of natural resources and the destabilization of natural ecosystems, the limited means of action available and the urgent need to strengthen development in many regions around the world. On the basis of lines of priority, Unesco together with its Member States decided to concentrate efforts and activities on key objectives.

The method of work consists in planning by objectives and by activity programming, and in defining goals, strategies and action themes.

In the present instance, the strategy for action is as follows: programmes oriented towards specific subjects and activities, the development of integrated research and of scientific co-operation, the drawing-up of guidelines for taking management decisions and the integration of research, management and training.

This programme led to the formal establishment of the COMAR project during the twenty-first session of the General Conference of Unesco in 1980.

In Unesco's programme for 1981-1983, COMAR constitutes a programme theme under objective 7.4, 'Ocean and coastal marine systems', while in the Second Medium-Term Plan for 1984-1989 COMAR is the main component of Programme X.5, 'Management of coastal and island regions', which is linked with Programme X.4, 'The ocean and its resources'.

The specific objectives of COMAR may be defined as to contribute to the establishment of a scientific basis for an understanding of the nature and functioning of coastal systems with a view to the integrated management of coastal areas; to use training and information associated with research activities, to increase the competence of countries in regard to the utilization, management and protection of their coasts.

As for content, COMAR is interregional and multidisciplinary in its very conception. Nevertheless, although it is adapted to the needs and specific features of each region, it is based on a common core of scientific activities designed to gain an understanding of the various coastal systems. The international scientific community is closely involved in drawing up the programme for these activities.

These activities have focused on gaining a better scientific understanding of a number of characteristics of ecosystems in themselves, of their interactions and exchanges of energy and matter, as well as of their relations with coastal waters, the open sea and with land. Stress has also been laid on the 'management' aspect. All these activities are co-ordinated by a UNESCO/SCOR consultative panel.

At the same time, COMAR also seeks to help Member States increase their scientific and technological capacity for making more rational use of coastal areas. The first goal is, then, to define priorities and specific objectives. Regional meetings such as this one and specialized workshops constitute extremely useful means of achieving that goal.

Once objectives and priorities have been properly defined, the corresponding projects and activities must be programmed. Some strategic considerations that might well be borne in mind are the use of suitable methods for carrying out projects concerned with concrete activities; the linking of scientific activities with management activities; the organization of post-graduate training as a basis for research programmes etc. A strategy for co-operation and a timetable of activities are also of great importance.

The choice of means of putting the strategy into effect may be considered to depend on:

the specific features of the countries and regions involved in terms of the degree to which research has been developed, research and training needs and the requirements of overall development;

financial and infrastructural support.

This leads to another very important consideration: the need to establish a graded list of priorities among the activities to be carried out and to carry out the activities in the order thus established.

It may perhaps be more realistic to carry out a limited number of pilot projects chosen among top priorities, with a view to achieving concrete results in a relatively short space of time.

A project in itself could be considered as a single regional project or be divided into various subregional or specific-activity projects.

Finally, the establishment of machinery for co-ordinating and disseminating information should make it possible to pass on the results of the project to government services, research institutions and the international scientific community.

## 2.2 Country reports on coastal ecosystems

Participants in the meeting presented brief reports on the following topics related to coastal ecosystems in their respective countries:

- (i) socio-economic importance and human impact;
- (ii) the research and training programmes carried out (background, justification, goals...);
- (iii) the relationships between these programmes within the COSALC project;
- (iv) proposals for the establishment or expansion of regional programmes for co-operation in research and/or training;
- (v) the priorities of each country in developing such programmes of co-operation.

These reports are summarized below.

Mr Mariano Pizarro (ARGENTINA) began by singling out the objectives related to coastal areas in his country's National Renewable Natural Resources Programme (PNRNR) that are connected with the objectives of the COMAR project.

He defined the concepts of 'receptive capacity' and 'risk evaluation' which must form part of all projects concerned with the management of coastal areas and which imply a degree of integration between the natural and human systems that would make it possible to regulate the use of the natural environment on the basis of a receptive capacity defined and accepted by the human community.

He discussed a research project on the dynamics of the marine fluvial system of the River Plate. He stressed that research in this field must be co-ordinated

by the River Plate Administrative Commission set up under the convention between Argentina and Uruguay regulating activities in this region. As a result, these research activities will not be included in the COMAR project.

He then gave a brief description of projects conducted by the PNRNR that may possibly become components of the COMAR project. In regard to the integrated management of coastal areas, he outlined a project to be carried out on the Atlantic coast in the Mar del Plata region and which includes the only coastal lagoon in Argentina. This entire region is under heavy pressure owing to the multiple uses to which it is being put, so that proper planning will be needed to ensure that this coastal resource is preserved.

Finally, he described a project for a course on the integrated management of marine coastal systems considered as an information feedback programme for the public sector. He laid special emphasis on the need for planning and decision-making sectors at the political level to have better information available on the dynamics of natural systems, that being the only way to achieve better-integrated planning of basic studies for the management of coastal areas.

Through its Programme for Renewable Natural Resources, the Sub-Secretariat for Science and Technology offers the collaboration of Argentina's oceanographic institutions in support of research or manpower training within the framework of COMAR.

Mrs Euna Moore (BARBADOS) presented a report on coastal activities and related problems in Barbados.

Coastal areas are the centre of small-scale fishing activities (sea urchins of the Tripneustes ventricosus species, coral reef fish and other species of less importance). Deep-sea fishing is concentrated on the migratory pelagic species.

On the west and south coasts of the island, there has been intensive development of industrial activities (including the construction of a deep-water harbour) and tourist activities.

Parts of the south-west coast have also been earmarked for industrial activities. Other coastal development plans include the building of a fairly long breakwater on the east coast with a view to using wave energy to supplement conventional energy sources. The lagoon created by this breakwater is to be used for aquaculture.

The possible effects of such structures on coastal currents and morphology could serve as a basis for intensive research. In addition, it must be mentioned that the acceleration of the rate of erosion of the beaches, which has been a well-known fact for twenty years, constitutes an ever-increasing threat to the results of the economic development efforts mentioned above.

Many multidisciplinary research projects have been carried out during the past thirty years on coastal ecosystems. However, they lack continuity in space and time and there has been no attempt to make a comprehensive synthesis of the information gathered.

In regard to its participation in the COMAR project, the island offers excellent facilities for seminars and conferences and opportunities for field training and research at the Cave Hill Campus of the University of the West Indies and at the Bellaire Research Institute, which has dry and wet laboratories and small vessels adapted to the study of the island's continental shelf.

The areas of greatest interest are beach erosion, sandy beaches, coral reefs, sea-grass beds, mangrove swamps, aquaculture and the production of manuals on management and education.

Mr Luiz R. Martins (BRAZIL) pointed out that the complexity of coastal ecosystems means that a multidisciplinary and interdisciplinary basis is essential for their study and management. That basis can only be provided by teams of highly qualified research workers in various branches.

Many studies have been carried out in Brazil on the various coastal ecosystems, either by individuals or by teams. However, for various reasons they have been insufficiently multidisciplinary and integrated.

During the past few years some institutions have carried out intensive scientific activities, sometimes in co-operation with other institutions, with a view to gaining an adequate scientific understanding of coastal ecosystems.

In view of the laboratories available, their floating equipment, their library stocks and their teaching and research staff, three regions in Brazil seem to fulfil the conditions required of a pilot area.

- (a) The first region consists of the lagoon system found on the coast of Rio Grande do Sul, or more specifically, the Lagoa dos Patos. It is backed up by the already existing structures in the Federal University of Rio Grande do Sul (CECO and CECLIMAR) and by the Rio Grande University Foundation (Atlantic Oceanographic Base).
- (b) The second is an estuarine region surrounded by the mangrove swamps of Cananeia (São Paulo). The supporting establishment would be the São Paulo University Institute of Oceanography.
- (c) A third possibility would be the small estuaries in the North-East Region, and the Bays of São Marcos and Todos los Santos, where the laboratories of the Federal Universities of Maranhão, Ceará, Rio Grande do Norte, Pernambuco and Bahia and the Rural Federal University of Pernambuco could work together.

The project component would be carried out through the research data already available and the holding of post-graduate courses and seminars.

Mr Armando Hernandez (COLOMBIA) stressed the need to protect and preserve the coastal area, which is the most affected by man's activities, given technological progress, industrial development population growth, the increase of pollution, etc. He also emphasized the social and economic importance of the coastal area in view of the development of small-scale fishing, recreation, tourism, transport, the extraction of raw materials and the development of aquaculture programmes.

A knowledge of the coastal area is indispensable for promoting development plans that integrate these ecosystems with the local economy and make possible the rational management of the resources involved. Bearing in mind the high cost of marine research and the time needed to carry it out, concrete short-term, medium-term and long-term plans of action must be formulated which deal with the priorities, the problems to be solved and the alternatives and enable the available resources to be put to proper use.

A report was presented on research centres, the existing infrastructure, oceanographic research vessels and the training and research programmes under way in Colombia both in the Caribbean and in the Pacific.

Attention was drawn to the Plan for the Development of Marine Sciences and Techniques in Colombia, which points out the need to intensify research through national programmes, marine support services and manpower development. Special mention was made of the National Programme for the Development and Administration of the Coastal Area. The strengthening of this programme makes it possible to promote the studies needed if effective and rational use is to be made of these areas.

On the basis of this Plan, which lays down the priorities for each zone, the following fields of interest were singled out:

- (1) Research on coastal morphology, coastal processes and coastal circulation.
- (2) Comprehensive research on the utilization and management of the coastal area.
- (3) Interdisciplinary studies on Cartagena Bay; conservation and the improvement of environmental conditions.
- (4) Studies on the Magdalena River Delta and the Canal de Bique; dynamics and evolution.
- (5) Studies of the mangrove swamp ecosystem.
- (6) Study of coral reefs.
- (7) Study of physical and chemical structures, plankton distribution and primary productivity.
- (8) Biological research: structure and distribution of species of commercial interest.

He also pointed out the advisability of carrying out intercalibration exercises on equipment, standardizing methods, analysing data and working for the establishment of an information system that would make it easier for countries to exchange experience.

Finally, he stated that the Colombian Oceanographic Commission would be responsible for co-ordination between the COMAR project and Colombia, and that FONDEMAR (COLCIENCIAS), the Special Fund for the Development of Marine Sciences Technology, is apparently prepared to support programmes carried out by national bodies in developing the project. Colombia would participate along the lines established in the Development Plan already mentioned and the bodies involved would co-operate in such research, training and advisory services as would be jointly decided.

Mrs Luisa Lopez (CUBA) presented Cuba's proposal for participation in the COMAR project in regard to the research to be conducted in coastal areas, especially multidisciplinary studies in areas of the island shelf aimed at acquiring spatio-temporal knowledge of the ecosystem, which includes mangrove swamps, coastal lagoons, estuaries and coral reefs. It is considered appropriate to include the island shelves in the project.



A total of twelve research topics are proposed, involving the scientific and technical participation of five bodies in Cuba:

Oceanography of the Gulf of Batabaró;

Distribution of heterotrophic bacteria in the Gulf of Batabaró;

Plankton of representative biotopes of the Gulf of Batabaró;

Benthic and fish communities in the Gulf of Batabaró;

Ecology of neritic fish communities and species in Cuba;

Hydrology of the Enserada de la Broa;

Plankton and benthos of the Enserada de la Broa.

Study of algae and invertebrate communities in the roots of the rhizophora mangrove in a group of cays to the east of Isla de la Juventud, Gulf of Batabaró;

Study of coral reefs in the Gulf of Cazones and of the influence of the Zapata swamp;

Oceanography of the Gulfs of Ana Maria and Guacanayabo;

Plankton and benthos of representative biotopes of the Gulfs of Ana Maria and Guacanayabo;

Characterization and mapping of plant communities.

Three advanced courses have, or are to be given in Cuba under the auspices of the Cuban Academy of Sciences, through the Institute of Oceanology and Havana University, and specifically by the Centre for Marine Research in collaboration with the Cuban National Committee for MAB:

Regional course on island ecosystems (1982);

Advanced course on mangrove areas and wetlands (1983);

International course on Cuban marine ecosystems.

Cuba's participation in and contribution to the project will focus on its willingness to offer advisory services in the region as well as short training courses in Cuba and the exchange of experience and information.

Mr José Stuardo (CHILE) spoke of coastal ecosystems affecting the adjoining marine environment and which are in turn affected by various terrestrial (natural or artificial) processes and factors. Comprehensive studies of these ecosystems are now being launched in Chile, to determine their characteristics from the productivity point of view, particularly in regard to aquaculture and fisheries; pollution and environmental impact will be studied to a lesser extent and, last, but no less important, the dynamics of each system will be investigated.

An analysis of Chile's concerns in respect of coastal research, made it possible to distinguish two main sets of coastal systems:

I. Exposed coastal ecosystems which, in turn, can be divided into three types:

- (a) those in areas influenced by upwellings;
- (b) those in estuarine areas;
- (c) those highly productive rocky intertidal and subtidal areas.

The combination of the characteristics of littoral and coastal morphology, upwellings (particularly strong on the Chilean coast), the southward penetration of subsurface equatorial waters and the local inflows of fresh water and sediments transported by winter rains and summer thaws, create a series of environmental pressures which more often than not condition the associations of coastal organisms and their succession and productivity. In each case, mention is made of coastal areas which have been or are being studied.

II. Estuarine ecosystems in southern channels and fjords of South America.

The combination of archipelagoes, channels and fjords in the southern part of South America between the Chacao Channel and Cape Horn constitutes a highly productive estuarine ecosystem of almost 250,000 km<sup>2</sup> whose hydrological characteristics, determined by blizzards, mountain rivers and a rainy climate make it totally different from the other systems that can be distinguished on the South American coasts.

Finally, with regard to training, it may be pointed out that a number of graduate and postgraduate training programmes are now being carried out and adapted in various educational centres in Chile. Some are being discussed with a view to making them regional in scope.

Mr William Gutierrez (DOMINICAN REPUBLIC) reported on the present status of the coastal areas in the Dominican Republic, with reference to the activities concerned with them and to their management and regulation. A frame of reference was provided by a description of the institutions connected with the coastal area, and of the existing legislation and of measures designed to achieve a satisfactory coastal policy.

In addition, the activities affecting the various environments were analysed. It is considered that the greatest influence is exerted by activities connected with urban settlements and by sugar mill effluents.

There are heavy pressures on some littoral ecosystems, such as coral reefs in the Andres Bay and some estuaries affected by pollution, like those of the Ozama, Haina and Higuamo rivers and Giubia beach.

Recommendations are being drafted on the strategy to adopt for setting up a multisectoral coastal development programme as part of general national planning. The Dominican Republic would be interested in conducting research under the COMAR project on mangrove swamps, coastal lagoons, coral reefs and, fishing in coral-reef areas.

Mr Roberto Jiménez (ECUADOR) presented a summary of the present state of marine sciences research in Ecuador, with special emphasis on studies conducted in coastal areas.

He also presented a report summarizing the activities carried out in Ecuador during the past ten years under the Multinational Marine Sciences Project of the Organization of American States (OAS), in which the Naval Oceanographic Institute, the National Fisheries Institute, the Coast Polytechnical College and the Faculty of Natural Sciences of the University of Guayaquil are participating. These institutions have proposed that they should participate in the COMAR project with particular reference to the 'Study of mangrove ecosystems in Ecuador', more specifically in the Gulf of Guayaquil. The main objectives would be: (a) to inventory mangrove-swamp resources and carry out biological studies on them; (b) to study physico-chemical and biological processes in mangrove swamps; (c) to analyse the geology of the littoral; (d) to rehabilitate mangrove areas and exploit them rationally; (e) to study the impact of pollution, mainly from hydrocarbons and heavy metals in estuarine areas and in the Gulf of Guayaquil; (f) to determine what animal species can be reared in mangrove areas, including crustaceans, molluscs and fish.

Ecuador's participation in and contribution to the Project would be to conduct research on pelagic and neritic fishing resources and to continue the research in progress on certain pollutants.

Mr Manuel Benítez (EL SALVADOR) described the main coastal systems, of El Salvador, outlining the priority areas in which the following study topics are proposed:

- (1) The productivity of mangrove swamps in relation to climatic and hydrological factors.
- (2) Evaluation and stocktaking of fishing resources.
- (3) Evaluation of the traditional exploitation of the flora and fauna of mangrove swamps by human communities.
- (4) Establishment of a documentation centre on living coastal resources in the Central American subregion of the Pacific.
- (5) Zoning and management of coastal areas for fishing shallow-water shrimps and Chilean prawns.
- (6) Evaluation and systematic listing of wild coastal species considered to be threatened with extinction.
- (7) Design of techniques for the rearing and preservation of fishery products industrially or on a small scale.

He stressed the need to devise adequate working methods for the Latin American region with a view to carrying out basic studies connected with communities or ecosystems characteristic of the region. In regard to advanced training, he emphasized the need for training in subject areas or disciplines not taught in El Salvador: marine geology, physical oceanography and marine biochemistry.

The major coastal areas are Barra de Santiago and the reefs of the Cobán region where the proposed projects are to be carried out. Finally, he described the present situation of institutions involved in the management of the coastal areas and which would lend support to the COMAR project.

Mr André Klingebiel (FRANCE) reported that France is developing the following programmes in the coastal areas of the Caribbean and Latin America:

1. Martinique, Guadeloupe and Guiana

In the three French regions, namely Guadeloupe, Martinique and Guiana there are administrative services that manage the coastal area.

Scientific personnel of the Université des Antilles-Guyane and biologists and geologists from Pointe-à-Pitre are beginning research on the coastal environment (mangrove swamps, reefs, urban and industrial pollution, beach erosion and the exploitation of nitrate deposits). These programmes make use of research initiated in other French universities.

For some years now the continental shelf has been the subject of studies by several French oceanographic survey vessels belonging to CNEXO (the GUYANTE, ARCHANTE and CARACOLANTE projects).

Fishing is studied by the Marine Fisheries Scientific and Technical Institute (ISTPM). There is a fishing school with a training vessel in Martinique but industrial fishing is not practised on a large scale.

Hydrological studies are now being launched with the offshore measurement of variables and data obtained by satellite with the CNES (National Centre for Space Studies).

Work is also being undertaken to set up national parks.

2. Scientific development and training

To improve its knowledge of the Caribbean region and specialists, France is developing programmes of research on coastal areas with special emphasis on their relationships with the environments of the continental shelf.

Thus, the territorial waters of the Guadeloupe, Martinique and Guiana are being studied in collaboration with the universities (hydrology, sedimentology, biology), ORSTOM AND ISTPM (renewable resources), and BRGM (non-renewable resources). Other zones are also under study, with the collaboration of countries with which France has agreements on co-operation and exchange of research workers; co-operative operations such as the CARACOLANTE project are also in progress.

There is also the SEACARIB deep-sea geology project which is concerned with study of the formation of the Caribbean volcanic island arc and of the deformation fronts of continental margins in Venezuela and Colombia. This programme, in which France, the United Kingdom, the United States of America, Venezuela and Colombia are participating, is connected with research on changes in sea level (or in this case, to be more precise, changes in the level of islands and the coast).

3. Structure of research in France

The various priority programmes defined by the national institutions for 1982, included:

in the Ministry of Research and Industry (CNRS and PIRO), programme to mobilize participation in economic development in the world, with special emphasis on the integrated development of natural regions;

in the Ministry of External Relations, a programme entitled: Sectoral Programme on 'Knowledge and management of coastal areas'. The intention of this programme is to define the principles that should underlie the management of zones of danger for the natural environment.

To conclude, it may be said that French participation in the COMAR project could be of considerable importance.

Mr Jorge Chapas (GUATEMALA) reported that his country has a wide variety of coastal ecosystems offering a high fishery potential but that as they have not been sufficiently studied, extractive activities alone have been carried out.

To solve the problem of a diet deficient in proteins and to safeguard its coastal ecosystems, Guatemala must achieve integrated management of such systems.

In view of the dearth of scientific information on these matters, financial support from specialized organizations is needed.

Two institutions, San Carlos University and the Ministry of Agriculture, Livestock Raising and Nutrition, are now conducting biological and ecological research and studies on the management of fishery resources and on aquaculture.

Basically it is the San Carlos University that is doing most of the research work, in its capacity as an institution of higher education. Nevertheless, other institutions do conduct some research.

The importance of coastal ecosystems in Guatemala should be noted; indeed, it is necessary to develop research to the greatest possible extent, in view of the fact that the potential in resources of these ecosystems has been insufficiently studied.

Miss Mirna Marín (HONDURAS) pointed out the existence of an Inter-institutional Committee for Fisheries Training (Comité Interinstitucional de Capacitacion Pesquera) and that an Interinstitutional Working Committee had been created with a view to analysing problems related to the sea. She gave a detailed description of institutions connected with coastal resources management and research.

She spoke of the aid that Honduras is receiving from Japan and Taiwan, which focuses on fisheries research.

She set forth the problems encountered in research, mentioning in particular the lack of specialized manpower and the inadequate basic infrastructure. She gave a list of research projects in progress such as protection of the sea turtle in Fonseca Bay, shrimp sampling with a view to determining the state of the shrimp population before the imposition of a close season; preliminary research on coastal areas with a view to setting up national marine parks; occasional research on specific points with a view to issuing recommendations on the utilization and management of marine resources.

She declared that her country gives priority to research on marine resources, particularly those of coastal lagoons, coral reefs and mangrove swamps, as well as to the preparation of technical outlines on physical, chemical and biological oceanography, marine ecology and fisheries biology.

She explained that there are some projects that are without funds such as the Research Project on the Marine and Continental Aquatic Ecology of Honduras; the National Centre for Training in Marine Technology (CONETMAR); the Preservation and Development of the Mangrove Swamps and Molluscs of Fonseca Bay; a study with a view to the establishment and management of marine parks; and biological research on shrimp, prawn and fishery resources.

She stated that her country's participation in the COMAR project would be to study (a) the coral reefs in the Islas de la Bahía, classified as the second largest and best preserved barrier reef in the world; (b) Atlantic coastal lagoons in the River Platano biota reserve and (c) the Gulf of Fonseca mangrove swamps, with a view to carrying out interdisciplinary studies to supplement a management programme.

Mr Eric Jordan (MEXICO) pointed out that the activities of the Institute of Marine Sciences and Limnology (ICML) of the Autonomous University of Mexico revolve around research and training related essentially to coastal systems. There are at present three research stations on the Pacific, Gulf and Caribbean coasts, provided with the necessary facilities and equipment as well as with two oceanographic vessels.

Interdisciplinary research is being conducted on coastal lagoons and coral reefs. It was suggested that the reefs should receive greater attention in view of their potential as sources of supply of living organisms of great commercial value.

In regard to advanced training, the Institute of Marine Sciences and Limnology (ICML) offers postgraduate programmes (masters degrees and doctorates) in the four basic oceanographic disciplines.

In regard to activities related to COMAR, the ICML gives priority to the understanding of such processes as:

- (1) sediment flows in the coastal area and their manifold effects;
- (2) pollution problems caused by human activities in the coastal area and adjoining regions; and
- (3) the rational utilization of the high economic potential of the coastal area.

As its contribution to COMAR, Mexico will offer the research stations and vessels already referred to for use in implementing co-ordinated research programmes and training, and providing advice to those who require it.

Mr Sergio Martinez (NICARAGUA) reported that no more than fifteen studies on coastal areas have been conducted in Nicaragua, most of them being of a descriptive and non-systematic nature. They include studies on oyster farming, shrimp breeding, the evaluation of resources, etc.

Currently, priority is being given to a qualitative and quantitative inventory of coastal lagoon resources with a view to their rational utilization. This can be carried out in parallel with physico-chemical studies, which would be supplemented by a description of pollutants, circulation, sedimentation and the nutrient cycle.

Given the lack of adequate infrastructure, Nicaragua's contribution to COMAR may not be very substantial, but the country supports activities tending to improve scientific and technical knowledge in Latin American countries through inter-regional co-operation.

Mr Jorge Bricéño (PANAMA) stressed that the socio-economic implications of activities in the coastal area have an ever-increasing impact on the Republic of Panama. In this respect, there has been an increase in fishing and port activities, both closely linked with coastal ecosystems. Panama's fisheries, based primarily on the catch of shrimps (6,000 tons per year), of anchovy and herring for the manufacture of fish meal and of certain scaly fish for human consumption, is carried out in shallow waters usually not more than twenty nautical miles from the shore.

As a result of the increased fishing activities, a decrease in catches has been observed, due apparently to over-fishing. Likewise, dangers induced by changes in the environment such as the high rate of mangrove felling, seem to be showing concrete signs of affecting coastal resources.

In addition, Panama has become an increasingly important transit route for oil going from Alaska to the eastern seaboard of the United States of America. Oil moves through the Panama Canal or the new oil pipeline that crosses the isthmus at a rate of at least 500,000 barrels per day, thus increasing the environmental risks inherent in this procedure.

For this reason, Panama must formulate an integrated management policy on the coastal zones, based on a comprehensive model of the ecosystem giving priority to the conservation of water resources and to ensuring the environmental conditions that will make such conservation possible. In view of this, problems of fish supplies, the management of mangrove swamps and the monitoring of water pollutants will have to be given serious thought.

Mr Manuel Vegas (PERU) said that during the past twenty years, marine research in Peru has concentrated on pelagic fish, owing to the importance of anchovy, sardine, scad and mackerel fishing for commercial purposes.

He reported that the National Board for Science and Technology (CONCYTEC) had formed a group of scientists from several institutions to carry out research on the benthic fauna in the Pisco-Bahía Independencia area, located 230 km to the south of Lima, with three main objectives:

- (1) study of the structural dynamics of existing communities (sandy, sandy-mud and shelly beaches, rocky shores);
- (2) research on certain populations of commercial importance (fish, molluscs, crustaceans);
- (3) basic research for the development of the aquaculture of certain species in the area.

He proposed that one of the objectives in the COMAR project should be fundamental research on organisms which could be artificially reared (life cycle, nutrition, ecological adaptations). Exchange of information should be promoted and species should be selected that could be studied by the same methods.

He suggested that when the Pisco-Bahia Independencia Project was in its final stages, a seminar could be convened with a view to making known the research findings and discussing them with colleagues from the COMAR project (approximate date: end of 1984).

Mr Don Ramsaroop (TRINIDAD AND TOBAGO), after describing the geographical features of Trinidad and Tobago, listed the following projects carried out by the Institute of Marine Affairs.

- (1) The Management and planning of coastal areas, taking into account the land-air interface, so as to enable the development of this area and the preparation of an ad hoc model.
- (2) The quality of the environment, taking into account the pressures to which the coastal areas are subjected by increasing urbanization and by oil exploration, production and pollution, sedimentation and coastal erosion and the discharge of chemical effluents.
- (3) Study of the nation's coastal resources with a view to managing them properly, especially in the case of reefs and minerals.
- (4) A socio-economic and legislative programme designed to maintain and safeguard coastal areas and ensure that citizens can enjoy them.

Finally, he stressed the problems of managing fishery resources and controlling pollution.

Mr Victor Scarabino (URUGUAY) gave a report on studies of coastal ecosystems in Uruguay. During the past two years, they had increased considerably owing, for the most part, to a manpower training programme launched in 1978.

That had made it possible to carry out and complete research on various physico-chemical and biological aspects of coastal areas.

Some of the topics studied concerned surveys of the flora and fauna, the biology of beach and shelf communities: the biodegradation and evaluation of exploited natural resources, vertebrate and invertebrate.

Three institutions are playing an active role in these studies: the Navy Oceanographic, Hydrographic and Meteorological Service (SOHMA), which conducts research on physical chemistry, marine geology, meteorology and pollution; the National Fisheries Institute (INAPE), which concentrates on the study of renewable natural resources (essentially fish and invertebrates, including evaluation of fish populations) as well as on aquaculture; the Faculty of Humanities and Sciences, which deals particularly with the basic and ecological aspects of coastal areas.

SOHMA is carrying out a joint programme with the Naval Hydrographic Service (Argentina) for an integrated study of the River Plate. INAPE has been assisted by the FAO fisheries development programme and the Faculty of Humanities and Sciences is currently receiving assistance from UNDP and Unesco in carrying out a multidisciplinary marine sciences programme, the main objective of which is to train manpower in biological oceanography.

Mr Federico Pannier and Mr Pablo Penchaszadeh (VENEZUELA) stated that the necessary conditions for a global study of coastal ecosystems in Venezuela were ensured by:



- (1) the existence of teams of researchers in various disciplines in a number of institutions concerned with marine questions, and in different coastal regions of the country;
- (2) the existence of a considerable body of specific research studies carried out during recent years concerning the coastal environment, including such aspects as mangrove swamps, coral reefs, productivity of sea-grass beds (thalassia), ecology of sandy and rocky beaches, ecology of estuaries and coastal lagoons, heavy metal pollution, organochlorine and domestic waste, oil and heat pollution.

It was important to:

- (1) carry out an analysis of the present state of the marine coastal ecosystem (evaluation of specific ecosystems and global coastal problems in terms of human activities;
- (2) formulate a research and training programme, based on priorities;
- (3) draw up a management policy making it possible to apply the findings obtained from research.

The importance of strengthening the co-ordination of national programmes and of obtaining financial support was also recognized.

Basically, research programmes now in progress in Venezuela are to be included in the COMAR project, although subregional studies, such as those on the Gulf of Paria, are also being considered. The COMAR project could also provide a framework for laying down standardized methods, establishing a regional documentation centre on coastal systems and analysing Latin American legislation connected with coastal areas.

In the initial stage of the COMAR project, Venezuela can offer:

- (1) to take the necessary steps with a view to organizing the first initiatory course in coastal research (May 1984);
- (2) to arrange for the integration of research programmes in pilot projects;
- (3) to arrange for the participation of Venezuelan scientists in the implementation of regional projects.

### 2.3 Definition of priorities, objectives and methods of implementation of COSALC

With a view to analysing the programmes needed in each country within the region and subregions connected with ECOSALC's action plan, the following three working groups were set up:

a 'research and training' group (RTG), divided into two committees, one for the tropical and sub-tropical zones (Committee RTG-1), and one for the temperate and sub-antarctic zones' (Committee RTG-2);

a management and training group (MTG); and

a project organization group (POG).

The reports from each working group were examined in plenary session and are summarized below.

### 2.3.1 Research and training working group (RTG)

#### Participants

Chairman:	Roberto Jiménez (Ecuador)
Rapporteur:	(Eric Jordan (Mexico) (Jose Stuardo (Chile) Jorge Briceño (Panama) Serge Caschetto (ROSTLAC/Unesco) Jorge Chapas (Guatemala) Marco Giglioli (Cayman Islands) André Klingebiel (France) Jean-Marie Martin (France) Sergio Martínez (Nicaragua) Luiz Martins (Brazil) Euna Moore (Barbados) Doon Ramsaroop (Trinidad and Tobago) Anthony Rock (United States of America) Víctor Scarabino (Uruguay) Marc Steyaert (SC/OCE/Unesco) Manuel Vegas (Peru)

The discussion began with a proposal to define coastal ecosystems immediately, incorporating the concepts of co-operation and multidisciplinary which they involve. It was proposed that after each participant had presented to the meeting a summary of topics of interest to his country the following ecosystems (which all imply relations with the continental shelf) should be considered:

mangrove swamps and wetlands;

coastal lagoons and sea meadows;

reefs and reef lagoons;

estuaries and deltas;

sandy beaches;

exposed coastal ecosystems, divided into:

- + areas influenced by upwellings;
- + highly productive intertidal and sub-tidal rocky coastal areas.

In the discussion that ensued, it was concluded that in addition to climatic zones, the following should be differentiated: islands (small and large) and continental coasts, ecosystems, problems, processes and activities. This would make it possible to consider additional criteria for arriving at a more comprehensive definition of priorities in research and training. It was felt necessary to take into account the following ecosystems:

mangrove swamps;  
coral reefs;  
coastal lagoons and sea-meadows;  
sandy beaches;  
rocky coasts;  
deltas and estuaries;  
southern estuaries.

In the plenary session that followed, the ecosystems mentioned below were examined on the basis of the working groups findings:

mangrove swamps;  
coral reefs;  
coastal lagoons and sea-meadows;  
estuaries and deltas;  
beaches.

The ascertainment of problems common to the whole region also determined the research activities to be carried out, in keeping with the following outline:

Problems listed:

1. Erosion;
2. Pollution;
3. Eutrophication;
4. Sedimentation;
5. Over exploitation of living resources;
6. Over exploitation of non-living resources.

Research activities:

1. Documentation;
2. Texts on methods and intercalibration exercises;
3. Selection of parameters (e.g. inventory of living resources, distribution of physical and chemical parameters, sediments, mapping and description of the environment);
4. Mass and energy balances;

5. Determination and quantitative evaluation of the major processes (e.g. coastal dynamics, restocking strategies, mixing processes, nutrient cycle);
6. Models + conceptual  
+ predictive.

It was insisted on that the group should seek to determine what processes ought to be studied with a view to achieving an integrated understanding of the functioning of coastal ecosystems. It was felt that the problems should be determined on the basis of an exchange of opinions between the RTG and MTG working groups, although the group went on to mention some, such as the need for an inventory of living resources and the problem of the exploitation of living and non-living resources.

It was then agreed to make a first attempt at correlating ecosystems, problems and processes in a double-entry table (Table I), in which priorities would also be taken into account, on the basis of the list previously established in accordance with the preferred research topics mentioned in participants' contributions (Table II).

Finally, considering the priorities established and the need to specify their importance regionally (or by geographical area), the Research and Training Group decided to set up two committees. One examined the situation in tropical and subtropical zones (Committee RTG-1) and the other studied that of temperate and sub-antarctic zones (Committee RTG-2). Each group carried out separately a detailed analysis of priorities in research and problems related to the ecosystems selected.

The committees' findings are summarized below:

- A. Tropical and subtropical zones (Committee RTG-1)
- A. Caribbean Islands
- A.1 Research priorities

It was decided that the most important ecosystems are:

1. coral reefs and mangrove swamps;
2. coastal lagoons, estuaries and mixing zones;
3. beaches (small islands).

The work carried out on each of these ecosystems in terms of research, training and the production of handbooks was also analysed.

It was considered that if the recommendations put forward by the working groups of St. Croix, Cali and Bordeaux which had analysed the problems occurring in coral reefs, mangrove swamps and estuaries and the interactions between them were adopted, they should be used in the meeting as important elements for establishing an order of priorities for research objectives in countries participating in COSALC.

TABLE I - RELATIONSHIPS BETWEEN ECOSYSTEMS (ACCORDING TO ORDER OF PRIORITY), PROBLEMS AND PROCESSES

PRIORITY	ECOSYSTEMS	PROBLEMS				PROCESSES								
1a.	MANGROVE SWAMPS AND WETLANDS	X			X			X	X	X	X	X	X	X
2a.	COASTAL LAGOONS	X	X	X	X		X	X	X	X	X	X	X	X
3a.	COASTAL REEFS	X	X		X	X		X	X	X	X	X	X	X
4a.	SANDY BEACHES	X	X	X	X			X	X	X	X	X	X	X
5a.	ROCKY SHORES	X	X	X	X		X		X	X	X	X		X
6a.	ESTUARIES AND DELTAS	X	X	X	X		X	X	X	X	X	X	X	X
		POLLUTION	EROSION	EXPLOITATION OF NON-RENEWABLE RESOURCES	EXPLOITATION OF RENEWABLE RESOURCES	UPWELLING AREAS	EUTROPHICATION	INTERACTION BETWEEN ECOSYSTEMS	COAST-SHELF RELATIONSHIP	RESTOCKING STRATEGIES	COASTAL DYNAMICS	MIXING PROCESSES	NUTRIENT CYCLES	LIVING RESOURCES

TABLE II - PREFERENCES OF COUNTRIES IN AREAS OF RESEARCH

1. Mangrove swamps	2. Reefs	3. Coastal Lagoons and sea-meadows	4. Sandy Beaches	5. Aquaculture
Ecuador	Cuba	Brazil	Uruguay	Guatemala
Brazil	Venezuela	Argentina	Chile	Peru
Guatemala	Trinidad and Tobago	Uruguay	Peru	Colombia
Panama	Mexico	Cuba	Venezuela	Ecuador
Cuba	Honduras	Venezuela	Trinidad and Tobago	Uruguay
Nicaragua	Dominican Republic	Mexico	Guadeloupe	Trinidad and Tobago
Peru	Colombia	Honduras	Martinique	Nicaragua
Venezuela	Guadeloupe	Dominican Republic	French Guiana	Guadeloupe
Trinidad and Tobago	Martinique	Colombia		Martinique
Mexico	French Guiana	Nicaragua		
Honduras		Guadeloupe		
El Salvador		Martinique		
Dominican Republic		French Guiana		
Colombia				
Guadeloupe				
Martinique				
French Guiana				
6. Rocky Shores	7. Documentation	8. Pollution	9. Estuaries	10. Continental Shelf
Chile	El Salvador	Ecuador	Brazil	Colombia
Peru	Honduras	Nicaragua	Ecuador	Uruguay
Uruguay	Trinidad and Tobago	Trinidad and Tobago		
	Guadeloupe	Panama		
	Martinique	Dominican Republic		
	French Guiana	Colombia		
	Ecuador	Guadeloupe		
	Uruguay	Martinique		
		French Guiana		
		Uruguay		

## A.2 Recommendations:

to compile a directory of researchers working on the coastal areas in the regions;

to draw up lists, for limited circulation, of work done and other data;

to publish handbooks on research methods for use in the ecosystems mentioned;

to bear in mind the need for both Venezuela and Trinidad and Tobago to participate in research on the Gulf of Paria, in view of the relationships between the insular and continental coastal areas;

to consider evaluation of renewable and non-renewable resources as a fundamental aspect of the Project's objectives.

## A.2 Continental margin

### A.2.1 Research priorities

The conclusion was reached that mangrove swamps are the most important ecosystems, although the importance of estuarine areas should not be disregarded.

It was also felt that according to the information available it was essential to draw up inventories of resources in mangrove areas with emphasis on quantitative studies and studies on productivity at the different trophic levels.

It was recognized that it is important to establish guidelines for a rational utilization of mangrove areas, and to ensure that those countries have embarked on the study of mangrove resources apply adequate management methods.

In this connection, stress was laid upon the urgency of implementing those aspects of the COSALC training programme concerned with the management of mangrove areas and their resources.

It was also recommended that countries be given the benefit of advisory services on land use and the development of fisheries and mariculture, with emphasis on the execution of specific projects concerned with resources.

It was considered that education and training must be an important component of the COSALC project, with due regard for similarities and points of interest common to countries in the region.

### A.2.2 General recommendations:

to organize training courses on drawing up inventories of natural resources;

to organize courses on research methods;

to carry out intercalibration exercises;

to organize courses on mapping;

to carry out studies on the contribution of rivers to estuaries and its effects on estuarine productivity.

It was recognized that it is important to organize courses on remote sensing for the region, although they would have to be financed by countries and institutions separately from COSALC funding.

### A.3 Global recommendation

Committee RTG-1 on tropical and sub-tropical zones, considering that:

tropical and sub-tropical zones in Latin America and the Caribbean are made up of three major sectors, namely small islands, large islands and the continental margin;

noting the results of analysing priorities in each sector on the basis of three fundamental criteria: ecosystems, problems and processes, as presented in III, IV and V (some changes in criteria may be noted in comparison with Table I);

and further recognizing that:

the problems vary greatly because of limitations in terms of personnel and facilities in participating countries and within the COSALC Project; and that

absolute priority cannot be given to any specific problem.

Recommends:

that COSALC considers four pilot projects, each as important as the others, which shall be carried out where most appropriate and on the basis of the following features:

1. beach erosion;
2. the mangrove swamp ecosystem;
3. the coral ecosystem;
4. the coastal lagoon system.

In the small Caribbean islands the study will be covered by Pilot Project 1, while in the large islands and on the continental margin studies will be covered by Pilot Project 2, 3 and 4.

### B. Temperate and sub-antarctic zones (Committee RTG-2)

It was considered that in this case the division between continent and islands was not relevant.

The following ecosystems, to which the analysis of proposed problems (pollution, eutrophication, erosion, overexploitation of living resources, overexploitation of non-renewable resources) could be applied, were differentiated:



TABLE III- PRIORITIES: ECOSYSTEMS

	ECOSYSTEMS				
	Mangrove areas	Coral reefs	Coastal lagoons and sea-meadows	Estuaries and deltas	Beaches
Small Islands	XX	XX	XX		XX
Large Islands	XX	XX	XX	X	XX
Continental Margin	XX	XX	XX	XX	XX

XX = High priority

X = Low priority

TABLE IV - PRIORITIES: PROBLEMS

Ecosystems Problems	Mangrove areas	Coral reefs	Coastal lagoons and sea-meadows	Estuaries and deltas	Beaches
Erosion	3x		2x 3x	2x 3x	1xx 2xx 3xx
Pollution	1xx 2xx 3xx	1xx 2xx 3xx	2xx 3xx	2xx 3xx	1xx 2xx 3xx
Eutrophication			2x 3x	2x 3x	
Sedimentation	1xx 2xx 3xx	1xx 2xx 3xx	2xx 3xx	2xx 3xx	
Overexploitation of living resources	1xx 2xx 3xx	1xx 2xx 3xx	2xx 3xx	2xx 3xx	
Overexploitation of non-renewable resources		1xx 2x 3x	2xx 3xx	2xx 3xx	1xx 2xx 3xx

1 = Small islands

2 = Large islands

3 = Continental Margin

xx = High priority

x = Low priority

TABLE V - PRIORITIES: PROCESSES

Ecosystems Processes	Mangrove areas	Coral reefs	Coastal lagoons and sea-meadows	Estuaries and deltas	Beaches
Water drainage (duration of drainage)	1XX 2XX 3XX	1XX 2XX 3XX	1XX 2XX 3XX	2XX 3XX	1 X 2 X 3 X
Adsorption/ desorption of sediments (interaction between solids)	1XX 2XX 3XX	1XX 2XX 3XX	1XX 2XX 3XX	1XX 2XX 3XX	1 X 2 X 3 X
Coastal dynamics	1XX 2XX 3XX	1XX 2XX 3XX	1XX 2XX 3XX	2XX	1XX 2XX 3XX
Upwellings		1XX 2XX 3XX			
Mixing processes	1XX 2XX 3XX	1XX 2XX 3XX	1XX 2XX 3XX	2XX 3XX	1 X 2 X 3 X
Water regime	1XX 2XX 3XX	1XX 2XX 3XX	1XX 2XX 3XX	2XX 3XX	1XX 2XX 3XX
Energy dissipation	1XX 2XX 3XX	1XX 2XX 3XX	1X 2X 3X	2XX 3XX	1XX 2XX 3XX
Nutrient cycles	1XX 2XX 3XX	1XX 2XX 3XX	1XX 2XX 3XX	2XX 3XX	
Degradation of organic matter	1XX 2XX 3XX	1XX 2XX 3XX	1XX 2XX 3XX	2XX 3XX	1 X 2 X 3 X
Dispersion of sediments and deposition rates	1XX 2XX 3XX	1XX 2XX 3XX	1XX 2XX 3XX	2XX 3XX	1XX 2XX 3XX
Production	1XX 2XX 3XX	1XX 2XX 3XX	1XX 2XX 3XX	2XX 3XX	1 X 2 X 3 X
Restocking policies	1XX 2XX 3XX	1XX 2XX 3XX	1XX 2XX 3XX	2XX 3XX	1 X 2 X 3 X
Interaction between ecosystems	1XX 2XX 3XX	1XX 2XX 3XX	1XX 2XX 3XX	2XX 3XX	1XX 2XX 3XX

1 = Small islands  
2 = Large islands  
3 = Continental margin

XX = high priority  
X = low priority

coastal lagoon ecosystems;

sandy beach ecosystems;

rocky shore ecosystem;

delta ecosystem;

estuarine ecosystem, which may be divided into two categories:

- + fluvial;
- + southern fiord;

coastal upwelling ecosystem.

It appeared feasible to assess the problem of sedimentation only in the case of coastal lagoon ecosystems and fluvial type estuaries.

Although it was recognized that all ecosystems are important for the area concerned, it was considered that priorities would be set on the basis of recognition of the magnitude of the existing problems in each case. From this angle, it was recognized that priority should be given in the temperate and sub-antarctic areas of Latin America to:

the coastal lagoon ecosystems, since they present problems of pollution of living resources and overexploitation of non-renewable resources;

estuarine ecosystems with their two subsystems, since they present problems caused by pollution, erosion, eutrophication and overexploitation of living resources;

sandy beach ecosystems, since they present problems of pollution, erosion and overexploitation.

Despite the fact that coastal upwellings were considered of great importance in the region, particularly along the Pacific coast, they were not included owing to the lack of concrete data on the possible importance of the problems considered in the general evaluation.

Regarding training, which is another objective of the RTG-2, it was suggested that possible programmes can be divided into three categories:

- (a) programmes connected with the project as such and which, in keeping with the COMAR project document, were concerned with:
  - beginners' courses;
  - advanced courses;
  - seminars;
- (b) programmes connected with marine science training in general offered by various Latin American countries;
- (c) programmes connected with applied specialized training.

Finally, it was pointed out that in view of the suggestions made by the different speakers, two types of course should be considered: graduate and postgraduate.

### 2.3.2 Management and training working group (MTG)

#### Participants

Chairman:	Armando Hernandez (Colombia)
Rapporteur:	Manuel Benítez (El Salvador) William Gutierrez (Dominican Republic) Robert Lankford (IOCARIBE) Luisa López (Cuba) Mirna Marín (Honduras) Federico Pannier (Venezuela) Mariano Pizarro (Argentina)

Members of the Working Group analysed the state of administration and management of coastal areas in Latin America and the Caribbean in order to single out the common problems and determine the alternatives to be considered in the COSALC project, with a view to co-ordinating research, planning and management, through training and study programmes in regard to critical subjects that would enable regional and subregional measures to be taken.

In addition, the group analysed the need to integrate in economic and social development plans specific programmes for the conservation of the coastal area with a view to ensuring a rational management of the ecosystems so as to achieve optimum long-term development for the benefit of present and future populations.

The social and economic importance of the coastal area for the countries is evident and for that reason in the existing machinery and institutions involved in the decision-making process use must be made of the findings of scientific and technical research. This means that there must be co-ordination between the research workers of the multidisciplinary teams and those responsible for guiding and managing these activities.

On the basis of information provided during the meeting, the experience and knowledge of the group's members and of the third revised version of the project document, the following conclusions were arrived at:

- (a) the COSALC project is very significant for Latin American and Caribbean countries, given that it combines efforts and allows for an exchange of experiences, for manpower training and for the development of research on subjects considered to have priority because they correspond to the development needs of the countries concerned;
- (b) the management and administration component is of paramount importance in the project if the various levels of decision are to be co-ordinated;
- (c) it is considered advisable to point out the problems that may affect the implementation of the COSALC project in terms of management and administration of coastal areas; these are enumerated below:
  - (c.1) determination of environmental problems of national importance and the establishment of national priorities;
  - (c.2) the finding of responsible and trained personnel to act as members of National COSALC Commissions and as programme executors;
  - (c.3) determination and mobilization of the national resources needed, namely:

- personnel (administrators, economists, biologists, oceanographers, engineers, sociologists, lawyers, etc.);
- institutions and data acquisition facilities;
- national funding.

(c.4) training of manpower specializing in the management of coastal areas;

(c.5) the setting-up of information systems covering data acquisition and processing, documentation and exchange of information between the different national programmes;

(c.6) the obtaining of counterpart funds for carrying out activities programmed in the COSALC project;

(c.7) problems related to continuity of national commitments;

(c.8) problems related to communication and internal co-ordination of the various national components so as to sustain a two-way flow (researchers, planners, administrators, etc.);

(c.9) problems related to multiple use of coastal areas and which depend on the internal decisions taken by each country.

Bearing all the above in mind, the following modes of action were proposed:

- (i) Incorporation in scientific and technological research of socio-economic studies and a review of legal norms and national development plans with a view to determining the prerequisites for formulating management and administration programmes in keeping with the nature and needs of a given ecosystem.
- (ii) COSALC sponsorship of the preparation and consolidation of a situation diagnosis to contain the information indispensable for analysing the overall and specific problems of the region. Its purpose would be to single out situations common to more than one country so that bilateral programmes can be drawn up and to provide COSALC with a basis for its decisions. To achieve this, it is proposed that Unesco should employ an expert to establish a basis and framework for National Groups to supply the information needed; this information would then be brought together by Unesco and duly published and disseminated.
- (iii) The group considers it important as part of the COSALC project to carry out pilot projects in which common cases would be studied, thus making it possible to apply standard or alternative methods for use in similar environments. These research projects must integrate socio-economic and cultural components into ecological research if it is to be of value in coastal management. The planning of research projects to aid in coastal management should concentrate on two aspects:
  - from the general standpoint, on the basic factors that play a determinant role in coastal management - the problems of the water balance of coastal basins, the quality of coastal waters, fisheries resources, coastal productivity and definition of vital areas;

- from the point of view of ecosystems, on the interaction between the effects of human activities and the various ecosystems composing the coast.

A prerequisite for study of the first aspect is determination of coastal problems and for study of the second, measurement of the structural and functional changes caused in the ecosystem concerned by human intervention.

As an example of coastal management projects using the general approach, it was suggested that research should be carried out:

to establish the effects of changes in the water balance of coastal basins brought about by dykes, drainage and landfill works and the cutting of vegetation on the sedimentation and salinity pattern on the coastline;

on the capacity of coastal mangrove areas to purify waste waters and polluted waters;

to define on an ecological basis the sites in the coastal area suitable for developing marine aquaculture;

to develop rehabilitation techniques for coastal areas with degraded mangrove and other ecosystems and for landfill areas;

on techniques for planting and sowing mangroves, reafforesting beaches and stabilizing dunes;

to apply the criteria previously established to determination of 'critical habitats' in coastal areas, with a view to establishing marine and coastal biological reserves.

As an example of management projects using the ecosystem approach, it was recommended that research should be carried out on the effect of pesticides used in agricultural areas on the structural composition and functioning of coastal ecosystems; the effects of the change in water volume brought about by the building of levees and dams on rivers; on fishery productivity in nearshore coastal areas; the geodynamic effect of the removal of sand used for various building purposes, and its impact on coastal ecosystems; the effect of the direct discharge of domestic sewage on the coastal flora and fauna in the area; the effects of recreational (tourist) activities on local coastal ecosystems.

The methods and general lines of coastal management research applicable to recommended projects could be determined through studies on impact; socio-economic research on coastal populations depending for their subsistence on certain coastal ecosystems; study of the demand for coastal biological products (fish, forest products); research on coastal management policies and programmes (assessment of a particular project on the basis of these concepts).

Some of the criteria to be recommended for evaluating pilot projects according to their importance are as follows:

projects in progress;

projects receiving institutional or governmental support that do not have sufficient economic resources available;

projects that can be used to solve specific coastal problems;

projects in places where material facilities are available for carrying them out;

projects that will have maximum repercussions on the development of training activities in the region.

- (d) Regarding training activities, it was thought that to achieve a real impact on the planning of the rational management of coastal resources, the following steps are necessary:

(d.1) Inclusion of two courses in the programme for training on the administration or management of coastal resources, namely:

(d.1.1) A workshop seminar (lasting three or four days) designed for management personnel, with a view to making them aware of the importance of integrated planning and management of coastal areas, and of the need to make it easy for their staff to take part in formal courses on planning and management of coastal areas and the use of the techniques learned.

(d.1.2) An introductory course on methods of planning and evaluation in connection with the problems of coastal area management, designed essentially to standardize certain methods applicable to countries in the region.

(d.2) Insertion in the programme of the introductory course envisaged in the project ('Introductory course on the management of coastal areas'): Basic principles of oceanography with a view to providing professionals in the different disciplines with a basic knowledge of oceanic processes and their relationship to the coastal area.

(d.3) If the desired results are to be achieved, the courses mentioned should be held in the following sequence:

- Workshop/Seminar (3-4 days) for managerial staff;
- Introductory course on the management of coastal areas;
- Course on methods of planning and evaluating the management of coastal areas.

(d.4) In regard to specialized training activities through advanced courses, it is considered that the subjects covered by the courses described in the preliminary project document (second version) are adequate for training suitable manpower for dealing with specific normal and regional objectives connected with the management of coastal areas that include mangrove ecosystems, coastal lagoons, coral reefs, deltas and estuaries and the continental shelf so far as its interactions with the coastal area are concerned. The location of these courses will have to be determined in accordance with the machinery established for implementation of the project.

(d.5) It is suggested that the programme should include the course entitled 'Integrated management of coastal marine resources in the Patagonian region - Transfer programme for the public sector', under the auspices of Argentina's Sub-secretariat for Science and Technology. The course will be held during 1983.

- (e) For the management of coastal environments, it is undoubtedly necessary to have information available concerning the system to be managed. It is therefore essential to have available a system of information on coastal environments that ensures an adequate flow of data, documents, accounts of new developments, etc.

It is hence necessary to organize through COSALC an information system that will provide information on:

environmental factors in different areas, whether critical or not;

legislation, scientific documentation and new developments in the research in progress on coastal areas and news of various activities involving the coastal areas.

Considering the great importance for the decision-making and planning sectors and for education at various levels of circulating information on coastal problems related to socio-economic development, it is recommended that COSALC should produce, or encourage the production of articles, brochures, books, audio-visual material, etc., for disseminating at different levels (political, planning, educational, etc.) information concerning coastal problems and their implications for human activities.

Considering the large number of different natural environments and the sometimes vague or confused names given to them, as well as the use of ill-defined units of physical or chemical measurement (p.p.m. p.p.b., etc.) it is recommended that COSALC promote the adoption of a standard terminology (with equivalents in several languages even if they are not used in the United Nations) for the naming of physiographical areas or units, and the use for physical and chemical data of standardized units, symbols and abbreviations recommended by the International Association for the Physical Sciences of the Ocean in its scientific publication No. 31 (1979) (SUN\* REPORT).

Finally, the COSALC project should study the possibility of setting up an information system suited to the conditions and level of development of the countries concerned.

### 2.3.3 Project Organization Working Group (POG)

#### Participants

Chairman:	Luiz Martins (Brazil)
Rapporteurs:	(Eric Jordán (Mexico) (Víctor Scarabino (Uruguay) Manuel Benítez (El Salvador) Jorge Briceño (Panama) Serge Cassetto (ROSTLAC/Unesco) Jorge Chapas (Guatemala) Marco Giglioli (Cayman Islands) Armando Hernández (Colombia) Roberto Jiménez (Ecuador) Robert Lankford (IOCARIBE) Luisa López (Cuba) Mirna Marín (Honduras) Sergio Martínez (Nicaragua)

\* SUN: Symbols, units and nomenclature.



Rapporteurs:

Euna Moore (Barbados)  
Federico Pannier (Venezuela)  
Mariano Pizarro (Argentina)  
Doon Ramsaroop (Trinidad and Tobago)  
Marc Steyaert (SC/OCE/Unesco)  
José Stuardo (Chile)  
Manuel Vegas (Peru)

Approved agenda:

subject priorities;  
pilot phase;  
working plan;  
implementation strategies  
project organization.

Subject priorities:

The priorities determined by the RTG and MTG Working Groups were considered, special attention being paid to the MTG, which had assigned the following order of importance to operational proposals in this group:

1. training;
2. situation analysis;
3. pilot projects;
4. information.

Preliminary Phase II (on the basis that Preliminary Phase I ended after the Caracas Meeting and the carrying-out of the activities reported in section 1.6(i), (ii) and (iii)).

Consideration was given to the criteria to be borne in mind in integrating projects and pilot activities and the guidelines established in the MTG Report were welcomed.

Training:

It was recommended the the COMAR project should give priority support to the following courses:

the workshop/seminar recommended by the MTG;  
a workshop on the problem of sandy beaches;  
a symposium on mangrove areas;  
an introductory course on basic research in coastal areas.

Some courses already organized by participating countries were described to the meeting, a list of them is presented below:

Remote Sensors (Panama), United States of America, Unesco/NOAA/University of Delaware, March 1983.

Postgraduate - Course on paleogeographical evolution;  
Unesco/CECO/Mar del Plata University.

Postgraduate - Marine Ecosystems of Cuba;  
University of La Havana, June/July 1983.

Postgraduate - Integrated management of coastal marine ecosystems in Patagonia;  
Argentina, October 1983, OAS/Argentina.

Postgraduate - IOCARIBE/CARIPOL - Heavy metal and pesticide pollution in organisms  
and sediments; México, April 1984.

Postgraduate - Instrumentation and analysis of pollutants in the sea;  
OAS/IOC/Ecuador, February/March 1983.

Furthermore, it was agreed that countries would inform Unesco of other  
courses that it is planned to hold in the region.

#### Implementation strategies

It was recommended that the criteria for selecting pilot projects as set  
forth in the MTG Report be included.

The third version of Unesco's proposal was accepted.

#### Project organization

The proposal to consider COSALC as a single project with three components was  
accepted, the components being the Caribbean Islands, Continental Tropical Zones  
and Temperate and Sub-antarctic Zones as differentiated by the RTG1. Unesco/COMAR  
would be responsible for project organization, whereas the components would be  
regional and would therefore be dealt with at the operational level. They would  
include regional problems in terms of the structure, dynamics and interface in  
each region.

### 3. RECOMMENDATIONS OF THE MEETING

1. Recognizing that the coastal zone constitutes an area of primary importance  
for the socio-economic development of the Latin American and Caribbean  
countries;
2. Considering that the coastal zone of Latin America and the Caribbean  
encompasses a number of complex and diverse ecosystems situated in the  
tropical, sub-tropical, temperate and sub-antarctic climatic zones, as well  
as belonging to both the continental and insular types.
3. Further recognizing the need for research and training and for the management  
of the coastal zone as a series of ecosystems that represent areas of social  
and economic importance for the population of each state as well as making  
evident the need to promote their conservation through management plans  
adjusted to the local needs and which will make possible the correction or  
prevention of noxious effects and degradation to this zone.

#### Recognizing also,

4. that the COSALC project constitutes a mechanism for integrating the national  
programmes and for reinforcing regional co-operation in order to improve the  
rational utilization of the presently and potentially available resources of  
the coastal zones,

5. that the COSALC project, considering the priorities established by the Working Group that dealt with this matter and as far as research is concerned, will have to comprise three components as follows: insular countries of the Caribbean, continental tropical countries and countries belonging to the temperate and sub-antarctic zone,
6. that it is of highest importance that Unesco promote and support in countries participating in the COSALC project the preparation of a consolidated diagnosis on the coastal zone as a means of identifying regional programmes,

Recommends

7. that the specific and more general recommendations contained in the different working groups' reports and concerning the various actions which need to be undertaken in the short and medium term, be implemented by Unesco,
8. that governments, Unesco and the various international agencies participating in the project make the necessary arrangements and promote co-operative agreements as required for the project to be implemented, and therefore contribute to a reinforcement of national mechanisms and of international co-operation for research and training and the management of coastal zone resources.

ANNEX 1Monday, 15 November

- 11.00 a.m.            Opening session
- Address by Mr F. Pannier, Chairman of the Organizing Committee
- Address of welcome by Mr M. Romano, Assistant Director of IVIC
- Address by MR B. Oteiza, Unesco Representative in Venezuela and Director of CRESALC
- Statement by Mr M. Steyaert of Unesco (SC/OCE, Paris), on the historical background and objectives of the meetings within the framework of the COMAR project
- Opening address by Mr R. Villegas, Venezuelan Minister of Science and Technology
- 12.00 noon            Lunch
- 2.30 p.m.            Plenary session
- Election of the Chairman (Mr F. Pannier), the vice-chairman (Mr D. Ramsaroop) and the rapporteurs (Mrs E. Moore and Mr M. Vegas)
- Adoption of the Agenda
- 3.00 p.m.            Lecture
- Lecture by Mrs E. Moore on 'Coastal zone ecosystem of the Eastern Caribbean - main features and subjects of concern'
- Lecture by Mr L.R. Martins on 'Present state of research on coastal ecosystems in Latin America'
- 4.00 p.m.            Coffee break
- 4.15 p.m.            Lecture
- Lecture by Mr F. Pannier on 'Venezuelan coastal ecosystems and their problems'
- 5.00 p.m.            Presentation
- Presentation by Mr M. Steyaert of the COMAR project
- 5.30 p.m.            Presentation
- Presentation by Mr R. Lankford of the objectives and programmes of IOCARIBE

Tuesday, 16 November

9.00 a.m.

Plenary session

Explanation by Mr M. Steyaert of the relationships between the meeting and the international symposium 'Utilization of Coastal Ecosystems: Planning, Pollution and Productivity' (22-27 November 1982, Rio Grande, Rio Grande del Sul, Brazil).

Presentations of each country's marine sciences activities and contributions to the COMAR project.

1.00 p.m.

Lunch

2.00 p.m.

Presentations

Presentations of each country's marine sciences activities and contributions to the COMAR project.

5.15 p.m.

Lecture

Lecture by Mr A.P. Rock (NOAA, United States of America) on the 'Use of remote sensing in the study of coastal areas'.

5.50 p.m.

Presentation

Presentation of each country's marine sciences activities and contributions to the COMAR project.

Wednesday, 17 November

8.30 a.m.

Plenary session

Presentation of each country's marine sciences activities and contributions to the COMAR Project.

Summary by Mr Jimenez of the country presentations.

Discussion on the standpoint of each country.

10.30 a.m.

Coffee break

10.45 a.m.

Lecture

Lecture by Mr M. Giglioli (M.R.C.U., Cayman Islands) on 'Mapping methods applied to mangrove and related vegetation used in the coastal areas of the Cayman Islands'.

11.00 a.m.	Working Groups
	Establishment of the working groups
	Research and Training Group (RTG)
	Management and Training Group (MTG)
	Project Organization Group (POG)
12.00 noon	Visit
	Visit to the International Institute of Advanced Studies (IIEA)
1.00 p.m.	Lunch offered by the IIEA
2.30 p.m.	Meetings
	Meetings of the RTG and MTG Working Groups

Thursday, 18 November

8.30 a.m.	Meetings
	Meetings of the RTG and MTG Working Groups
10.45 a.m.	Coffee break
11.00 a.m.	Plenary session
	Exchange of ideas and findings of the meetings of the RTG and MTG Working Groups.
12.00 noon	Lunch
2.00 p.m.	Working Group
	Meeting of the Project Organization Working Group (POG)

Friday, 19 November

9.00 a.m.	Plenary session
	Review and adoption of the reports submitted by the three working groups
	Discussions
10.45 a.m.	Coffee break
11.00 a.m.	Discussions
12.00 noon	Lunch

2.30 p.m.	Drafting Committees
	Meetings of Drafting Committees
3.00 p.m.	Plenary session
	Adoption of the summary general report and general recommendations
4.00 p.m.	Closing session.

ANNEX 2

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