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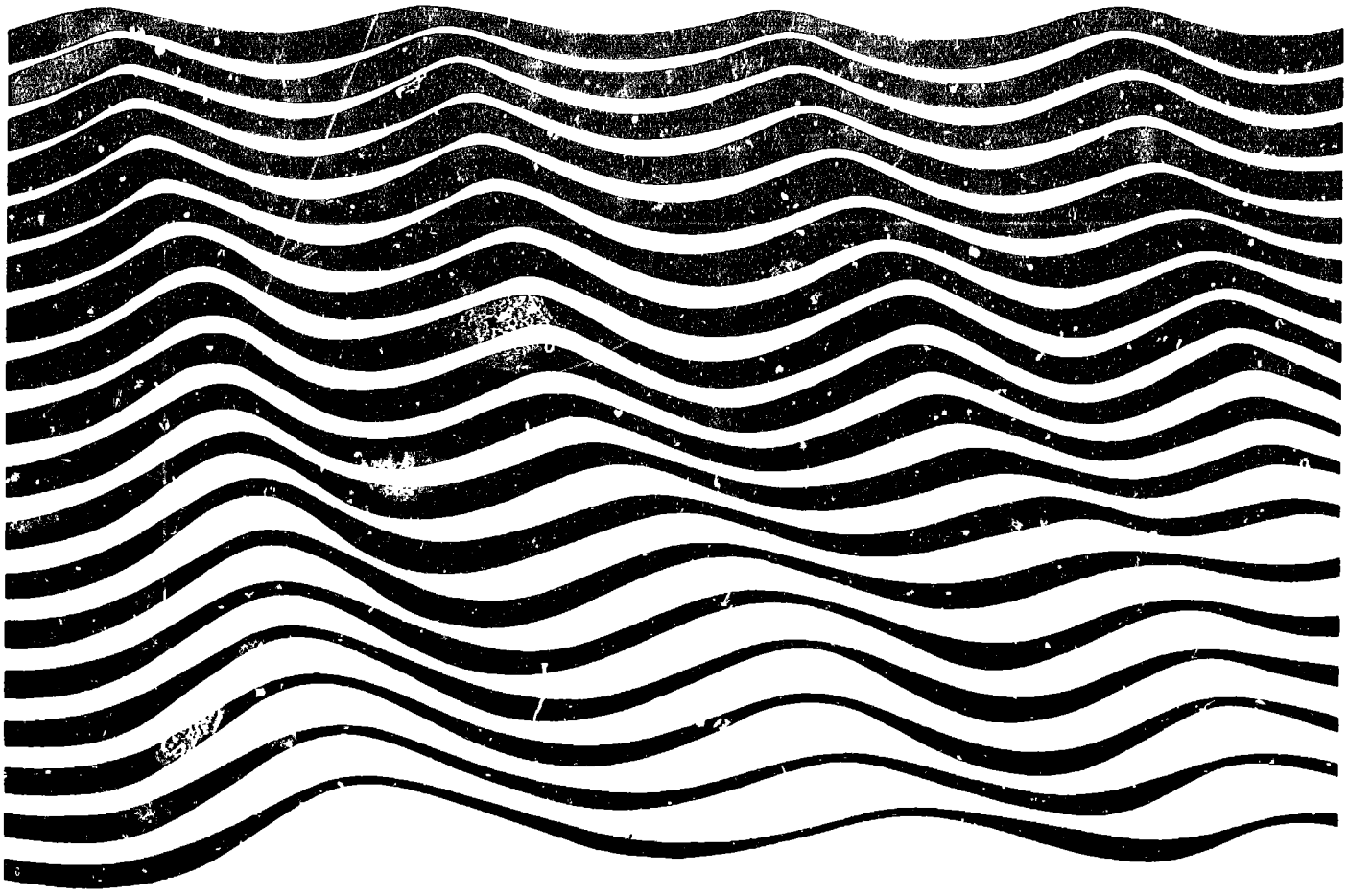
Unesco reports
in marine science

Coastal marine ecosystems of Africa

Objectives and strategy of the COMARAF Regional Project



Unesco, 1988

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No.		Year
1	Marine ecosystem modelling in the Eastern Mediterranean Report of a Unesco workshop held in Alexandria, Egypt, December 1974 English only	1977
2	Marine ecosystem modelling in the Mediterranean Report of the Second Unesco Workshop on Marine Ecosystem Modelling English only	1977
4	Syllabus for training marine technicians Report of an IOC/Unesco workshop held in Miami, Florida, 22-26 May 1978 Available in English, French, Russian and Spanish	1979
5	Marine science syllabus for secondary schools Report of an IOC workshop held at United World College of the Atlantic, United Kingdom, 5-9 June 1978 Available in Arabic, English, French, Russian and Spanish	1979
6	Organization of marine biological reference collections in the Mediterranean Arab countries Expert meeting held in Tunis, 20-23 September 1978 Available in Arabic, English and French	1979
8	The mangrove ecosystem: Human uses and management implications Report of a Unesco regional seminar held in Dacca, Bangladesh, December 1978 English only	1979
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
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
14	Marine science and technology in Africa: present state and future development Synthesis of Unesco/ECA survey missions to African coastal states, 1980 Available in English and French	1981
15	Fishery science teaching at the university level Report of a Unesco/FAO workshop on university curricula in fishery science, Paris, May 1980 Available in Arabic, English, French, Russian and Spanish	1981
16	Marine and coastal processes in the Pacific: ecological aspects of coastal zone management Report of a Unesco seminar held at Motupore Island Research Centre, University of Papua New Guinea, 14-17 July 1980 English only	1981
18	Coral reef management in Asia and the Pacific: some research and training priorities Report of a Unesco workshop held in Manila, Philippines 21-22 May 1981 English only	1982
19	Mareas rojas en el Plancton del Pacífico Oriental Informe del Segundo Taller del Programa de Plancton del Pacífico Oriental, Instituto del Mar, Callao, Perú 19-20 de noviembre de 1981 Spanish only	1982
20	Quantitative analysis and simulation of Mediterranean coastal ecosystems: The Gulf of Naples, a case study Report of a workshop on ecosystem modelling Ischia, Naples, Italy, 25 March to 10 April 1981 Organized by the United Nations, Educational, Scientific and Cultural Organization (Unesco) and the Stazione Zoologica, Naples English only	1983
21	Comparing coral reef survey methods A regional Unesco/UNEP workshop, Phuket Marine Biological Centre, Thailand, December 1982 English only	1983
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
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
24	Coastal ecosystems of Latin America and the Caribbean The objectives, priorities and activities of Unesco's COMAR project for the Latin America and Caribbean region Caracas, Venezuela, 15-19 November 1982 Available in English and Spanish	1983
25	Ocean engineering teaching at the university level Recommended guidelines from the Unesco/IOC/ECOR workshop on advanced university curricula in ocean engineering and related fields, Paris, October 1982 Available in English, French, Spanish, Russian, Arabic and Chinese	1983
26	Global survey and analysis of post-graduate curricula in ocean engineering English only	1984
27	Productivity and processes in island marine ecosystems. Recommendations and scientific papers from the Unesco/IOC sessions on marine science co-operation in the Pacific, at the XVth Pacific Science Congress, Dunedin, New Zealand, February 1983 English only	1984
28	Oceanographic modelling of the Kuwait Action Plan (KAP) Region. Report of simposium/workshop; University of Petroleum and Minerals, Dhahran, Kingdom of Saudi Arabia 15-18 October 1983 English only	1984
29	Eutrophication in coastal marine areas and lagoons: a case study of 'Lac de Tunis' Report prepared by Dr M. Kelly and Dr M. Naguib English only	1984
30	Physical oceanography of the Eastern Mediterranean: an overview and research plan Report of a workshop held in Lerici, La Spezia (Italy), September 1983 English only	1984
31	MABAHISS/John Murray 50th anniversary: Marine science of the North West Indian Ocean and adjacent waters Report of a symposium on the occasion of the 50th anniversary of the MABAHISS/John Murray Expedition (1933/34), University of Alexandria, Egypt, 3 to 7 September 1983 English only	1985
32	L'estuaire et la mangrove du Sine Saloum Résultats d'un Atelier régional Unesco-COMAR tenu à Dakar (Sénégal) du 28 février au 5 mars 1983 French only	1985
33	Coral taxonomy Results and recommendations of a regional Unesco (COMAR)/UNEP Workshop with advanced training Phuket Marine Biological Centre Thailand, 10-26 February 1984 English only	1985
34	Bibliography on costal lagoons and salt marshes along the Southern Mediterranean coast (Algeria, Egypt, Libya, Morocco, Tunisia) Available in Arabic, English and French	1985
35	Physical oceanography of the Eastern Mediterranean (POEM): A Research Programme. Reports of the Organizing Committee Meeting, Paris, August 1984, and the Scientific Workshop, Lucerne, October 1984 English only	1985
36	Méthodologie d'étude des lagunes côtières. Résultats d'un atelier régional réuni à Abidjan du 6 au 11 mai 1985 French only	1986
37	Principles of Geological Mapping of Marine Sediments (with special reference to the African continental margin) Available in English and Russian	1986
38	Marine Sciences in CMEA countries Programme and results of co-operation Available in English and Russian	1986
39	Development of marine sciences in Arab Universities Meeting of Experts held at the Marine Science Station Aqaba, Jordan 1-5 December 1985 Available in Arabic, English, French	1986

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in marine science 48

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Unesco, 1988

ISSN 0253-0112

Published in 1988
by the United Nations Educational,
Scientific and Cultural Organization,
7, place de Fontenoy, 75700 Paris.
Printed in Unesco's workshops.

I N M E M O R I A M

Boniface Mwaiseje

1947-1986

The groundwork for the Regional Project on the Coastal Marine Ecosystems of Africa was laid in large measure through the efforts and talent of a son of Africa: Dr Boniface Mwaiseje. Dr Mwaiseje was killed in Nairobi in the latter days of 1986, shortly before the meeting which launched the project. He worked in Unesco during 1983-1986. His creative efforts gave a new dimension of coherence and direction to the Unesco programme of Africa for assisting the countries and institutions in the development and strengthening of their marine science capabilities.

"Boni", as he was known to all his friends, was born on 21 December 1947 in the village of Kyimo, in the Tukuyu District of Tanzania. His intelligence and scholastic ability led him to higher studies at the University of Dar-Es-Salaam, where he received a B.Sc. with Honours in zoology and an M.Sc. in marine biology. In 1973, he embarked upon a doctoral programme in marine ecology at University College of North Wales (United Kingdom), which ended successfully in 1977 with the bestowal of a Ph.D. The sentiments of many of those who knew Dr Mwaiseje in later years are reflected, in great measure, in the comments of Professor D.J. Crisp, who supervised his doctoral work. Professor Crisp wrote:

"I first met Boniface Mwaiseje when he suddenly appeared in my office and told me smilingly that I was his Ph.D. supervisor. The college registration system had entirely failed to alert me. We were soon talking about his project and marine ecology in general. He decided to study and classify British tide-pools and was quickly out on the shore collecting material for his thesis. He radiated enjoyment in his work and was liked by us all. We admired his lithe and powerful physique as he strode away at the head of the student classes on field trips. I nicknamed him "Kip Kieno" after the well-known Kenyan long-distance runner. Yet he was the gentlest of characters."

"He was always enthusiastic and well-motivated in his work, which took him to various sites in England, Wales, Scotland and Ireland. His intelligence enabled him to master the then new methods of multi-variate analysis and successfully apply them to tide-pool ecology. He took his place among those students who have shown themselves capable of working with the independence and competence that makes them a pleasure to teach. It was no surprise to me to learn how well he progressed when he returned to Africa."

Dr Mwaiseje's teaching and research career began in 1971 when he joined the faculty of the University of Dar-Es-Salaam, attaining the rank of Senior Lecturer in zoology and marine biology. He also served as Director of the University's Sub-department of Marine Biology and of the Kunduchi Marine Biological Station.

In June 1983, Dr Mwaiseje joined Unesco in Paris as a programme specialist in the Division of Marine Sciences. In July 1986, he took on additional responsibilities as the marine science specialist in the Office for Science and Technology in Africa, located in Nairobi (Kenya). His contributions were vital in formulating and executing the Organization's programme for Africa over these years. During the relatively few years which destiny allowed him to work in his capacity as a Unesco programme specialist, Dr Mwaiseje's grasp for the potential and needs of the African region in marine science formed the basis for new initiatives. The new directions of the programme are exemplified by four important meetings which he organized for the benefit of African scientists:

(1) the International Symposium on the Comparative Ecology of the Aquatic Environment; held in Nairobi, 30 September to 4 October 1985 (the proceedings of this meeting will be published in Limnology and Oceanography, with some of the papers to appear in a special issue of Hydrobiologia);

(2) l'Atelier Regional sur la Methodologie d'Etudes des Lagunes Cotieres (the regional workshop on methods of research on coastal lagoons), held in Abidjan, 6-11 May 1986;

(3) the Meeting of Deans of African Universities and Marine Science Institutions; held in Nairobi, 4-9 August 1986; organized to determine the region's needs in the domain of marine science education; and

(4) preparation for the meeting, covered by this Report, on Objectives and Strategy of the Unesco COMAR Regional Project for Africa, held in Dakar, 18-23 December 1986. Unfortunately, his death prevented his participation in the meeting itself.

In energetic pursuit of Unesco's programme on the development of marine scientific education in the African coastal countries, he also organized fellowships, study and research grants and training courses, as well as consultancy missions to advise Member States on the development of their university programmes. He was responsible for the elaboration of several proposals for regional and country projects on training and research in marine sciences.

His colleagues of the Division of Marine Sciences and other Unesco staff members who had the pleasure of working with him, join with other friends to pay tribute to Dr Mwaiseje, whose untimely and cruel death has deprived his continent of a careful scholar and a builder who had a clear vision on how to develop African marine science.

PREFACE

Unesco Reports in Marine Science are designed to serve specific programme needs and to report on developments in projects conducted by the Unesco Division of Marine Sciences, including those involving collaboration between the Division and the Intergovernmental Oceanographic Commission.

Designed to serve as a complement to the Unesco Technical Papers in Marine Science, the Reports are distributed automatically to various institutions and governmental authorities. Individuals may, at their request, receive copies of specific titles, but cannot be included on the automatic distribution list. Both the Reports and the Technical Papers series are free of charge.

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Division of Marine Sciences
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75700 Paris
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ABSTRACT

As part of the Unesco Major Interregional Project on Research and Training leading to Integrated Management of Coastal Systems (COMAR), a regional meeting of experts to discuss proposals and strategy for implementation of a project entitled "Regional Project for Training and Research on Coastal Ecosystems of Africa (COMARAF)", was convened at the Unesco/BREDA office, Dakar, Senegal, 18-23 December 1986. The meeting was attended by 31 scientists most of them being from the region.

The meeting discussed the project document prepared by the Unesco Division of Marine Sciences and produced recommendations on the objectives, methods and mechanism for the implementation of the project.

Discussions were followed by lectures on various subjects concerning the coastal marine systems and related to the project, and a one-day field excursion.

The discussions demonstrated that a high interest is existing in the countries of Africa for problems related to the studies and rational management of coastal areas.

It was recommended to submit the project document to UNDP for funding.

RESUME

Dans le cadre du Projet interrégional majeur de l'Unesco pour la recherche et la formation en vue de l'aménagement intégré des systèmes côtiers (COMAR), une réunion régionale d'experts, dont l'objet était d'examiner des propositions et une stratégie relatives à la mise en oeuvre d'un projet intitulé "Projet régional de formation et de recherche concernant les écosystèmes côtiers d'Afrique (COMARAF)", s'est tenue au Bureau régional d'éducation pour l'Afrique de l'Unesco, à Dakar (Sénégal), du 18 au 23 décembre 1986. Trente et un scientifiques venant pour la plupart de la région y ont participé.

Les participants ont examiné le descriptif du projet établi par la Division des sciences de la mer de l'Unesco et ont formulé des recommandations sur les objectifs, les méthodes et le mécanisme de l'exécution du projet.

Les débats ont été suivis d'exposés sur divers sujets relatifs aux systèmes marins côtiers et intéressant le projet, ainsi que d'une excursion d'une journée.

Il ressort des débats qu'il existe dans les pays d'Afrique un vif intérêt pour les problèmes liés à l'étude et à l'aménagement rationnel des zones côtières.

Il a été recommandé que le projet soit soumis au PNUD pour financement.

RESUMEN ANALITICO

En el marco del Proyecto Principal interregional de investigación y formación con miras a la gestión integrada de los ecosistemas costeros (COMAR) de la Unesco, tuvo lugar del 18 al 23 de diciembre de 1986 en la Oficina Regional de Educación para Africa, de la Unesco, Dakar (Senegal) una reunión regional de expertos encargados de examinar las propuestas y la estrategia de ejecución de un proyecto titulado "Proyecto Regional de Formación e Investigación para los Ecosistemas Costeros de Africa (COMARAF)". Asistieron a la reunión 31 especialistas, en su mayoría de la región.

En la reunión se examinó el documento de proyecto preparado por la División de Ciencias del Mar de la Unesco y se formularon recomendaciones sobre los objetivos, los métodos y el mecanismo de ejecución del proyecto.

Después de los debates, se pronunciaron conferencias sobre diversos aspectos de los marinos costeros, así como sobre temas relacionados con el proyecto, y se efectuó una visita sobre el terreno de un día de duración.

En los debates se puso de manifiesto el gran interés que despiertan en los países de Africa los problemas relacionados con el estudio y la gestión racional de las zonas costeras.

Se recomendó presentar el documento de proyecto al PNUD para su financiación.

РЕЗЮМЕ

В рамках Основного межрегионального проекта по исследованиям и подготовке кадров с целью комплексного освоения прибрежных морских систем (КОМАР) 18-23 декабря 1986 г. в бюро ЮНЕСКО/БРЕДА (Дакар, Сенегал) было созвано региональное совещание экспертов для обсуждения предложений и стратегии осуществления проекта под названием "Региональный проект по подготовке кадров и исследованиям в области прибрежных экосистем Африки (КОМАРАФ)". В совещании приняли участие 31 ученый, в основном из стран этого региона.

На совещании был обсужден документ по проекту, подготовленный Отделом морских наук ЮНЕСКО, и выработаны рекомендации относительно целей, методов и механизма осуществления проекта.

Дискуссии сопровождались лекциями по различным вопросам, связанным с прибрежными морскими системами и данным проектом, а также однодневной ознакомительной поездкой в места проведения работ.

Дискуссии показали, что в африканских странах имеется большая заинтересованность проблемами, связанными с исследованиями и рациональным управлением прибрежными зонами.

Было рекомендовано представить документ по проекту в ПРООН в целях обеспечения финансирования.

摘　要

作为教科文组织沿海生态系统综合治理研究与培训地区间重大项目（COMAR）的一部分，1986年12月18－23日在塞内加尔达喀尔教科文组织非洲地区教育办事处（BREDA）召开了一次地区专家会议，讨论了“非洲地区沿海生态系统培训与研究项目（COMARF）”的实施建议和战略。出席会议的有三十一位科学家，其中大多数来自该地区。

会议讨论了教科文组织海洋科学处拟订的项目文件，并就实施该项目的目标、方法和机构问题提出了建议。

讨论后，就有关沿海海洋系统和该项目的各种问题举办了若干讲座，并组织了为期一天的实地考察。

讨论表明，非洲各国目前对沿海地区研究与合理管理等问题极为关心。

会议建议将该项目文件提交联合国开发计划署，以求得资助。

خلاصة

كجزء من مشروع اليونسكو الرئيسى المشترك بين المناطق بشأن البحوث والتدريب فى مجال التخطيط المتكامل للنظم الساحلية (كومار)، تولى مكتب اليونسكو للتربية فى أفريقيا (بريدا)، فى داكار (السنغال)، عقد اجتماع اقليمى للخبراء من ١٨ الى ٢٣ ديسمبر/كانون الأول ١٩٨٦، لمناقشة الاقتراحات والاستراتيجية الخاصة بتنفيذ مشروع بعنوان "المشروع الاقليمى للتدريب، والبحوث فى مجال النظم الايكولوجية الساحلية فى أفريقيا (كومار اف)". وحضر هذا الاجتماع ٣١ علميا ينتمى معظمهم الى بلدان المنطقة.

وقد ناقش هذا الاجتماع الوثيقة الخاصة بالمشروع التى أعدها قسم علوم البحار فى اليونسكو، وقدم توصياته بشأن أهداف المشروع وأساليب تنفيذه والجهاز الذى يناط به ذلك.

وقد أعقب المناقشات القاء محاضرات فى شتى الموضوعات المتعلقة بالنظم البحرية الساحلية ذات الصلة بالمشروع، كما نظمت رحلة ميدانية استغرقت يوما واحدا.

وأثبتت المناقشات أن هناك اهتماما كبيرا فى البلدان الأفريقية بالمشكلات المتعلقة بالدراسات الخاصة بالمناطق الساحلية وادارتها الرشيدة.

وقد أوصى بعرض وثيقة مشروع على برنامج الأمم المتحدة للتنمية (بامنت) لتمويله.

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COASTAL MARINE ECOSYSTEMS OF AFRICA

Objectives, Priorities and Activities of Unesco's COMAR Regional Project

Dakar (BREDA), Senegal, 18-23 December 1986

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Report of the Meeting on the Coastal Marine Ecosystems of Africa Projet (COMARAF)

(Dakar, 18-23 December 1986)

Agenda item 1. Opening Session

The meeting was opened by H.E. Cheikh Abdoul Kadre Cissoko, Ministre de la Protection de la Nature of Senegal. Mr. B. Haidara, Unesco co-ordinator for Africa and Director of BREDA, gave a speech on tasks of the meeting referring to COMAR and its African component, COMARAF.

Agenda item 2. Administrative arrangements

- Dr. M. Steyaert (UNESCO) proposed to elect Bureau of the meeting.
- Dr. S. Zabi proposed Dr. S. Diop as president.
- Dr. S. Diop acknowledged this but referred to the fact that being a co-organizer of the meeting he may not be available permanently. He proposed to elect Prof. M. Bopelet as president.
- Election of Prof. M. Bopelet (Cameroon) and Dr. S. Diop (Senegal) as co-presidents of the meeting was supported unanimously.
- Dr. S. Zabi (Côte d'Ivoire) and Dr. F. Chale (Tanzania) were elected as co-Vice-presidents, and
- Dr. A. Ibe (Nigeria) and Dr. D. Leung-Tack (Senegal) were nominated as co-rapporteurs.
- The provisional agenda was adopted with little modifications.

Agenda item 3.

3.1. The floor was given then to Dr. Steyaert, who described the Unesco Major Interregional Project on Research and Training leading to the Integrated management of coastal systems (COMAR):

COMAR was formally established by Unesco General Conference in 1986 along with eight other Major Projects of the Science Sector.

However the coastal zone including its marine systems has been part of the Unesco programmes since the early seventies.

When the project started it was obvious that because of its complexity the subject was not that easy to tackle as a whole and by a single group of specialists.

A basic question was to define the objective of a Unesco programme in this field, considering the fundamental goals of the organization.

We would consider for instance:

- the promotion of science and scientific research
- the assistance to and cooperation with the Member States in order to reinforce their scientific and management capabilities, in line with the development requirements
- the impact of man and of its industries on nature, the multiple uses of the environment and of its resources, and the potential conflicts between traditional and modern societies.

These three manners of considering the problem have all their own merit and can easily be justified.

As far as the first point is concerned the understanding of the natural environment and processes is the basis of human settlement in the environment. This understanding must be improved as the human pressure is increasing. Traditional societies have progressively integrated themselves in the environment accumulated through the generations.

With the emergence of modern societies, demography and development have suddenly accelerated to the point of disconnecting man from "nature" and creating a crisis which we are in fact facing today and for which, as far as the coastal areas are concerned, the COMAR project is meant to try to contribute to finding solutions.

In addition to taking into consideration the traditional knowledge, which we should certainly not ignore, scientific research must come to the rescue. It is one of the major objectives of COMAR.

The second point: the reinforcement of the countries' and institutions' capabilities to face the problem in all its facets and by joining forces, as this meeting is an example, is certainly another major objective of Unesco and of COMAR.

The third point: the human impact on natural systems and of their resources and their protection is another way of approaching the problem. It is the point of view favoured by our sister organization, the United Nations Environment Programme (UNEP). This approach is definitely complementary to the first two.

In reality, the three approaches were complementary and mutually supportive.

It is by giving careful attention to each of these approaches, to their relations and to a balanced integration of their different components that we may hope to establish the bases for a "reconnection" of man with his environment and for long-term rational management of its resources. This is what we hope to contribute to, with the COMAR project. The task is certainly not an easy one, but there is no way to escape it.

Which aspects of the coastal zone we ought to know, study and what has to be managed?

The present coastal physiography shows a number of systems among which the most characteristic are: deltas and estuaries, coastal lagoons, sandy beaches, rocky shores, and a variety of narrow or extended shallow water shelves with different types of sandy and muddy bottoms.

These systems are the result of active physical forces, which after the rising of the sea level of about 100 meters during the holocene post glaciation period (15,000 B.C. to 5,000 B.C.) were and are continuing to shape the coast and to create the conditions to which its various (eco) systems have adapted. The physical forces are for examples crust (isostatic) movements, winds, currents and tides; the continental run off, sediment accretion and erosion, etc.

Playing also an important role in this process are the living communities of plants and animals, such as the coral-building reefs, mangroves trapping the sediments and absorbing winds and tide energy, seaweed and seagrass beds, pelagic and bottom communities, each one being linked to the others in one or another way depending on the type of system and the climate conditions.

The coastal zone is therefore the site of complex and intense interactions between land, sea and atmosphere. The coastal ecosystems are also considered among the most productive of the natural ecosystems.

How should a Unesco programme tackle the problem considering the three main goals mentioned earlier?

Cooperation with ICSU, SCOR and IABO

In 1973 Unesco raised the question to its scientific advisory bodies namely the International Council of Scientific Unions (ICSU) and within ICSU to the Scientific Committee on Oceanic Research (SCOR) and the International Association of Biological Oceanographers (IABO).

It resulted from this first discussion with SCOR and IABO that the coastal zone was far too complex to be tackled as a single entity.

The subject was recognized to be of a multidisciplinary nature and within the scientific community people were specialized in one discipline and within their discipline, in one of the coastal (eco)systems.

It was therefore decided to organize different programmes according to the main (eco)systems encountered in the coastal areas such as:

- mangroves
- coral reefs
- coastal lagoons
- estuaries and deltas
- seagrasses, etc.

Various working groups were organized producing various basic publications such as manuals of research methodologies, proceedings of symposium, etc.

The results of these preliminary programmes were used to help in setting up regional projects, summarized in Table I.

Besides giving consideration to separate (eco)systems, in the early eighties, attention was turned to interaction between several "open" ecosystems and the question was raised whether this interaction exists and important enough to be given close attention. This question may become "the point of departure" of interregional project within COMAR.

Proceeding in this direction cooperation with SCOR and IABO concentrated on land-sea interfact and on the functioning of and processes in the ecosystems themselves through two programmes:

- a SCOR/IABO working group on coastal offshore ecosystems relationship and
- an IABO working group on highly diverse marine ecosystems.

Regional COMAR activities

Besides several fact-finding missions of Unesco three main regional COMAR activities started:

- in 1978, in Asia and the Pacific, with a first seminar on mangroves, in Bangladesh

Table I - COMAR regional activities (1984-1986)

Asia and the Pacific	Latin America & the Caribbean	Africa	Mediterranean, Red Sea and the Gulf
- mangroves and related systems (RAS-Phase I and II)	- COSALC-I-coastal and beach stability	- COMARAF-Preparatory phase	- coastal lagoon
- coral reefs	- COSALC-II-coastal lagoons	- Coastal lagoon	
- Pacific coastal marine productivity (PACICOMP)	- COSALC-III-Caribbean coastal marine produtivity (CARICOMP)	- African Coastal Marine Productivity (AFRICOMP)	
	- COSALC-VII-Temperate coastal and estuarine environments	- Coastal erosion	
	- costal geology		

Europe

- lagoon of Venice

- In 1979, in Africa, with the workshop on coastal ecosystems of West Africa: coastal lagoons, estuaries and mangroves, held in June 1979 in BREDA, Dakar

- in 1978, in Latin America and the Caribbean, with the workshop on benthic ecology and sedimentation of the South Atlantic Continental platform, in May 1978, in Montevideo.

Table I gives a listing of the main COMAR pilot projects and activities in the various regions of the world.

3.2. Dr. Suzyumov described the COMARAF project. He mentioned that the project intends to promote the development of a comprehensive framework for a better and more appropriate understanding of coastal systems in view of their rational management for the coastal states of Africa. The project should also contribute to the establishment of a scientific basis for understanding the characteristics and functioning of the coastal systems with a view to integrated management of the coastal zone, and to reinforcing the capacity of countries in terms of utilization, management and protection of their marine/coastal zone through appropriate training and the dissemination of information on research activities.

Development objectives of the project are:

- developping an understanding of the nature and funcitoning of the coastal system

- establishing an active regional network of institutions and scientific groups within region, for which the present project will create the appropriate base.

Among immediate objectives of the project, the following was mentionned:

- formulation and consolitation of a programme for research and training on the multi-disciplinary aspects of coastal marine systems,

- promotion for the establishing of regional co-operation as a bsic mechanism for the implementation of the programme,

- implementation of pilot research and training projects,

- provision of synthesis concerning the status of scientific knowledge and guidelines for the management of the coastal systems including their resources and their utilisation by man.

To prepare the region for the COMARAF project, several seminars, workshops and meetings have been held in Africa under Unesco-COMAR project programme. Some of these meetings are:

- Workshop on the coastal ecosystems of West Africa (Dakar, Senegal, 1979).
- Regional training workshop on methodology of estuaries and mangrove research (Dakar, Senegal, 1983).
- Field research methodology workshop on coastal lagoons (Abidjan, Côte d'Ivoire, 1985).
- Training course on remote sensing techniques in oceanography (Reunion and Mauritius, 1985°.
- Workshop on comparison of characteristics and functioning of lakes and coastal marine systems (Nairobi, Kenya, 1985).
- Regional semi ar on traditionsl knowledge and management of coastal marine systems in Africa (Cotonou, Benin, 1985).

Unesco has also supported research teams in Africa, as well as individual scientists with research grants, literature, equipment to enable them to undertake research work on estuaries, lagoons, mangroves, problems of coastal dynamics.

A multidisciplinary approach is the "core" of the COMARAF project. This requires the collaboration of scientists from the widest backgrounds - physicists, geologists, chemists, biologists, mathematicians, meteorologists, etc., and also a close co-operation between managers and scientists including engineers and socio-economists.

Some general trends in research of this kind can be exemplified as follows:

a) To develop our ecological research programme and apply the techniques of ecological systems analysis and numerical modelling to coastal systems.

b) To emphasize the interaction of hydrological, geomorphological and geological features of coastal ecosystems and their influence on the ecological systems that have emerged.

c) To study interactions, exchanges of material and energy and their retations with the marine and terrestrial ecosystems.

d) To analyse historical changes in the systems: variations in human land use in coastal ecosystems and the drainage basin.

e) To develop methods for carrying out experimental ecosystem research in replicate sections of the various coastal systems.

f) To develop research programmes within the context of the above and with due consideration of the socio-cultural and economic environment, including possible conflicting schemes of traditional versus modern practices and utilization of resources.

g) To promote co-operative research activities and develop pilot research programmes through provision of research grants.

Strategy of implementation of the project was proposed as follows:

- COMARAF project will be implemented under the general umbrella of the Unesco-COMAR project.

- Training and research activities in fields relevant to marine coastal system studies at regional level, and interregional co-operation, will be supported and encouraged.

As far as training activities, mentioned in the project document, are concerned, the following, as possibilities for this meeting to chose, were mentioned:

- creation of EPEEC*-type teams and donation of research grants to these teams working in accordance with selected pilot projects.

- exchange of scientists between these teams, or between research centres, to ensure regional character of the project.

- exchange of scientific information at a regional level.

- technical aid (equipment, literature) to promote regional pilot projects.

- access to Data Banks, or date sources, should be assured.

- consultancy missions, exchange of consultants between co-operating teams to improve certain activity, as well as interregionally (at international level) should be considered.

Creation of a Regional Task Force (RTF) has been proposed to operate the project. Regular meetings of RTF to discuss operational matters will be needed. Regional meetings of co-operating teams within certain project, and between projects, may be considered as well.

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* EPEEC: Equipe pluridisciplinaire d'étude des écosystèmes côtiers - Interdisciplinary research team to study coastal ecosystems.

Necessity to ensure interregional co-operation (between South American, African, Asian components of the COMAR project) may be taken into consideration.

Summing up, multidisciplinary character, and simultaneously regional character of the COMARAF project should be assured when discussing lines of its implementation.

It was reminded that Abidjan - 1985 (ad hoc) meeting recommended to take into consideration several possible pilot projects on:

- mangroves and estuaries
- coastal lagoons studies
- coastal systems interaction and productivity
- coastal dynamics and shelf geology

More details may be found in the report of the meeting (Unesco Reports in Marine Sciences, No. 36, 1986) as well as in the COMARAF Prodoc, both being distributed to participants.

3.3. The floor then was given to the following lecturers:

- Prof. H. Postma (Lecture 1 - Dynamic equilibrium in coastal systems)
- Prof. J.T. Baker (Lecture 2 - Challenge for coastal zone management and Lecture 3 - Studies on pollution relative to the Grate Barrier Reef, Australia)
- Dr. E.S. Diop (Lecture 4 - Summary of the activities of the EPEEC of Senegal)
- Dr. J-P Barusseau (Lecture 5 - Factors of coastal changes in Africa)
- Dr. Ch. Birkland (Lecture 6 - Nutrient availability as a major determinant of differences among coastal hard-substratum communities in different regions of the tropics)
- Dr. S.G. Zabi (Lecture 7 - Review of research programmes of lagoons in Côte d'Ivoire)
- Prof. Ph. Polk (Lecture 8 - Kenya/Belgium project, example of bilateral collaboration)

Agenda Item 4.

Two working groups submitted their respective reports and recommendations.

The reports of these two groups have been discussed, and it was proposed to include them with the report of the meeting as reference material.

REPORT OF THE WORKING GROUP ON PRODUCTIVITY (Group 1)

1. Introduction

Discussions in plenary session resulted in a refocussing of the terms of reference of the 5 pilot projects for the implementation of the COMAR Project in Africa.

This re-orientation of activities was necessary in order to meet the concern of establishing more solid scientific bases, which are indispensable for better definition of the role of coastal ecosystems in the process of development of African coastal States. In particular, the choice of the PRODUCTIVITY theme is motivated by this fundamental concern.

2. Objectives

The main coastal ecosystems covered by the productivity study are as follows:

- estuaries and mangroves,
- coastal lagoons,
- the inner continental shelf,
- coral reefs.

Thus the multidisciplinary and integrated research programme on productivity should be aimed at:

a) better understanding of the mechanisms at work in coastal ecosystems;

b) conservation and protection of these ecosystems against all forms of pollution and other harmful effects;

c) elaboration of development strategies for a more rational management of coastal ecosystem resources.

3. Terms of reference of the productivity study

The entire coastal zone of Western, Central and Eastern Africa, dominated by all these estuarine, mangrove, lagoon, coral reef and inner continental shelf ecosystems, enjoys a substantial influx of organic matter, as well as telluric material which enriches these various biotopes.

Therefore it seems necessary and indispensable to define metodological approaches to studying productivity, to show its importance in coastal ecosytems, whose enhancement is one of the ultimate objectives.

4. Strategy for studying productivity of coastal ecosystems

In order to be efficient, productivity studies must make it possible to understand the spatial and temporal variability of the physico-chemical and biological parameters that are relevant for measuring productivity.

The following study plan, designed with this consideration in mind, is applicable for gaining knowledge about the productivity of each of the coastal ecosystems in question:

4.1 Study of the hydrosphere and climate

This has to do with the physical environment of the coastal ecosystem, which must always be well known before the biotope's various biological phenomena can be understood.

4.2 The cycle of nutrient salts

Evaluation of nutrient salts sets out the basic conditions underlying the food chain.

4.3 Biological productivity

This covers the following aspects:

- planktonic production,
- benthonic production,
- energy tranfers among the different links of the food chain.

4.4 Study of interfaces

The contact ecosystems which represent sensitive points of exchange are the following:

Continent-estuaries-inner continental shelf-mangrove-lagoon,

Continent-lagoon-inner continental shelf,

Continent-reefs,

Continent-water-sediments.

5. Modelling coastal ecosystems

Building models applicable to coastal ecosystems is laborious and trickly. Therefore it is crucial that particular stress be laid on the variability, with respect both to space and time, of parameters to be used in modelling.

RECOMMENDATIONS (Group 1)

Group 1,

- Taking into consideration the document of the Regional Project for Training and Research on Coastal Systems (COMARAF), as it was drawn up on the strength of the recommendations of the Field Workshop on Coastal Lagoons, held in Abidjan from 6 to 10 May 1985.

- On the basis of presentations by each of the participating countries, with a view to establishing a modelling theory that would allow for introduction of a development strategy, in order rationally to harvest the biological, mineral, mining and petroleum resources of the continental shelf;

Recommends that:

1. The COMARAF Project concentrate its activities, on a priority basis, on the two selected major themes, namely productivity and geology, through the following six pilot projects:

   a) mangroves and estuaries,

   b) coastal lagoons,

   c) coral reefs,

   d) continental shelf,

   e) hydrodynamics and sediments,

   f) desertification.

2. The project's research activities be aimed at meeting the objectives of development and enhancement of coastal resources, protection and conservation of coastal marine systems, and technical and scientific training;

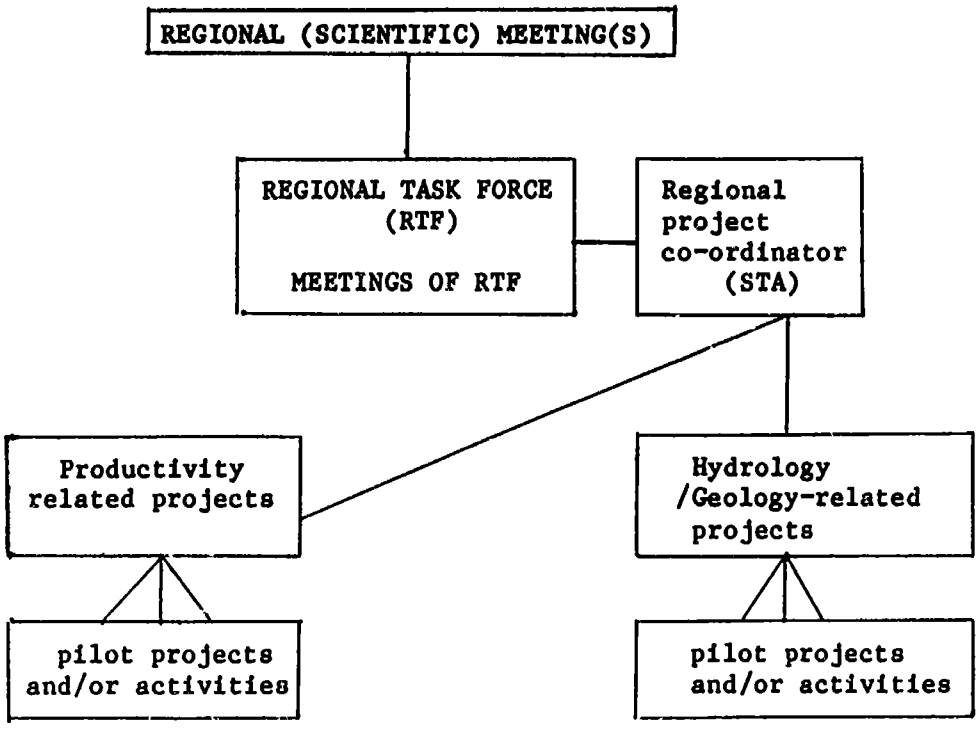
3. Specialized training of researchers in the specific fields be provided, in accordance with the region's needs. Such training should be delivered through courses accompained by field trips, through short- and medium-term study fellowhips, etc.;

4. Training be provided for technicians specialized in the maintenance and operation of research equipment;

5. In the initial phase, regional training workshop be organized in the field of the following subjects:

   a) the Productivity of coastal systems and of their adjacent continental shelves, taking into consideration the proposal made by Cameroon to organize this workshop in 1987, in Yaoundé for theoretical teaching part, and in the estuary of the Wouri in Douala for the practical work part,

Structure of the Regional COMARAF Project



b) the taxonomy of reefs species, on the island of Mauritius or in Madagascar,

c) the methodology of studying Productivity of reef systems, on the island of Mauritius or in Madagascar,

d) the taxonomy of plankton in estuarine and lagoon environments,

e) the role of mangrove, estuarine and lagoon ecosystems in secondary and tertiary production, in Tanzania (taking advantage of experience racquired in Asia and Latin America),

f) the study of the benthos and the water-sediment interface, in Kenya;

6. A documentation network be established, taking existing infrastructures into consideration (data banks, documentation centres, etc.);

7. The equipment needed for implementation of the COMARAF Project's regional activities be provided, as an addition to the equipment already available in participating countries;

8. Each participating country set up a focal point, to act as link among the specialized institutions of the country in question, for their participation in the COMARAF Project;

9. A Regional Co-ordination Committee be constituted, with representatives of each of the focal points of participating countries as members;

10. A post of Regional Co-ordinator be established, to ensure successful implementation of the COMARAF Project.

REPORT OF THE WORKING GROUP ON HYDRODYNAMIC SYNTHESIS AND COASTAL GEOLOGY (Group 2)

The group recognized that its scope of activities should encompass characteristics of the physical environment both on continental shelves, and in coastal or marginal-littoral areas (estuaries, lagoons, reefs, etc.).

To begin with, the group defined priorities on the basis of the current state of progress of work in the different countries. From this point of view, the first theme, namely the geology and hydrodynamics as related to coastal ecosystems, would seem to be the first priority, with the theme of the influence of desertification on the coastal zone coming in second.

First priority: Geology and hydrodynamics of coastal ecosystems

The following table summarizes the situation prevailing in the different countries with respect to this theme:

	Programme	Team	Means
Senegal	yes	yes	yes (CRODT) but requiring extension
Guinea	yes	yes	yes (Ukrainian Acad. of Sciences)
Sierra Leone	no	no	no
Liberia	yes		
Côte d'Ivoire	yes	yes	yes
Ghana	yes	yes (+BRGM)	trawler but requiring extension
Togo	yes	yes	yes but requiring extension
Benin	yes	yes (+ORSTOM)	yes
Nigeria	yes	yes	yes but requiring extension
Cameroon	no	no	
Madagascar	no	no	

In terms of studying the physical environment, the main objectives are as follows:

- Topography/Bathymetry,
- Geology/Sedimentology

- Sea-Level variation,
- Cartography with remote sensing,
- Hydrology/hydrodynamics
  (study of sediment flows, turbidity, sedimentation rates).

Second priority: influence of desertification on the coastal zone

Desertificiation as such is not an object of study of the COMARAF Programme, but COMARAF must take certain aspects of this problem into consideration, in particular the implications for coastal areas: quantitative determination of dust settling, the water balance of water tables and river systems, the impact of human activities and the changes they result in.

Finally, the group defined its needs, which are of three types:

- research,
- training,
- co-operation.

1. Research needs

To meet these needs requires extending or reinforcing existing infrastructures, which is the subject of a budget sheet annexte to the present report.

2. Training needs

The group recognized the need for more or less continuous training courses both on subject material and on methodology, and in particular on shelf geology, on hydrodynamics and on state-of-the-art techniques, such as remote sensing.

Such training should be planned on a regional scale, and it should be accompanied by the granting of study fellowships.

3. Co-operation needs

This would seem to be necessary at several levels.

First of all, at the international level, where several study and research programmes, in particular on the phenomena of coastal erosion and desertification, are already in existence. In this respect, provision should be made for on-going exchange with bodies such as the IGCP-200 (see-level variation), the SCOR, the IOC (establishment of a network of tide recorders), the WCP, and the MAB programme. Moreover, provision must be made for systematic participation in foreign expeditions off the coasts of our countries.

Then on a regional scale, where there are different degrees of progress made in the study of coastal and desertification phenomena. It would be desirable to provide for exchanges of documentation, of research means and of scientists whithin certain regional zones.

Finally, at the national level, because it would be fruitful to establish relations with governmental and non-governmental bodies working in the areas of interest of defined above.

RECOMMENDATIONS (Goup 2)

Working goup No. 2, after having examined the priorities and defined the activities of the regional programme, as they pertain to the physical environment, and to coastal geology and hydrodynamics, noting the genuine interest of participants in this project,

Recommends

1. to UNESCO

   - that the holding of a regional training workshop on marine geology, planned for March 1987 in Conakry (Guinea), be considered a preparatory phase to the launching of the COMARAF Project,

   - that a second training course on marine geology and coastal hydrodynamics, including modelling and advanced techniques, be planned and organized for the benefit of all participating countries,

   - the constitution of a permanent committee entrusted with monitoring the implementation of the project (see the project's enclosed organizational structure),

   - the establishment of a mechanism for exchanging information and experiences within COMARAF itself, and among the different regional COMAR projects, and whose modalities will be specified by the permanent committee for co-ordination and monitoring,

   - for the execution of the COMARAF programme, the creation of a post of project co-ordinator, who would work closely with the monitoring committee, and whose expense would be born by UNDP,

   - that particular attention be paid to the acquisition and installation of the scientific equipment needed for successful execution of the regional programme,

2. to Governements of the countries concerned

   - that they notify UNDP of their agreement as to the programme's funding and implementation,

   - that they take the necessary measures and extend all assistance needed for successful execution of the planned activities,

3. Requests the technical and logistical support, as well as the active participation of countries and research institutes having appropriate means of investigation at their disposal.

Recommendations of the meeting were then discussed and adopted (Annex II).

Agenda item 5. The meeting was closed by a representative of the Ministry for the Protection of Nature (Senegal).

GENERAL RECOMMENDATIONS

of the COMARAF meeting

(Dakar, 18-23 December 1986)

The participants in the "Regional project for Africa for research and training on coastal ecosystems" meeting, a COMAR project for Africa (COMARAF), held in Dakar, Senegal, from 18 to 23 December 1986,

- considering the social and economic importance of coastal ecosystems for the development of African countries;

- noting the baneful influence of pollution and mismanagement on the productivity of these ecosystems;

- underlining the necessity of understanding the functioning of these ecosystems, in order to harvest them rationally and to conserve their resources;

Recommend

1. concentration of COMARAF Project activities, on a priority basis, around the two main themes of Productivity, and Hydrodynamics and Coastal Geology, with the following 6 pilot projects:

   - mangroves and estuaries,
   - coastal lagoons,
   - coral reefs,
   - continental shelf, sand and rocky shorelines,
   - hydrodynamics and geology,
   - influence of desertification on coastal ecosystems (second priority),

2. that the project's research activities be aimed at meeting the objectives of development and enhancement of coastal resources, and of protection and conservation of coastal marine systems;

3. specialized training for researchers and technicians, as a function of the region's needs, provided through study trips, and short-and medium-term study fellowships;

4. that the holding of a regional training workshop on marine geology, planned for March 1987 in Conakry (Guinea), be considered a preparatory phase to the first COMARAF training course on marine geology and coastal hydrodynamics, including modellling and advanced techniques (remote sensing);

5. that during the preparatory phase, 2 regional workshops be held, devoted, on the one hand, to the methodology of studying the productivity of mangroves, estuaries, lagoons and the continental shelf, and on the other hand, to the taxonomy of reefs fauna, and to the methodology of studying the production of reef systems;

6. that the equipment needed for the implementation of regional activities of the COMARAF Project be provided, to complement the equipment already installed in participating countries;

7. the establishment of a mechanism for exchanging information and experiences within the region, and among the different regional components of COMAR: Asia and the Pacific, Latin America and the Caribbean, Europe and the Arab Countries;

8. the constitution of a restricted regional committee entrusted with monitoring the COMARAF Project;

9. the creation of a post of regional co-ordinator for this project;

Express the hope that Unesco will continue to develop appropriate contacts with non-governmental scientific organizations such as SCOR and IABO, especially within the framework of the Unesco/SCOR/IABO Consultative Panel on Coastal Systems;

Calls on the Governements concerned

- to notify UNDP of their desire to see the COMARAF Project implemented.

- to facilitate and create favourable conditions, at the national level, for execution of COMARAF Project activities.

Lectures

Lecture 1

DYNAMIC EQUILIBRIUM IN COASTAL SYSTEMS

H. POSTMA

There is such a large variety in coastal systems that one may well ask whether there is any sense in looking for common characteristics. However, starting from the fact that together they form the relatively narrow separation between land and sea, at least a number of common questions can be asked. These refer to their stability, their mutual dependence and exchange with land and sea, and their biological productivity.

Stability is closely related with climatic change, since this influences sea level, river run-off, evaporation and storm frequencies. Of these, especially sea level is relevant. The fact rise in the last 20,000 years over about 140 m. has moved the shorelines over an average of a 100 miles inward, not continuosly but episodically, so that several times coastal environments had to be rebuilt. Relative stability in sea level has only been attained the last few thousand years.

New coastal environments rapidly reassemble the biotic and abiotic components they need. This is facilitated by their position as transit areas of water, nutrients and, particular inorganic and organic matter. Water transport through coastal systems, measured as residence times, is on an average very fast, but on the shelf long-shore transport predominates. This is an important means to exchange materials between adjacent coastal systems often over very large distances. Concerning particular materials, special estuarine and tidal circulation patterns tend to prevent losses of such material to the open sea. A large percentage of suspended matter brought down by rivers settles in the coastal zone.

Vegetations support these accumulation processes; combined, there is a firm basis for assuming that coastal systems, by collecting the necessary elements, are richer and have a higher productivity than offshore marine environments and, frequently, the adjacent land. However, there are also conditions which exert a negative influence on biological productivity. A high turbidity of the water often suppreses primary production by algae. Denitrification may decrease the availability of nitrogen. Fast changes in salinity hamper phytoplankton growth. Imported organic matter often is low quality food, etc.

As a result, the undeniably large abundance of coastal systems for secondary producers, including commercial fish and shellfish, is probably in the first place caused by the fact that they provide shelter and that they are shallow.

Export of excess organic matter and nutrients offshore may increase productivity just outside coastal systems. This happens, for example, in front of a turbid estuary or lagoons. It should be stressed, however, that this is often a closed system, the new materials produced being returned to the shore. Widespread "outwelling" is by no means proven. More research on mutual dependence of coastal and offshore systems is especially needed in tropical regions.

CHALLENGE FOR COASTAL ZONE MANAGEMENT

J.T. BAKER

Introduction

In Australia and in the countries with which Australia has increasing interaction in the Pacific and Indian Oceans as well as Papua New Guinea and the South-east Asian countries, there is increasing emphasis on the importance of the coastal zone in most aspects of development.

When analysing the relationship of management to strategic planning on this topic, it is first necessary to understand what we are trying to manage and then to look at the strategic planning required to lead to efficient management. This should not be attempted in the isolation of one district of Australia, nor in Australia by itself, but throughout that community of countries with which Australia has a very direct relationship.

The question of a coastal zone is something which attracts different definitions. One may first look at the simplest possible statement which is the lineal length of a country's coastline; realizing inadequacy in this simplicity, one may then look inward and outward from the land/sea interface and come up with different definitions. In the publication of the Department of Arts, Heritage and Environment "State of the Environment in Australia 1985". It was noted that "the coast line of Australia extends for 32,000 kilometres, or 50,000 kilometres if island coasts, estuary shorelines and inshore waters are included". The coastal zone itself in that publication was seen as best defined as "those lands within 3 kilometres inland of the shoreline, including the area extending seawards to the mid-tide level". "This is the area where land use is most directly affected by proximity to the sea". Within this definition the waters included in the coastal zone comprise "a complex range of environments such as wetlands, estuaries, bays and different types of marine areas".

By contrast the Northern Rivers College of Advanced Education in developing its course on Coastal Zone Management took note of the House of Representative Standing Committee on Environment Conservation publication "Management of the Australian Coastal Zone" 1980 and adopted the definition of the Coastal Zone as "the land/sea interface extending from the upper limits of catchment areas of coastal

rivers to the seaward limits of terrestrial influences". This is of course an extremely extensive definition but probably a very safe one to take by a tertiary institution introducing a program of study which appeared at the time to be not available in any other institution in Australia, as an integrated 3-year diploma or degree program.

Certainly it would be consistent with the proposed National Conservation Strategy for Australia to look at the Coastal Zone area requiring management as that which includes the catchment areas for the major rivers which flow into Australia's oceans and also to include the marine environment to the extent that terrestrial impact can be determined.

Given general acceptance that the coastal zone must include extensive areas of land and sea, one has next to ask the fundamental question on management - "for what purpose?"

Management-for What Purpose?

Traditionally the marine portion of the coastal zone has been open to much more exploitation of species than one would expect in the land area. For example, one would seldom ever consider going to an area of land and taking the koala bears or the wallabies for a luncheon feast, yet in the rivers and in the ocean there are many examples where people may take different crustacea, different molluscs, and different fish all of which are native to the area but for some reason are seen to be open for human exploitation. In the past, the marine environment in particular has been seen as representing a place comparatively free of regulations protecting the environment or the species.

One of the challenges of developing a soundly based management regime for the coastal zone is to give the "native" organisms which live in the marine environment a comparable level of protection to that available to their terrestrial counterparts.

Coastal areas are those of maximum human population density for the majority of countries in our region. In Australia for example, it is estimated that more than 80 percent of our population lives within a band which extends not more than 50 kilometres from the shoreline. With the exception of the national capital, all capital cities of Australia and the vast majority of major towns are in this coastal fringe.

In 1985 it was estimated that only six urban areas in Australia with populations in excess of 30,000 people, were not situated in the coastal zone.

By contrast there are also vast lengths of the Australian coast line which are almost completely unpopulated and it is important to also plan, at the present time, for likely industries or likely developments of centres of human settlement which may take place in future years. Such forward planning may well avert problems characterising coastal settlements where development has taken place too close to the water's edge or without consideration of flood heights and water movements in general.

Australia is a vast continent which many different types of coastal characteristics. Our sparsely populated continent must be viewed with some envy by many of our neighbours. Table I shows the coastal characteristics of Commonwealth nations and associated terrorities in the Asia-Pacific region. Australia, because of its size and diversity, has a variety of coastal features which may be studied, and the results of those studies could well assist other countries in the region. Within this region, in which we must be generally concerned, it is interesting to note the comparison of coastal length with area of the different countries and the population that is accommodated in those different countries, this is summarised in Table 2.

The principal reason for an emphasis on management of the coastal zone directly relates to the popularity of this region for industrial and urban development and the consequent high population density of the area. The emphasis can be strongly justified on the basis that the utilization of coastal resources has never been carefully managed on an integrated basis taking into account the terrestrial, fresh water and marine resources nor taking into account the specific interactions which occur between the aquatic and terrestrial areas. The number of exploitable resources represented in the coastal zone will never be constant over time. Terrestrial crops will change with market pressures and international competition. Mineral resources may come under different demands depending on changing technologies and on developments of different materials. Planning for the Coastal Zone should take special note of the need to protect the land/water interface from excessive human modification, not only to preserve the water courses and their quality, but also to conserve the land, minimizing erosion and soil loss, and accomplishing the bonus of keeping the waterways free of excess siltation and of pollutants. We already have examples of mining, of beach modification, of modification due to general anthropogenic activities which are not to our credit as a thinking nation. In these cases we must apply corrective measures.

However there are many resources which in other countries are utilized but in Australia effectively go unexploited. For these we have the opportunity to develop

good management practices from the outset. In this latter category one could possibly include the mangrove forests, but we should take note that scientists now are beginning to understand and communicate the true ecological role and the importance of maintaining significant stands of mangrove forests throughout Australia. The future could well see genetic selection of specific mangrove types for timber products.

The challenge of developing good management practices is to recognize the changing demands of society, the differing social characteristics of different ethnic groups and our long-term dependence on practices that will ensure minimum modification of the environment.

Effectively we have the guidelines for such a management regime in the proposed National Conservation Strategy for Australia. Its interpretation and translation for the Coastal Zone is of a high priority.

No general management policy could be adopted which would satisfy the need of all states and of all countries. In different parts of Australia, we are at very different stages of development. Regionally it is even more complex. Whereas some countries can afford to introduce legislation which carefully controls all types of exploitation of the coastal zone others may be at the stage of development where they would prefer to have comparatively unconstrained development and utilization of their marine resources.

One objective of the current paper would be to show the urgency of taking into account not only the short term obvious needs whether it be a newly opened area of Australia or one of the developing countries - but also to consider the longer terms consequences of poor management practices at a time of rapid economic growth.

The Commonwealth Science Council, London has been very concerned about the inadequacies of integrated management plans for coastal zones and has introduced a group chaired by Professor José Furtado to analyze the needs of different countries in the Pacific and Indian Ocean regions as well as in South-east Asia and Papua New Guinea with respect to their coastal zones.

The strategies to follow

The problems facing decision makers on the development of soundly based management practices for the coastal zone are very little different from those faced by the drafters of the United Nations Conference on the Law of the Sea. A fundamental hurdle to overcome is the traditional freedom that one has associated

with the sea. For many centuries the seas have been recognised as the open passage for people of all races and it is only comparatively recently that countries have tried to exercise their authority on the aquatic areas around the different countries. One of the basic and important aspects of a long-term successful strategy is education at all levels of society. It is necessary to be able to influence the general public to show the consequences of over-exploitation of areas, particularly where there has been a recent significant increase in population and/or of changes in ethnic groupings. Many recent Australian immigrants come from countries where the rich resources characteristic of the marine component of the Australian coast had long been denuded by excessive human action.

It is imperative that Australian authorities move to impose legislation to protect the marine environment from too heavy human exploitation. This will be necessary at all levels of government - the federal, the state and local. The concept of a strategy which must turn over practices established over many generations is indeed challenging and one may be classed as optimistic to expect immediate returns in all areas. But one must develop and implement the strategies immediately. The smallest local success may well stimulate wider acceptance and implementation.

Relevant components in formal education from the very first days of primary school are essential to ensure that future generations will better understand the relationships between different land and water forms in the coastal zone and understand the need to protect our waterways, our beaches and our oceans in a way that no previous generation has seen the need to do.

There must be a strategy developed which takes into account not only the recreational use but also the industrial use that can be made of the coastal zone, within each type of practice ensuring that adequate areas are laid aside for conservation and maintenance of the ecosystem.

There is no need to bring in any new strategy above that which is already potentially in place. I refer to the National Conservation Strategy for Australia which is yet to be implemented by the Federal Government and by all states, but which by its own construction and with a justifiable emphasis on certain features of the coastal zone, could be a perfectly satisfactory planning document to allow management plans to emerge.

It is essential that such a strategy be studied and adopted as the viable base on which to establish good management practices.

Examples of soundly based management principles for coastal zones in Australia can be shown in two different parts. The proposed Ningaloo Marine Park in Western Australia has both a terrestrial and a marine component. The relevant recommendations on marine management and terrestrial management are worth noting.

That document is comparatively simple when compared with the documentation and arrangements which are necessary for the sound management of the Great Barrier Reef Marine Park. In the Great Barrier Reef region the Great Barrier Reef Marine Park Act applies to those areas from low water mark to the open ocean, but does not apply to Queensland Islands or to the mainland.

For the vast majority of the Great Barrier Reef Region it is necessary to evoke at least two Queensland Acts to ensure that the immediate marine coastal zone is adequately protected. These are the Queensland Marine Park Act and the Queensland National Parks and Wildlife Service Act. The Queensland Marine Parks Act covers those areas from low water to high water and the Queensland National Parks and Wildlife Service Act allows protection in the Queensland's national parks for the area above high water. In addition to the Commonwealth and State Acts mentioned, it is also necessary to take into account several other Queensland and Commonwealth Government Acts which regulate certain types of practices in the marine environment and a number of Queensland Acts which apply to the terrestrial space represented in the coastal zone.

The successful management has depended on immense personal commitment by the Chairman and his staff of the Great Barrier Reef Marine Park Authority and has been accomplished on the basis of a careful analysis of the responsibilities of different agencies, the establishment of a policy of compatible zoning between land and sea wherever practicable, and the discharge of day-to-day management of the marine park by a single agency. The GBRMPA concept of Zoning for different levels and type of use and access is worth careful consideration in any Coastal Zone Management Plan to be established.

Implementation of Strategies and Management Practices

It is impractical and impraticable in the current economic climate to set up new organizations and new structures to manage our coastal zone. We must find ways to build on the existing organisations to provide the necessary human resources to ensure a proper management practice. Inevitably this will involve a close collaboration between a number of different agencies and one can forecast that there will have to

be very careful strategic planning to ensure that all different agencies are involved in a way which satisfies their individual demands and maintains their security within a government system, currently seeking to reduce government spending.

The concepts of management and strategy are therefore integrated continuously throughout the planning for the wise use of coastal zones. The ultimate management plan requires not only a careful consideration of the strategies to overcome past practices but also to ensure that the plan developed for future management is in a form which makes the maximum use of existing organisations and allows for the freedom of thought and planning which will ensure that new practices which will develop in our coastal zone can be properly implemented without adversely affecting the productivity and stability of the coastal zone, that is within a National Conservation Strategy for the Coastal Zone.

Table 1: Coastal Characteristics of Commonwealth Nations and Associated Territories in the Asia-Pacific Region

Nation/Territory	Coastal characteristic
Australia	Hilly, cliffs, widely varied; tropical to temperate; broad shelf
Bangladesh	Deltaic
Brunei	Swampy plains, mangrove
Fiji	Volcanic origin
India	Varied
Kiribati	Coral atolls; on submerged volcanic chain
Malaysia	Complex
Maldives	Coral
Nauru	Coral atoll
New Zealand	Complex; mountainous, partly glaciated
Papua New Guniea	Swamps in S., mountainous in N.
Singapore	Low-lying swamps, mangroves
Solomon Islands	Volcanic
Sir Lanka	Terraced sea coast
Tonga	Coral islands in E., volcanic in W.
Tuvalu	Coral atolls
Vanuatu	Narrow coastal strip
Western Samoa	Coral Reefs
Christmas Islands	Steep slopes and terraces
Cocos Islands	Coral atolls, lagoons
Cook Islands	Atolls in N., volcanic
Hong Kong	Steep slopes
Niue	Coral
Norfolk Island	Cliffs and steep slopes
Pitcairn Islands	Rugged
Tokelau	Coral atolls, lagoons

Source: N.C. Fleming, Institute of Oceanographic Sciences, Wormley, Surrey, United Kingdom

Table 2: Coastal Parameters and Ratios for Commonwealth Members

Name	Land Area (Km^2 = A)	Coast Length (Km = L)	Population (P)	$\frac{P}{A}$	$\frac{P}{L}$
Australia	7,686,848	25,760	14,500,000	1.9	562.88
Bangladesh	143,998	580	88,513,000	629.8	152,608.62
Fiji	18,272	1,129	630,000	32.8	558.01
India	3,287,782	7,003	685,184,692	209.9	97,841.59
Malaysia	329,749	4,675	13,900,000	43.0	2,973.26
Maldives	298	644	154,000	666.6	239.13
Nauru	21	24	7,254	380.9	302.25
New Zealand	268,676	15,134	3,300,000	12.2	218.05
Papua New Guinea	461,691	5,152	3,007,000	6.7	583.65
Singapore	581	193	2,400,000	4,130.8	12,430.00
Solomon Islands	28,446	5,313	229,000	7.0	43.10
Sri Lanka	65,610	1,340	14,815,000	228.6	11,055.97
Tonga	699	419	97,000	1.3	231.50
Tuvalu	28	24	8,000	285.7	333.33
Vanuatu	14,763	x	117,000	6.7	-
Western Samoa	2,842	403	157,000	70.3	309.00
*Brunei	5,765	161	220,000	38.16	1,366.45
Christmas Islands	135	-	3,184	23.58	-
Cocos Islands	14	-	487	34.78	-
Cook Islands	234	120	18,200	77.77	151.66
Hong Kong	1,060.18	733	5,147,000	4,854.83	7,021.82

* Now a Commonwealth nation

Source: N.C. Fleming, Institute of Oceanographic Sciences, Wormley, Surrey, United Kingdom.

STUDIES ON POLLUTION RELATIVE TO THE GREAT BARRIER REEF, AUSTRALIA

Dr. J.T. BAKER

ABSTRACT

The majority of studies on pollution of the marine environment have been in temperate waters and methods currently in practice for evaluation of levels of pollution using marine "monitors" have also involved temperate water species as the principal organisms. The emphasis on development in the next 20 to 30 years will move progressively to the Pacific region where many of the countries are in tropical environments and many have relatively entrapped waters such as coral reef lagoons. The impact of pollutants discharged into the water may therefore be more directly obvious than they are in open seas, and also may have more direct effects on regions which are important either for local industries or for the increasing tourism in this region. In near-shore areas mangroves are important resources in local industries for many of the developing countries and the coral reefs and associated waters off-shore represent the most important tourist resource.

Lecture N° 4

Summary of the activities of Senegal's "Equipe Pluridisciplinaire d'Etude des Ecosystèmes Côtiers" (EPEEC) ("Multidisciplinary Team for Coastal Ecosystem Studies")

by E.S. Diop*

The estuaries and mangroves of Senegal have attracted the attention of naturalists in particular and researchers in general for some time. The management programme of the Senegal valley, and in particular of the Knew river delta, was executed back in the fifties (J. Tricart, from 1954 to 1956). Later on, and especially during the sixties, Quaternarists, geologists, geomorphologists, pedologists and others succeeded one another, all stressing the boundary and chronology problems associated with studying coastal formations.

However, multidisciplinary research activities have manifested themselves only very recently, with the formation in various African countries of multidisciplinary teams; as one of these, EPEEC contributes to research and training activities on West African coastal systems within the framework of the COMAR (1) and MAB (2) programmes. The Senegalese team is composed of scientists actively interested in marine coastal systems, such as geomorphologists, geologists, botanists, physical oceanographers, chemists, biologists, socio-economists, etc., who work not only at the University, but come from other research centres as well. The team has concentrated its activities on research (in the broad sense - including training activities, integrated and rational coastal management, etc.) in the mangrove and estuarine areas.

Prior to the formal establishment of EPEEC-Senegal, some of its present members participated in a first workshop held in Dakar in June of 1979 (see N° 17 of the Unesco Marine Science Reports), which was devoted to West African coastal ecosystems: lagoons, estuaries and mangroves. This inaugurated COMAR activities in Africa. Other seminars and field workshops have followed, both at the national level, on the initiative of EPEEC-Senegal, and at the regional level.

Senegal's EPEEC was formed in 1981. Since that time it has promoted a series of training and research programmes on the estuaries and mangroves of Senegal. A number of scientific results have been obtained and published, with the support of Unesco's Division of Marine Sciences, on the following subjects:

1982 : mangrove of the Saloum estuary.

1983 : Diomboss and Bandiala rivers (Saloum area).

1984 : estuaries of Senegal.

1985 : "La mangrove à usages multiples de l'estuaire du Saloum (Sénégal)" ("Multiple uses of the mangrove of Saloum estuary (Senegal)"), edited by A. Doyen and C. Agbogba of the Forestry ecology team of EPEEC, with additional support from Unesco--MAB-Dakar.

1985 : "Evidence of Dynamics reversal in tropical estuaries, geomorphological and sedimentological consequences (Saloum and Casamance Rivers, Senegal)". J.P. Barusseau, E.H.S. Diop, J.L. Saos: Sedimentology 32: 543-552.

- Monitoring and modelling of a selected number of sites where research stations will be established, with the participation of specialists from various disciplines. This should allow for more detailed study of the phenomena, better correlations, and the development of an automatic data processing system. Such a programme is based on the possibility of undertaking long series of measurements and observations.

- "Farm" type experimentation, with a view to developing aquaculture, in the small-sized and semi-open lagoon area of the Somone. This Senegalese "Programme d'ostréiculture" ("Oyster-Farming Programme") has already been the subject of a detailed prospective study by some of our researchers: a biologist, a physical oceanographer and a socio-economic geographer. The project is already established and funding for it is presently being sought.

- Two other programmes must be taken into consideration:

  (1) Extension of forestry research, with the participation of EPEEC's forestry ecology team, which has organized a training seminar in conjunction with the present meeting in Dakar. The working document was the 1985 report: "La mangrove à usages multiples de l'estuaire du Saloum (Sénégal)".

  (2) A southwards extension of research programmes being conducted by EPEEC, with the co-operation of CRODT, for the study of the Casamance River. Some results are already available and were discussed during a seminar organized by CRODT, in which EPEEC members participated actively. The EPEEC report of December 1986 is devoted to the mangrove and estuarine area of Casamance.

EPEEC-Senegal has been closely associated with COMAR activities at the regional level.

An EPEEC team visited Gambia and Guinea Bissau to study the coasts of those countries.

EPEEC-Senegal has participated actively in the following COMAR activities, which are described in more detail in Document COASTAL IV/9.1.2:

i. - Workshop on the coastal ecosystems of West Africa: Coastal lagoons, estuaries and mangroves (Dakar, Senegal: 11-15 June 1986);

ii. - Regional training workshop on methodology of estuaries and mangroves (Dakar, Senegal: 28 February - 5 March 1983);

iii. - Field research methodology on coastal lagoons (Abidjan, Côte d'Ivoire: 6-11 May 1985);

iv. - Workshop on comparison of characteristics and functioning of lakes and coastal marine systems (Nairobi, Kenya: 30 September - 4 October 1985);

v. - Regional seminar on traditional knowledge and management of coastal marine systems in Africa (Cotonou, Benin: 27-30 November 1985).

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* Dr. E.S. Diop, EPEEC, Head, Dept. of Geography, University of Dakar, Senegal. Contribution to the the fourth meeting of the Unesco/SCOR/IABO Consultative Panel on Coastal Systems, Dakar, BREDA (15-17 December 1986).

(1) Coastal marine project of Unesco - Division of Marine Sciences

(2) Man and the Biosphere

FACTORS OF COASTAL CHANGES IN AFRICA (a summary)[x]

J. Paul BARUSSEAU

The topic of this talk is a brief outline of the geological constraints controlling the coastal marine environments in Africa. Three aspects will be put forward:

- Structural control inherited from the geological evolution of the African margins;
- Quaternary history;
- Present geological trends.

1. The geological evolution will be illustrated by examples taken from the Western margins which give a good illustration of the phenomena.

The principal phases of the formation of the Atlantic Ocean were given. Emphasis is put on the rift and drift developments. Note the time shift for the three main regions.

Two kinds of margins have been demonstrated: divergent, translation but with some problems resulting from the geological history of the South Atlantic or from changes in the fracture zone orientation and extinct spreading belts (Sierra Leone).

The distribution of great structural and sedimentary units (bains, rises, arches...) resulted from these events and the Proterozoic and Paleozoic structure or from the opening mechanism.

Which are the most important factors to be considered as active agents of the present evolution of the coastal zone?

- whatever controls the margin geometry (width, thickness): location of basins and arches, depocentres, deltas;
- major geological trends (at the continent scale) with drainage reorientation;
- minor geological trends (at a regional or intraregiona scale) with uplift or subsiding zones.

2. Two major points are related to the Quaternary history of the African margins: the high sea levels and the development of shelf in Quaternary.

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x) For more details see: Unesco Reports in Marine Sciences No. 43, Unesco, 1987.

High sea levels occurred during two major periods according to the shoreline map of D.O. COLQUHOUN (1981): 120000 BP and (Holocene maximum) 5000 BP.

Only data obtained where research was carried out with several radiometric controls can ensure satisfactory knowledge on the matter:

- Morocco and Western Sahara, Mauritania, North Senegal
- Angola, Namibia, South Africa
- Madagascar, Mascarene Islands, Seychelles
- Red Sea coasts

Determination is much more problematic on the Atlantic coasts between Senegal and Angola and on the Indian Ocean coasts.

The most complete picture is provided by the Moroccan high sea levels but two ideas may be kept in mind:

- no general behaviour of vast compartments;

- no premature correlations with other regions when radio-metric data are lacking.

Further south of Morocco, a similar but less complete picture may be seen.

The Quaternary shelf is mainly dominated by the last glacial - interglacial cycle. The general aspect of the eustatic curve is known but no general curve can be given even for the more recent part of the curve.

From a methodological point of view a map of superficial shelf sediments always gives a picture of separated sedimentary units of various ages.

To solve the problems and recognize the deposit pattern, vibrocorings provides a useful tool.

Other methods may be prudently used, especially grain-size modal analysis.

One basic aim is to determine the successive environments in order to define local evolutions, regional evolutions and qualitative models.

3. The last aspect to be examined concerns the present geological factors and their effects. The following factors and effects should be considered:

- the current pattern

- the waves

- the tidal characteristics
- the sea level changes
- the river discharges
- the river solid influx
- the aeolian input: direct dune field collapse in sea and dust falls
- the coastal erosion input
- the transport and accumulation forms
- the coastal erosion

Three major themes are clearly illustrated. They are:

Phenomena with an obvious climatic cause:

- recent hydrological changes (salt wedge intrusion; reverse estuary regime; soil salinisation and acidification);
- recent sedimentological changes (occurences of aeolian fine silt/sand layers; dune migrations);
- recent ecological changes (disappearance or decreased area extension of species; reduction of mangrove vegetation).

Phenomena of coastal evolution:

Erosion processes are the most researched because of their impact on coastal settlements:

- local erosion;
- extensive erosion;
- factors;
- difficulties of trend evaluation.

Phenomena due to a human cause:

- interruption of littoral longshore sedimentary drift;
- great hydraulic dams;
- beach sand mining;
- mangrove reduction due to exploitation of wood for cooking purposes.

Lecture 6

NUTRIENT AVAILABILITY AS A MAJOR DETERMINANT OF DIFFERENCES AMONG COASTAL HARD-SUBSTRATUM COMMUNITIES IN DIFFERENT REGIONS OF THE TROPICS

Charles BIRKELAND

ABSTRACT

Despite taxonomic affinities among the species found in different tropical regions of the oceans around the world, differences prevail among these regions in terms of processes which structure the communities. These processes bring about differences in the elements of the species pool that predominate and thereby regional differences in community structure. It is proposed that nutrient availability is one of the major determinants of these regional differences. In particular, the phytoplankton food-web preempts the benthic algal food-web as nutrient input increases; success of recruitment of particular year-classes from planktotrophic larvae is occasionally facilitated by strong nutrient pulses and, because of this, competition for space and grazing pressure increase with nutrient input; heavy grazing pressure forces generalized diets and this compounds the grazing pressure; K-selected traits are favored in regions of low nutrient availability while r-selected traits are favored in regions of high nutrient availability or nutrient-pulse conditions. These processes are most influential on recent recruits or juveniles and much less on adults, so community structure is largely determined by factors influencing these early stages. Along a gradient of decreasing nutrient input, whether on a geographical or a local scale, the predominant occupants of primary substrata in shallow water change from heterotrophic suspension-feeders to benthic plants to phototrophic animal-plant symbionts.

This subject is of practical importance as a basis for rational management plans for tropical coastal ecosystems. Communities in areas of nutrient input from upwelling might be managed for an export economy, but coral reefs on atolls should be managed for local subsistence and as a service-oriented economy in relation to the world market. It is urgent that UNESCO encourage international cooperative studies on the mechanisms and effects of nutrient input into tropical coastal ecosystems because with modern technology, human activities such as construction of the Aswan Dam and coastal clear-cut logging can have international effects on fisheries and coastal resources.

Lecture 7

REVUE DES PROGRAMMES DE RECHERCHE EN MILIEU LAGUNAIRE EN COTE D'IVOIRE

S.G. ZABI

1. INTRODUCTION

La Côte d'Ivoire a un plateau continental étroit et est très handicapée par la faiblesse des upwellings le long de sa frange litorrale. Ces conditions naturelles assez défavorables obligent le pays à importer du poisson ne couvrant que la moitié de sa consommation nationale.

Un défi se trouve ainsi lancé au Centre de Recherches Océanographiques qui s'est proposé, d'une part de mener des études sur les écosystèmes et lagunaires afin de développer et suggérer des mesures de gestion rationnelle des resources halieutiques, et d'autre part, de développer des recherches en aquaculture.

Cette note vise donc à faire une présentation rapide, notamment des programmes de recherche en milieu lagunaire, afin d'essayer de dégager leurs perspectives d'évolution.

2. PROGRAMMES DE RECHERCHES EN MILIEU LAGUNAIRE

Le réseau ivoirien constitué de trois grandes lagunes côtières, la lagune de Grand Lahou, la lagune Ebrié et la lagune Aby, couvre une superficie totale de 1200 km2. Il a de tout temps été l'objet d'une exploitation traditionnelle par les populations riveraines.

Mais avec les exigences du développement économique national, cette exploitation du milieu lagunaire s'est fortement accrue; ce qui a imposé la mise en place de programmes de recherche pour une meilleure connaissance des écosystèmes lagunaires.

Les premières observations en milieu lagunaire ont été réalisées par l'ORSTOM de 1947 à 1955 surtout en lagune Ebrié.

Les recherches plus approfondies ont réellement débuté en 1984 avec 4 grands programmes.

2.1. Hydrobioclimat lagunaire

Ce programme comprend 5 opérations de recherche.

2.1.1. Hydroclimat lagunaire

Le thème retenu pour cette opération est la variabilité interannuelle de l'hydroclimat de la lagune Ebrié.

Cette étude qui trouve son intérêt depuis l'ouverture en 1950 du Canal Vridi a permis de décrire l'évolution irréversible du milieu physique.

Les premières données importantes qui ont été obtenues ont permis de décrire le régime de la lagune Ebrié en insistant sur:

- la topographie lagunaire
- le régime thermique
- l'hydrodynamique
- l'hydrochimie

Cette étude est le prolongement du travail de base réalisé sur l'environnement physique du Système Ebrié.

2.2. Production primaire en milieu lagunaire

Elle constitue en soi un thème d'étude qui fait appel à une évaluation des éléments nutritifs limitant la production de biomasse végétale et benthique.

2.3. Production zooplanctonique en milieu lagunaire

Cette opération a permis de mettre l'accent sur l'étude du zooplancton qui est dominé en lagune par la copépode Acartia clausi.

2.4. Production benthique en milieu lagunaire

Elle constitue un autre maillon de la production secondaire et traduit dans l'espace et le temps tous les changements du milieu lagunaire.

les 112 espèces benthiques reconnaissables dans 8 groupes zoologiques sont dominées par les mollusques avec Arca senilis, Pachymelania aurita, Tympanotonos fuscatus et Curbula trigona.

2.5. Heterotrophie en milieu lagunaire

Elle a permis de mieux comprendre le cycle des composés carbonés et souffrés.

2.2. Conséquences des pollutions sur la lagune Ebrié

Le développement démographique de la ville d'Abidjan et le redéploiement des activites industrielles exercent une forte pression sur le milieu lagunaire.

Ce programme se compose de 4 opérations :

2.2.1. Modification du milieu physico-chimique et leurs conséquences

Le déversement en milieu lagunaire des effluents domestiques et des eaux usées industrielles a changé, parfois de façon irréversible dans certains compartiments lagunaires, l'état physico-chimique du milieu.

2.2.2. Pouvoir auto-épurateur des eaux vis-à-vis des matières organiques

La menace d'eutrophisation est toujours permanente en lagune notamment avec l'envahissement ces derniers temps de la zone urbaine d'Abidjan par des végétations flottantes qui s'accumulent régulièrement. La demande biologique en oxygène (DBO) en regard de cette accumulation de matières organiques se trouve donc être en constante augmentation.

2.2.3. Flore bactérienne reductrice et pollution fécale

L'activité de recherche sur la flore bactérienne vise la définition des normes de qualité bactériologique des eaux lagunaires.

2.2.4. Influence des pollutions sur la production benthique

Le suivi des espèces benthiques dans les zones lagunaires réputées très polluées a permis de décrire des indicateurs de pollution.

2.3. Exploitation rationnelle des principales espèces lagunaires

Ce programme de recherches compte parmi les plus importantes du Centre de Recherches Océanographiques d'Abidjan (C.R.O).

Il comporte 8 opérations dont toutes visent la connaissance de la biologie et de l'écologie des principales espèces comme :

- Ethamolosa fimbriata
- Elops lacerta
- Tylochromis jentenki
- Tilapia guineensis et Saratherodon melanotheron
- Callinectes Spp.

Deux opérations importantes concernent la synécologie des peuplements lagunaires et la dynamique générale des stocks exploitables en lagune.

La monographie socio-économique de la pêche a permis de mieux maîtriser les problèmes d'un conditionnement et de commercialisation du poisson.

2.4. Aquaculture lagunaire

Le déficit en protéines animales impose à la Côte d'Ivoire d'importer près de 100.000 tonnes de poisson pour compléter sa consommation nationale. Ce qui dénote le regain d'intérêt pour la connaissance très approfondie des écosystèmes lagunaires pour un aménagement efficient en vue d'une exploitation rationnelle des ressources halieutiques grâce à la pêche et l'aquaculture.

Un accent particulier sera donc mis sur les recherches en aquaculture lagunaire dont le développement devrait permettre d'exercer de pression sur les stocks halieutiques lagunaires.

2.4.1. Activités de recherches de la Station d'Aquaculture Expérimentale de Layo

Un rappel de ces activités de recherches permet de noter que les efforts du Centre de Recherches Océanographiques d'Abidjan se sont focalisés sur la reproduction, l'alimentation et la croissance de deux expèces de mâchoirons du genre Chrysichthys.

Les recherches se sont, par la suite, étendues à l'élévage des tilapia.

Le développement encourageant de ces activités de recherche en aquaculture a été finalement reconnu par la Commission Mixte Ivoiro-Française de 1980 en matière de recherche scientifique.

Une Convention a été signée qui a permis au Centre Technique Forestier Tropical et le Centre de Recherches Océanographiques d'Abidjan.(?)

Une mise à jour de ce programme de recherche en aquaculture a été rendue nécessaire pour faire face aux besoins exprimés en poisson.

Deux volets d'études peuvent être proposés. D'une part, l'intensification des recherches engagées sur les Chrysichthys (mâchoirons) et sur les Tilapia/ Sarotherodon qui sont pour le moment les seuls dont l'élevage soit réalisé en lagune, et d'autre part, l'évaluation des potentialités pour l'élevage des autres espèces du peuplement ichtylogique lagunaire.

2.4.1.1. Recherche sur la reproduction des mâchoirons

Les deux espèces concernées sont Chrysichthys walkeri et C. nigrodigitatus.

2.4.1.1.1. Reproduction de C. Walkeri

Elle a lieu pendant les saisons de pluies (mai-juillet et octobre-novembre), et les poissons sont alors dans des nids et des caches (bambous évidés par exemple). C. Walskeri se reproduit aussi en captivité mais seulement encore pendant les saisons pluvieuses. Il se pose donc un problème d'obtention d'alevins durant les autres mois de l'année. Pour contourner cette difficulté il a été proposé de faire des études sur l'influence séparée ou conjointe des stimuli naturels et artificiels afin de déclencher à volonté, non seulement la maturation, mais aussi la pointe. Les premiers résultats obtenus sont très encourageants.

2.4.1.1.2. Reproduction de C. nigrodigitatus

Elle est bien moins connue que celle de C. wlkeri. Les premières observations laissent cependant supposer que le poisson se reproduit aussi pendant la saison des pluies, dans les infractuosités des rochers en zones dessalées de la lagune.

Son potentiel de croissance étant nettement supérieur à celui de C. walkeri (Dia, 1975, Amon et Dia, 1977) * et sa fécondité plus élevée (20.000 oeufs pour une femelle de taille moyenne), son élevage devrait être plus intéressant. Mais six pontes seulement ont été obtenues en captivité, malgré la présence de nombreux individus matures en étang et en enclos.

Des études plus poussées semblent dont nécessaires pour induire la reproduction en captivité. C'est ainsi que nous avons convenu de faire des recherches sur :

- la biologie et l'éthologie de la reproduction
- la physiologie de la reproduction.

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*- AMON KOTHIAS (J.B.) et DIA (A.K.), 1977 - Annexe I - Etude de la croissance des juvéniles de mâchoirons (Chrysichthys walekeri). Centre Rech. Océanogr. Abidjan, ORSTOM, document interne : 6p

- DIA (A.K), 1975 - Détermination de l'âge des machoirons (Chrysichthys négrodigitatus). Première estimation de la croissance. Doc. Sc. Centre Rech. Océanogr. Abidjan, ORTSOM 6 (2): 139-151.

2.4.1.2 Recherche sur l'alimentation

L'aliment représentant le poste budgétaire le plus important, il doit satisfaire deux conditions fondamentales : être moins cher et performant.

Pour cela, il est proposé de faire, dans un premier temps, une étude de la digestivité et de l'assimilation par les poissons des ingrédients entrant dans la composition de l'aliment. Dans un second temps, à partir des ingrédients les plus facilement assimilables, on pourra fabriquer des aliments de différentes teneurs en protéines. Ceux donnant les meilleurs résultats seront retenus, et l'élaboration de la formule alimentaire des juvéniles, des adultes et des géniteurs en sera facilitée.

Le mode de distribution des aliments conditionnant leur utilisation par les poissons et donc la rentabilité de l'élevage, il semble indispensable de déterminer les conditions optimales de distribution de la nourriture : poudre ou granulés, fréquence de distribution quotidienne, utilisation éventuelle de mangeoires. D'une manière générale, il paraît indispensable d'entamer les recherches sur la physiologie de la nutrition.

2.4.1.3. Recherche sur les tilapias

Les travaux préliminaires de Légendre (1983) (comm. pers.) portant sur la croissance en élevage de Tilapia guineensis et de Sarotherodon melanotheron on montré que :

- la croissance de T. guineensis est plus faible que celle de S. melanotheron durant l'alevinage et le prégrossissement jusqu'à environ 10 g. Par contre, durant la phase de grossissement en enclos, le relais est pris par T. guinéeensis. Il en résulte que la durée totale du cycle d'élevage est voisine pour ces deux espèces.

- au cours du grossissement, en enclos, une différence de croissance liée au sexe a été mise en évidence. Chez T. guineensis, le mâle présente la croissance la plus rapide, alors que chez S. melanotheron, c'est la femelle qui conduit aux meilleurs résultats. Cependant, pour cette dernière espèce, des observations récentes réalisées en élevage monosexe, montrent que la faible croissance du mâle est due, en enclos, à l'incubation buccale durant laquelle il ne se nourrit pas.

- différents problèmes liés à certains aspects du comportement des tilapias lagunaires ayant été rencontrés en enclos (nidification, prolifération, difficulté de capture), l'utilisation des cage-enclos est désormais jugée préférable dans le cadre d'un élevage intensif.

- la durée de la phase de grossissement en élevage est relativement longue pour les deux espèces et leur croissance doit être optimisée.

Compte tenu des résultats acquis, deux voies de recherches sont proposées :

a) optimisation de la croissance des deux espèces de Tilapias lagunaires en élevage intensif en cage-enclos :

Elle pase d'une part par la détermination de la densité optimale de stockage des poissons en cages-enclos et d'autre part par la mise au point d'une ration alimentaire qui réponde aux besoins nutritifs à déterminer par l'étude de la physiologie de la nutrition.

b) Elaboration d'une technique d'élevage extensif des Tilapias lagunaires

Cette étude vise à déterminer les conditions d'association de la technique des acadjas et celle des enclos. L'acadja est un enchevêtrement de branchages qui a l'avantage de diminuer le stress chez les poissons, surtout quand il couvre une assez bonne surface pour répondre au comportement territorial particulièrement marqué par des Tilapias.

2.4.1.4. Etude des potentialites pour l'élevage d'autres espèces lagunaires

Outre les mâchoirons et les tilapias, l'ichtyofaune lagunaire recèle de nombreuses espèces (Mugilidae, Claridae, Carangidae, Lutjandidae) localement appréciées et de bonne valeur marchande qui pourraient être un bon potentiel pour l'élevage.

Parmi ces espèces, Trachinotus falcatus et Heterobranchus langifilis présentent déjà de bonnes qualitées identifiées lors des essais préliminaires.

D'une manière générale, les espèces pressenties pour l'aquaculture doivent répondre aux conditions suivantes :

- Aspects socio-économiques

Ils visent à définir la valeur commerciale de l'espèce et de son degré d'acceptation par les populations locales.

- Aspects bio-écologiques

Ils concernent les zones de répartition de l'espèce, son régime alimentaire, sa croissance, les zones de reproduction.

Pour les essais d'élevage, les autres aspects suivants sont à étudier :

- résistance à la manipulation et aux variations des paramètres du milieu;

- croissance en élevage ;

- maturation de gonades;

- acceptation et rendement de la nourriture artificielle (pour chaque espèce, la formule à retenir est celle qui donne les meilleurs résultats avec les espèces voisines ayant un régime alimentaire similaire;

- études de la physiologie de la reproduction : ces études sont importantes pour détecter les possibilités d'obtention des alevins à n'importe quelle période de l'année à partir des techniques d'induction de la ponte et d'élevage larvaire à élaborer pour les espèces ayant les meilleures performances aquacoles.

2.4.1.5. Contribution des recherches de Layo au développent des activités piscicoles de la ferme de Jacqueville

La ferme de Jacqueville est la Station Pilote de l'Aquaculture Lagunaire de la Direction des Pêches du Ministère de la Production Animale dont les préoccupations fondamentales peuvent se résumer en trois points :

i) Amélioration de la croissance de Sarotherodon melanotheron et étude de la croissance de Tilapia guineensis.

ii) Reproduction artificielle de Chrysichthys walkeri et de C. nigrodigitatus.

iii) Surveillance du milieu pour expliquer les crises dyrtrophiques éventuelles.

En d'autres termes, des études de croissance sur les Tilapia spp semblent d'abord être nécessaires.

Et les premiers résultats du C.R.O. ont montré que pendant l'alevinage et le prégrossissement, c'est S. melanotheron qui croit plus vite jusqu'à 10g, alors que pendant la phase de grossissement, le relai est pris par T. guineensis.

Les expériences de grossissement menées en enclos font apparaître une différence de croissance liée au sexe.

Ces résultats sur la croissance sont donc importants et méritent d'être approfondis avant d'être communiqués au développement surtout lorsqu'intervient aussi la mise au point de formule alimentaire adéquate.

En ce qui concerne l'alevinage de Chrysichthys walkeri, le C.R.O. a réussi à faire la ponte pendant huit mois à l'exclusion de la saison chaude, mais ce réduit n'a pas encore un caractère répétitif confirmé avant d'être versé au développement avec une grande certitude de succès.

Pour aider la recherche, une redevance modique de 5F par alevin vendu serait versée au C.R.O. pour contribuer au financement des recherches sur le C. nigrodigitatus.

En effet le budget de fonctionnement de Layo étant estimé à près de 50 millions de Francs, la vente des alevins pourrait permettre de réaliser quelque bénéfice.

Pour conclure, la préoccupation fondamentale du C.R.O. est le transfert des résultats fiables au développement pour contribuer à la réalisation des objectifs de la politique de l'autosuffisance alimentaire.

D'une manière générale, lors de la mise en place de la phase en lagune Ebrié du Projet d'Aquaculture lagunaire, le C.R.O. a toujours suggéré l'insertion d'un volet de recherche.

2.4.1.6. Contribution du C.R.O. au Projet FIDA de pêche artisanale en lagune Aby

Le Projet FIDA est né du constat de la chute de la production en lagune Aby de 11.000 tonnes en 1979 à 5.000 tonnes en 1981. Cette baisse de production est, semble-t-il, due à une surexploitation du stock.

Les actions envisagées par le Projet pour pallier cette situation se résument en deux grands volets :

- les actions visant à la définition d'une nouvelle organisation de la pêche;

- les actions de mise en valeur de la ressource reconstituée et la promotion de nouvelles ressources par l'aquaculture.

Mais le Projet envisage d'améliorer les techniques de fumage du poisson. Fort de l'expérience en Lagune Ebrié, le C.R.O. a tout de suite introduit la notion de volet de recherche dans ce Projet FIDA. Ce qui lui a valu de réaliser l'étude sur la sélectivité des engins de pêche.

Pour une estimation à plus de 1.5 milliards, le Centre de Recherches a présenté une enveloppe de 190 millions pendant les 5 ans de vie du Projet.

Un rapport d'évaluation du Projet réalisé par la BAD a supprimé le volet de recherche.

Malgré toutes les argumentations en faveur de la recherche au service du développement, l'accord de prêt entre la Côte d'Ivoire et le FIDA qui a été signé le 22 juin 1984 à Rome et qui rentrera en vigueur le 20 septembre 1984, aucun volet de recherche n'a été envisagé.

Nous sommes donc devant l'évidence d'une approche différente de celle que nécessite le développement réel de l'aquaculture dans notre pays.

2.4.1.7. Encadrement en faveur des Agents de la Direction des Pêches

Le C.R.O. voulant entretenir une coopération avec la Direction des Pêches, doit encadrer un grand nombre d'assistants de P.V.A. avant leur insertion dans les services d'accueil.

Il en est de même pour l'encadrement au frais du C.R.O. de 2 ingénieurs halieutes de la D.P.R. (Direction de la Programmation de la Recherche).

En conclusion, le Centre de Recherches Océanographiques vise comme objectif de base, la Recherche Océanographique au Service du Développement. Toute action de coopération avec les structures de développement envisagée dans ce cadre est certainement un garant de succès pour l'action envisagée.

3. RESSOURCES HUMAINES ET FINANCIERES NECESSITEES PAR LES PROGRAMMES DE RECHERCHE EN MILIEU LAGUNAIRE

Depuis leur mise en place en 1974, les programmes de recherche en milieu lagunaire ont mobilisé des moyens humains et financiers qui sont à la mesure de l'intérêt accordé aux lagunes ivoiriennes.

3.1. Potentiel chercheur

Si on prend arbitrairement pour année de référence 1982 qui représente tout de même la période où l'effectif des chercheurs nationaux a connu une légère augmentation depuis le début des programmes de recherche en milieu lagunaire, on peut dire que sur 28 Chercheurs que compte le C.R.O., 12 c'est à dire moins de la moitié, sont des nationaux. Soit 42 % au total.

De cet effectif, il faut retenir 7 pour les activités de recherche en milieu lagunaire. Soit 58 % du potentiel national.

La situation s'est inversée en 1986 où sur les 30 Chercheurs du C.R.O., 16 sont des nationaux, soit 53 % au total.

Il faut préciser qu'au total 16 Chercheurs sur l'ensemble des effectifs de chercheurs du Centre consacrent leurs activités au milieu lagunaire.

Les lacunes se font sentir au niveau des personnels d'appui à la recherche.

Pour l'année 1986, on peut estimer à près de 169 le nombre de mois chercheurs dévolus au milieu lagunaire.

3.2. Resources financières

Le budget global de fonctionnementdu Centre a tourné autour de 130 millions de francs CFA pour l'année 1983, alors qu'il était de 256.224 millions de francs CFA en 1982.

On peut tout de suite percevoir les effets de la crise économique qui etaient encore persistants en 1986.

Les sources de financement sont :

a) pour la France :

- le budget ORSTOM - le FAC

b) pour la Côte d'Ivoire :

- le coût de la Convention 66/309 qui confie le C.R.O. en gestion à l'ORSTOM

- le financement des programmes de recherche en milieu lagunaire

- le budget spécial d'Investissement et d'équipement.

Il faut remarquer qu'un effort est globalement fait pour maintenir le financement des recherches en milieu lagunaire à un niveau qui aurait pu être meilleur si la crise économique n'avait pas conduit à rétrecir le budget du Centre.

4. PERSPECTIVES DE DEVELOPPEMENT DES PROGRAMMES DE RECHERCHE EN MILIEU LAGUNAIRE

Il n'y a pas de doute que l'effort de recherche consacré depuis 1974 au milieu lagunaire, en Côte d'Ivoire, soit un des plus importants de l'Afrique de l'Ouest et du Centre.

Ainsi les perspectives de développement de ce programmes de recherche s'appuient en tout premier lieu sur les objectifs du Réseau National pour la Qualité des Eaux marines et lagunaires, envisagé pour la surveillance du milieu marin et ses zones adjacentes.

Un aspect tès important est la mise à jour de la carte bathymétrique des lagunes.

Une des plus grandes maîtrises de la dynamique des populations halieutiques est rendue nécessaire pour une gestion rationnelle des stocks.

Une modelisation du système hydrodynamique lagunaire peut être une préoccupation fort justifiée.

Beaucoup d'espèces telle Hétérobranchus sp, Trachinotus sp, Callinectes sp, Arca sp, mériteraient d'être plus étudiées en vue de l'aquaculture.

Cette énumération, loin d'être exhaustive, doit à tout moment recouvrir des programmes de recherche qui répondent aux objectifs de développement.

5. CONCLUSION

L'analyse rapide qui vient d'être faite, indique l'importance accordée aux recherches en milieu lagunaire en Côte d'Ivoire.

Une autre manière de dire que ces programmes ont atteint un niveau qui permet aisément de définir un cadre de coopération régionale et interrégionale.

Le projet COMAR peut donc trouver en Côte d'Ivoire de très bonnes conditions d'implantation de projets pilotes, notamment le Projet Pilote sur les Lagunes Côtières. Un très vif intérêt s'est développé ces derniers temps dans notre pays pour le Projet Pilote sur la dynamique des zones côtières et la géologie du plateau continental.

Lecture 8

LE PROJECT KENYAN-BELGE, UN EXEMPLE DE COLLABORATION BILATERALE

Prof. Dr. Ph. Polk

Dans cette contribution-ci, les points suivants sont présentés dans notre intervention.

1. L'Organisation et le développement des Sciences Marines en Belgique.
2. L'Organisation et le fonctionnement du Projet Kenya-Belgique en Sciences Marines (PKB).
3. Les possibilités que le PKB peut offrir à la région africaine en collaborant avec les organismes internationaux.

1. L'ORGANISATION ET LE DEVELOPPEMENT DES SCIENCES MARINES EN BELGIQUE

Avant 1970, la recherche en science marine était individuelle, thématique et de haute valeur scientifique. Par contre, une recherche intégrée et multidisciplinaire était inexistante. A partir des années '70, le gouvernement belge a appelé les différentes institutions scientifiques et universitaires à faire des propositions pour l'organisation des recherches marines en tenant compte d'une enveloppe budgétaire déterminée.

Ensuite, des séminaires furent organisés annuellement pour présenter les résultats et discuter la progression des recherches. Les recherches interuniversitaires et de caractère multidisciplinaire s'intégrèrent dans un Modèle Mathématique de la Mer du Nord, modèle prédictif pour la gestion de cette mer.

Au bout d'environ sept ans, grâce à l'aide du "Fonds National pour la Recherche Scientifique" et au soutien logistique de "l'Institut des Recherches Scientifiques de la Mer du Nord", la Belgique comptait un nombre important de jeunes spécialistes qui avaient obtenu leur doctorat dans un domaine des sciences marines, souvent en collaboration avec des experts et des laboratoires étrangers. Il en est résulté la création de "l'Unité de Gestion du Modèle Mathématique de la Mer du Nord", composée de physiciens, chimistes et biologistes. La spécialisation des différents laboratoires au sein de la recherche en commun a conduit à une rationalisation de l'infrastructure logistique nécessaire.

A présent, la Belgique possède un bateau océanographique, une équipe de jeunes chercheurs et des laboratoires très spécialisés au sein des universités ainsi qu'un Modèle Mathématique de la Mer du Nord de plus en plus précis au fil des ans.

Cette expérience acquise d'une recherche intégrée et multidisciplinaire, avec les adaptations nécessaires au nouvel environnement, a servi d'exemple pour développer le PKB.

2. LE P.K.B.

Pour l'initiation de cet accord bilatérale, nous avons tenu compte des conseils et résolutions des différentes organisations internationales et nous avons essayé d'éviter les déficiences constatées dans d'autres projets existants.

Notre but principal est de lier recherche, infrastructure et spécialisation, et de donner au projet un caractère interdisciplinaire.

Les recherches sont faites pour la plus grande partie dans le pays même. Par ceci, nous voulons éviter les situations où des chercheurs africains passent plusieurs années dans des universités européennes en travaillant sur des problèmes typiquement européens pour obtenir leur doctorat. Une fois de retour, ils n'ont pas l'infrastructure ni assez d'éléments scientifiques de base pour appliquer leur connaissance dans leur propre pays.

Cependant le contraire existe également, dans le -cas où des chercheurs africains peuvent ne pas trouver chez eux les locaux adaptés et les compétences nécessaires pour l'utilisation d'un equipement sophistiqué.

L'idée de base que nous avons élaborée pour le PKB, consistait à envoyer un expert belge au Kenya pour travailler pendant plusieurs semaines avec un homologue kenyan, sur un problème africain bien précis. Ensuite un plan de recherche était rédigé.

Si nécessaire, un scientifique africain peut également effectuer une spécialisation de courte durée dans un laboratoire belge.

Les publications scientifiques sont rédigées par les kenyans en collaboration avec les collègues belges.

Mis à part la recherche pour laquelle le projet a un où laboratoire de base où les études biologiques et chimiques sont en és pleine expansion, deux unités logistiques ont été créées dans le de cadre du PKB: Le centre de Dcoumentation et le Centre d'Informatique.

2.1. Le Centre de Documentation

Avec les fonds attribués au PKB, il nous était impossible d'établir une bibliothèque complète pour les sciences marines. Celle-ci n'étant pas prioritaire, nous avons opté pour l'acquisition d'une littérature sélective.

Le Prof. Egghe, du Centre Universitaire du Limbourg (LUC), a organisé des séminaires pour les chercheurs du "Kenya Marine and Fisheries Research Institute (KMFRI)" où le PKB est basé, notamment sur les possibilités et moyens de se procurer la littérature scientifique.

Les demandes de littérature sont centralisées à Mombasa par Mme Mwobobia, bibliothécaire à la KMFRI, et envoyées ensuite au Prof. Egghe qui fait les recherches nécessaires pour obtenir les publications.

En plus, lors de leurs visites, les scientifiques belges apportent la littérature spécifique de leur domaine de recherche.

Il en est résulté, en moins de 2 ans, un Centre de Documentation disposant de plus de 50.000 pages de littérature scientifique à la disposition des chercheurs du KMFRI et de l'Université de Nairobi.

Ainsi, un résultat appréciable a pu être obtenu avec un minimum de dépenses.

Avec la coopération des organismes internationaux, il devrait être possible de développer ce centre en un Centre Régional.

2.2. Le Centre d'Informatique

Le Centre d'Informatique a été mis sur pied par M. Pissierssens et son homologue kenyan M. Onyango.

Ayant débuté avec un seul ordinateur Olivetti M21, très vite il a fallu acquérir deux autres ordinateurs (Olivetti M24 et Kaypro) pour satisfaire à la demande.

A présent, le Centre fonctionne à tel point qu'un travail de roulement est envisagé.

Le projet a informatisé la comptabilité, le compte des salaires et l'inventaire des stocks (infrastructure, matériel de laboratoire, produits chimiques, etc.) pour l'administration de la KMFRI. Des programmes spécifiques ont été élaborés pour stocker les données des recherches et pour le traitement des problèmes statistiques. Ceci permettra de calculer la corrélation entre les différents paramètres et de formuler une modelisation de l'écosystème.

Ce Centre d'Informatique deviendra encore plus important quand il sera lié au Centre de Documentation, ce qui, nous l'espérons, sera réalisé en 1987.

Avec l'élaboration de ce Centre, aussi bien pour la distribution de la documentation que pour le recueil et la centralisation des données scientifiques, espérons obtenir une infrastructure efficace et indispensable pour l'Afrique.

CONCLUSION

Après deux ans de collaboration Belgique-Kenya, la KMFRI possède l'infrastructure de base pour faire des recherches thématiques dans les domaines biologiques et chimiques, ainsi qu'un Centre de Documentation et d'Informatique qui fonctionnent à plein temps.

La recherche descriptive actuelle doit ensuite être intégrée dans un modèle fonctionnel.

A titre d'exemple, grâce à la recherche fondamentale, une culture pilote d'huitres a pu être établie.

3. LES POSSIBILITES DE L'EXPANSION DU PROJET

Au Kenya même, de bons contacts ont été établis avec l'Université de Nairobi, l'Institut Gouvernemental de Chimie et le Département National de la Pêche Marine.

L'intégration, la spécialisation et la rationalisation des moyens évite la duplication d'infrastructure lourde et permet d'en optimiser l'usage.

Le Centre de Documentation, ainsi que le Centre d'Informatique pourraient être développés pour toute la Région, et la publication d'un "Bulletin" pour la Région serait très utile.

En ce qui concerne le cours du 3ème cycle "Fundamental & Applied Marine Ecology (FAME) donné à l'Université Libre de Bruxelles, nous proposons que quelques bourses soient réservées pour des scientifiques africains.

La recherche, principalement faite dans les criques des mangroves et sur les coraux, est conforme aux priorités des organismes internationaux en ce qui concerne la préservation de la faune et de la flore de la Région de l'Océan Indien.

Nous souhaitons donc qu'en collaboration avec ces institutions, nous puissions développer les recherches dans toute la Région.

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40	Human induced damage to coral reefs Results of a regional Unesco (COMAR) workshop with advanced training Diponegoro University, Jepara and National Institute of Oceanology Jakarta, Indonesia May 1985 English only	1986
41	Caribbean coastal marine productivity Results of a Planning Workshop at Discovery Bay Marine Laboratory, University of the West Indies Jamaica, November, 1985 English only	1986
42	The application of digital remote sensing techniques in coral reef, oceanographic and estuarine studies. Report on a regional Unesco/COMAR/GBRMPA Workshop Townsville, Australia August 1985 English only	1986
43	Quaternary coastal geology of West Africa and South America. Papers prepared for the INQUA-ASEQUA Symposium in Dakar, April 1986 Available in English and French	1987
44	Physical oceanography of the Eastern Mediterranean (POEM): Initial Results Unesco/IOC First POEM Scientific Workshop Erdemli, Turkey 16-20 June 1986 English only	1987
45	Marine science teaching and training at first degree (undergraduate) level. Recommended guidelines from a Unesco workshop on university curricula Paris, November 1986 Available in Arabic, Chinese, English, French, Russian and Spanish	1987
46	Comparison between Atlantic and Pacific tropical marine coastal ecosystems: community structure, ecological processes, and productivity. Results and scientific papers of a Unesco/COMAR workshop. University of the South Pacific Suva, Fiji. 24-29 March 1986 English only	1987
47	Temperate coastal systems of Latin America. Report on meeting on COSALC Pilot Project No. VII November 1986 Spanish only	1987

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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	1981
12	Geologia y geoquimica del margen continental del Atlantico Sudoccidental Informe final del Taller de Trabajo organizado por la Unesco en Montevideo Uruguay, 2-4 de diciembre de 1980	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	1981
17	The coastal ecosystems of West Africa: coastal lagoons, estuaries and mangroves A workshop report, Dakar, 11-15 June 1979	1981