Coastal Ocean Space Utilization III

EDITED BY

Norberto Della Croce,
Shirley Connell and Robert Abel

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Table of Contents

Regional Seas & Embayments

New Concepts in the Governance of Ocean Space

The Coastal Environment: Assessment Standards & Issues

Ocean Resources & Sustainable Development

Ocean Space Development & Related Technologies

Editor's Preface

Editing the scientific papers that make up this volume was both *challenging* and *enlightening.* It was challenging because of the disparate nature of each paper, e.g., fonts, formats, figures, and use of language. It was enlightening because of the very creative and dynamic nature of the ideas presented.

We would like to thank the contributing authors for their time and assistance in this convoluted process. Where it was necessary, graphics were redrafted to meet production standards of clarity; however in a few instances, certain pieces of tone art had to be eliminated.

A great deal of gratitude is owed to Ms. Barbara Brengel and the staff of Your Other Office for their professionalism and honest concern. Finally, this Editor would like to thank Dr. Robert Abel for his abiding sense of Humor.

Shirley H. Connell

Acknowledgements

The editors gratefully acknowledge the sponsorship of the following organisations:

The Max and Victoria Dreyfus Foundation, Inc.
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The University of Genoa, Italy and several agencies and affiliates of the Government of Italy

Introduction

It is perhaps indicative of the perverseness of mankind that only as we attained the ability to leave our planet did we exhibit any interest in what lay within it – particularly its embracing seas.

Now, at last, scientists and engineers the world over discover – almost on a daily basis – new illustrations of the ocean's resource potential. Of even greater relevance, they continue to find new uses of this power, for food, health, and even fun.

The power of aquatic alchemy, i.e., to transmute seawater into metals, feeds, and fertilizers, is by no means, however, limited to a few large industrial nations. It is found in small, even landlocked, countries where the only raw material necessary to discovery is an unfettered mind.

It was this remarkable spread of accomplishment which lead a few dedicated entrepreneurs to design and nurture the concept of an International Symposium on Coastal Ocean Space Utilization, or "COSU." COSU allows anyone with an idea to test it on an assemblage gathered biennially from more than a dozen ocean-active countries. The first two Conferences were held in 1989 and 1991 in New York City and Long Beach, California, respectively.

COSU III departed American shores for Genoa, Italy, partly owing to the historical significance of the time and place and partly in recognition of that nation's intellectual leadership in our field.

In four days of discussions nearly fifty papers, ranging broadly over Coastal Zone Management, man-made islands and large platforms, new sources of energy, and inter-country cooperation, were presented by academicians, industrialists, and government officials from fifteen countries.

The relationship of papers included herein to those actually given is not precisely one-to-one. A few of the participants were apparently prevented by one thing or another from submitting completed papers. In two other cases, papers submitted by nonparticipant were deemed sufficiently pertinent for inclusion.

Viewed in a certain perspective, possibly the most valuable aspect of the COSU series is that each conference in the series acts as a sort of training ground for its successor, as technology advances and the ocean's service to man continues to grow in both real and perceived importance. Looking back to 1989, several such advances in thoughts and deeds are discernible, and hopefully, COSU III will breed inspiring contributions to COSU's IV, V, and VI, already in planning stages.

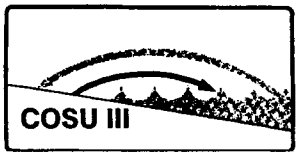
Finally, by its nature, COSU probably needs larger and more varied input than any other meeting of its type, and the officials responsible for COSU III were fortunate in finding and receiving much help from a number of sources. In this connection it is important to recognize the sponsors of the conference: The Consiglio Nazionale dell Recherche (Italy); Consortium Telerobot (Italy); Ente Nazionale per L'Energia Elettrica, S.p.A. (Italy); the U.S. National Science Foundation; U.S. National Oceanic and Atmospheric Administration; Regione Liguria (Italy); and Universita Di Genova (Italy), who furnished the resources to plan, coordinate, and execute the conference; and the Max and Victroia Dreyfus Foundation, which made possible the printing and publication of this book, and Rachel Jones, E&FN SPON, Chapman & Hall, Ltd. who arranged for its publication.

The staff of the Institute of Marine Environmental Sciences of the University of Genoa, directed by Dr. Mario Petrillo, Conference Coordinator, administered the conference superbly and the Davidson Laboratory of Stevens Institute of Technology translated the myriad software inputs into a common standard for publication. A special note of gratitude is due Mr. Joseph Vadus of NOAA – clearly the sparkplug of the COSU series. His hands are in evidence during all phases of the meeting's preparation and conduct.

Finally, the Co-Chairmen wish to acknowledge with deepest appreciation the intensive and dedicated effort put forth by our colleague, Editor Shirley Connell, without which, this book, once born, could never have left the delivery room.

Norberto Della Croce
Robert A. Abel
February 1995

PROGRAM ANNOUNCEMENT



THE THIRD INTERNATIONAL SYMPOSIUM

ON

COASTAL OCEAN SPACE UTILIZATION

MARGINAL SEAS: PROBLEMS & OPPORTUNITIES

HOSTED BY:

UNIVERSITÁ DI GENOVA

INSTITUTO DI SCIENZE AMBIENTALI MARINE

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Italy

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Inst. Marine Environmental Sciences
University of Genoa, Italy

COSU III

Coastal Ocean Space Utilization (COSU III) is the first in this symposium series to be held outside the United States. The theme of "Marginal Seas: Problems and Opportunities" encompasses and emphasizes harmonious, multiple uses of the world's many enclosed ocean regions. This symposium will present significant international developments which apply to coastal nations and regions facing similar environmental, political, social and economic challenges.

TUESDAY 30 MARCH, 1993

SYMPOSIUM REGISTRATION

Registration opens at 7:30 AM in the lobby area adjacent to the meeting room. Coffee and tea service will be available in the registration area throughout the symposium.

CONVENE THE SYMPOSIUM & INTRODUCTIONS

09:00-10:00

Remarks:

Joseph R. Vadus (*session moderator*)
Senior Advisor
National Ocean Service
National Oceanic and Atmospheric Administration (NOAA)
Washington, D.C.

OPENING ADDRESSES

Professor Norberto Della Croce

COSU III Co-Chairman
Director
Institute of Marine Environmental Sciences
University of Genoa

Mr. Norman Caplan

Head
Environmental & Ocean Systems
National Science Foundation
Washington, D.C.

Professor Sandro Pontremoli

Rector
University of Genoa

KEYNOTE ADDRESS

10:15-11:30

Inner and Outer Space: Technology for Ocean Observation and Assessment

Dr. Sylvia A. Earle
Hydronaut and former Chief Scientist
National Oceanic and Atmospheric Administration
Washington, D.C.

Protection and Management of the Coastal Area Among Bordering Countries (Ramoge Agreement)

Ing. Giovanni Gallino
Assessorship for the Environment
Regione Liguria
Genoa, Italy
&
Prof. Norberto Della Croce
University of Genoa

12:00 - 14:00

LUNCH

SESSION I. REGIONAL SEAS & EMBAYMENTS

14:00 - 18:00

Moderators: Professors Della Croce & Abel

First Approach for an Integrated Environmental Planning at Regional Level of the Coastal Marine System (Regione Liguria)

Arch. Lino Tirelli
Assessorship for the Environment
Regione Liguria
Genoa

The Baltic Sea

Dr. Gotthilf Hempel
Director
Baltic Sea Research Institute
Warnemünde, Germany

Egypt-Israel Cooperative Program

Dr. Robert B. Abel
Program Manager
New Jersey Marine Sciences Consortium

Shared Solutions for Land-Based Marine Pollution: Case of the Black Sea

Dr. Raphael Vartanov
Director
Institute of World Economy & International Relations
Russian Academy of Sciences
Moscow, Russia

Shared Solutions for Land-Based Pollution: Case of the Gulf of Mexico

Dr. James Broadus
Director
Marine Policy Center
Woods Hole Oceanographic Institution
Woods Hole, Massachusetts

Rio de la Plata Regional Maritime System: Potential for an Integrated Multifunction Offshore Complex

Ascensio C. Lara & Esteban L. Biondi
Catholic University of Argentina
&
Albina L. Lara
University del Salvador & Consejo Nacional de Investigaciones
Cientificas y Tecnicas, Argentina
&
Joseph R. Vadus
National Oceanic and Atmospheric Administration
Washington, D.C., U.S.A.

The Special Case of the Gulf of Aqaba

Dr. Mohammed Wahbeh
Director
Marine Science Center
Aqaba, Jordan

Latin America and the Caribbean: Utilization and Development of the Coastal Zone

Dr. Alberto G. Lonardi
Coordinator, Multinational Project on the Environment & Natural Resources
Department of Scientific & Technical Affairs
Organization of American States
Washington, D.C.

ADJOURN

18:00

INTERNATIONAL RECEPTION

18:00-20:00

Hors D'Oeuvres and Complimentary Wine Sampling at the Park Hotel Suisse

Sponsored by the hotel and the COSU III Committees

WEDNESDAY 31 MARCH

KEYNOTE ADDRESS

08:30 - 09:15

Russian Technology for Coastal Ocean Observations, Measurements and Assessments

Academician Vladimir E. Zuev
Chairman, Department of Oceans
Atmospheric Physics, and Geography
Russian Academy of Sciences
Moscow, Russia

SESSION II. NEW CONCEPTS IN THE GOVERNANCE OF OCEAN SPACE

09:15-11:30

Moderator: Prof. Nicola Greco, Edistudio, Rome

Management Issues in Coastal Lagoon Ecosystem: the Case of Venice Lagoon

Arch. Francesco Bandarin
Consortium "Venezia Nuova"
Palazzo Morosin
Venice

The Jersey Shore Partnership Inc.: The Role of the Public/Private Partnership in Governance of the Coastline

Senator S. T. Gagliano
President, Jersey Shore Partnership, Inc.
Giordano, Halleran & Ciesla
Middletown, New Jersey

Legal Rules, Administrative Planning and Negotiation to Solve Clashing Interests in Coastal Zones: Italian and Mediterranean Perspectives

Prof. Nicola Greco
Edistudio
Rome

Creative Financing for Coastal Ocean Ventures

Dennis de Vito and Dan Skowski
Chemical Bank of New York
&
Giuseppe Spotoforro
Chemical Bank of Italy

The Coastal Use Framework as a Methodological Tool for Coastal Area Management

Prof. Adalberto Vallega
Institute of Geographical Sciences
University of Genoa

Improvement in Mathematical Modelling for Shore Line Changes Evaluation: An Application to the Veneto Coast Case

Ing. Piero Ruol & Ing. Massimo Tondello
Institute of Maritime Constructions & Geotechnics
University of Padua
Padua, Italy

ECO^2: A New Concept in Coastal Management

Ing. Alfredo Fanara
Alenia Elsag Naval Systems
Genoa, Italy

12:00 - 14:00

LUNCH

SESSION III. THE COASTAL ENVIRONMENT: ASSESSMENT STANDARDS & ISSUES

14:00 - 18:00

Moderators: Mr. Charles N. Ehler, NOAA & Ing. Mario Tomasino, Head Hydrologic Service, ENEL, S.p.A., Mestre, Venice

Coastal Ocean Space Management: Challenges for the Next Decade

Mr. Charles N. Ehler, Director
Office of Ocean Resources Conservation & Assessment
NOAA
Rockville, Maryland

Reasonable Approach for Special Regulations and Standards to Enable Environmentally Sustainable Development in the Coastal Zone

Francisco Jose Montoya Font
Head, Coastal Service
Ministry of Public Works and Transports
Tarragona, Spain

A Sea Change for Oil Tanker Safety

Charles A. Bookman
Director, Marine Board
National Research Council
Washington, D.C.

Scientific Approach for Evaluating the Sites of Coastal Thermoelectric Power Stations

Ing. Mario Tomasino
Hydraulics & Structure Research Center
ENEL, S.p.A.
Mestre, Venice
&
Dr. Romano Ambrogi
Nuclear and Thermal Research Center
ENEL S.p.A.
Milan
&
Dr. Edmondo Ioannilli
Central Laboratory Unit
ENEL, S.p.A., Piacenza

Estuarine Dynamics and Global Change

Dr. Norbert Psuty, Associate Director
Institute of Marine and Coastal Sciences
Rutgers University
New Brunswick, New Jersey

Coastal Management: A New Approach for the Evaluation of the Beach Trend

Prof. Antonio Brambati
Institute of Geology and Paleontology
University of Trieste

Oceanography and Coastal Environmental Assessment: Two Case Studies of Different Areas in the Mediterranean and Adriatic Seas

Dr. Romano Ambrogi
ENEL, S.p.A., Milan
&
Dr. Giulio Queirazza
Nuclear and Thermal Research Center
ENEL, S.p.A., Milan
&
Prof. Tecla Zunini Sertorio
Institute for Marine Environmental Sciences
University of Genoa

Coastal-Dependent Marine Leisure Activities: Considerations of Economic Development and Environmental Conservation

Dr. Don Walsh
President
International Maritime Incorporated
San Pedro, California

Waste Management in the Coastal Ocean

Dr. Jerry Schubel, Dean
Marine Sciences Research Center
State University of New York
Stony Brook, N.Y.

IFREMER's Activities in Environmental Monitoring

Mr. Jean Jarry
Director
IFREMER Mediterranean Center
Toulon, France

Monitoring and Testing Programs for Identifying Ciguatera Fish Poisoning Risks

Douglas Park
&
Catherine Goldsmith
Hawaii Chemtect International
Pasadena, California

Large Marine Ecosystems: A New Concept in Ocean Management

Thomas Laughlin & Kenneth Sherman
National Oceanic and Atmospheric Administration
(To be read by Charles Ehler, time permitting.)

ADJOURN

18:00

THIS EVENING THERE WILL BE AN OPTIONAL SPECIAL DINNER FOR SPEAKERS AND PARTICIPANTS FOR AN ADDITIONAL CHARGE OF $25.

THURSDAY 1 APRIL

KEYNOTE ADDRESS

08:30 - 09:15

An Innovative Power Generation System From Sea Currents in the Messina Straits

Ing. Dario Berti
Tecnomare S.p.A.
Venice

SESSION IV. OCEAN RESOURCES & SUSTAINABLE DEVELOPMENT

09:15-11:30

Moderators: Mr. Terry Veness, DTI & Mr. Joseph R. Vadus, NOAA

A Multi-Purpose Approach to Coastal Zone Development: A Case Study

Dr. C. Y. Li
&
Dr. Karl Pan
Science & Technology Advisory Group
The Executive Yuan
Republic of China
Taipei, Taiwan

U.S. Ocean Resources & Technology Development

Dr. Patrick Takahashi
Director, Hawaii National Energy Institute
University of Hawaii

Wealth from the Oceans: A U.K. Program

Mr. Terry Veness
Department of Trade & Industry
United Kingdom
London

Coastal Ocean Space Development in Korea

Dr. Hyung Tack Huh
Korea Ocean Research & Development Institute
Seoul, Korea

Potential Impact of Algae Biotechnology on the Utilization of Coastal Areas

Dr. Riccardo Materassi
Autotrophic Microorganisms Study Center
National Research Council

12:00 - 14:00

LUNCH

SESSION IV. OCEAN RESOURCES & SUSTAINABLE DEVELOPMENT (CONTINUED)

14:00 - 18:00

Moderators: Mr. Terry Veness, DTI & Mr. Joseph Vadus, NOAA

Lobster Ranching in Coastal Waters

Prof. Jens G. Balchen
Division of Engineering Cybernetics
Norwegian Institute of Technology
Trondheim, Norway

Derivation of Beta-Carotene from Marine Organisms

Prof. Ami Ben Amotz
Institute of Oceanographic & Limnological Research
Haifa, Israel

Marine Biotechnology Applications in the Coastal Oceans

Dr. Rita Colwell
President
Maryland Biotechnology Institute
University of Maryland System

Potential of Wave Energy for Coastal Applications

Dr. Even Mehlum
President, Norwave A.S.
Lysaker, Norway

Singling Out of New Breeding Species for a Better Strategy in Aquaculture and Mariculture

Prof. Francesco Faranda
Institute of Marine Environmental Sciences
University of Genoa

Artificial Habitats for Rearing Slow-Growing Marine Invertebrates

G.C. Albertelli, G. Bavestrello, R. Catteneo-Vietti, E. Olivari, & M. Petrillo
Applied Marine Studies Center
University of Genoa

Sustainable Coastal Development Through Integrated Coastal Policy, via Building With Nature

Dr. Ronald Waterman
The Hague, Netherlands

The Environmentally Sound Disposal of Waste in an Offshore Island Developed for Multipurpose Uses

Walter Tengelsen
Chairman, MACROSYSTEMS Inst.
Fort Lee, New Jersey

ADJOURN

(EVENING FREE)

FRIDAY 2 APRIL

KEYNOTE ADDRESS

08:30 - 09:15

Coastal Development in Harmony with the Environment

Dr. Willard Bascom
Ocean Engineer & Scientist
Long Beach, California

SESSION V. OCEAN SPACE DEVELOPMENT & RELATED TECHNOLOGIES

09:15 - 11:30

Moderators: Mr. Norman Caplan, NSF & Professor Ezio Volta, D.I.S.T. Faculty of Engineering, University of Genoa

Very Large Platforms for Floating Offshore Facilities

Dr. Hajime Inoue
Director-General
Ship Research Institute
Ministry of Transport
Government of Japan
Tokyo

Technology for Coastal Development Activities in Japan

Dr. Hajime Tsuchida
Director
Coastal Development Institute of Technology
Tokyo, Japan

Advances in Coastal Ocean Space Utilization: Artificial Islands and Floating Cities

Prof. Takeo Kondo
Nihon University
Tokyo

Large Scale, Multi-Purpose Artificial Island Development Near the Gaza Strip

Prof. Ernst Frankel
Department of Ocean Engineering
Massachusetts Institute of Technology
Cambridge, Massachusetts

Changing Nature of Ports in Coastal Management

Mr. Gerhardt Muller
Port Authority of New York & New Jersey
New York, N.Y.

Technological Innovations for Marine Geology: General Views and Apllications of Advanced Robotics

Ing. Ettore Gallo
Consortium Telerobot
Genoa, Italy
&
Com. Gian Luigi Figari
Environmental Division
Ansaldo Industries
Genoa, Italy

Development of Artificial Reclaimed Lands and their Integrated Planning in Taiwan, ROC

Dr. Ho-Shong Hou
Institute of Transportation
Ministry of Transportation & Communications
Republic of China
Taipei, Taiwan

Underwater Road Link in the Gulf of Naples: A Case Study for EIA in Coastal Zone

Dr. Marco Berta
Tecnomare S.p.A.
Venice

12:00 - 14:00

LUNCH

SESSION VI. SUMMING UP COSU III

14:00 - 15:30

Moderators: Professor Della Croce & Dr. Abel

Agenda:

- Reports by co-chairs of each session
- Open discussion of the program, questions and answers
- COSU III critique for future meeting planning
- Closing remarks by Professor Della Croce

COSU III ADJOURNS

FAREWELL WINE AND CHEESE RECEPTION TO BE HELD IN THE CONFERENCE AREA, HOTEL PARK SUISSE
HOSTED BY THE HOTEL AND COSUIII ORGANIZERS 17:00 - 18:30

Opening Address

The Coastal Ocean - Challenges and Opportunities

Norman Caplan, Head
Environmental and Ocean Systems
National Science Foundation, Washington, D.C.

On behalf of the United States and the National Science Foundation, I would like to welcome you to this extremely important meeting.

The COSU International Symposium series was originated and continues because of the deep concern that many of us have for the coastal ocean. A concern that goes beyond a longing for the pristine environment that existed in bygone days, and extends to the opportunities that are available to use the ocean for the benefit of mankind. This is where we discover the first problem: 'for the benefit of mankind' has many meanings and different interpretations. One hundred years ago, at the height of the industrial revolution, the coastline was used to play host to piers, harbors, warehouses that soon became rat-infested, and other facilities involved with shipping and the transportation of goods. Soon, coal burning power plants, mills, and other industrial facilities filled the waterfront, since these areas were undesirable, inexpensive, and provided quick and cheap access. The harbors and coastal ocean deteriorated rapidly for the 'benefit of mankind'.

Today we have an opportunity and a challenge to reverse that condition and move forward in a responsible manner to use and enjoy our coastal ocean. In the rush to use the coastline irresponsibly, the real wealth that could have been derived from this natural resource was neglected. Everyone has their own list of natural, mineral, and living resources that represent wealth and jobs, as well as beauty and recreation. This challenge and opportunity is being referred to as *sustainable development.*

In the United Nations report entitled, "Our Common Future," published by the Oxford University Press in 1987, a definition of sustainable (here somewhat shortened and paraphrased) was put forth as follows:

> Sustainable Development is a process of change in which the direction of investment, the orientation of technology, the allocation of resources, and the development and functioning of institutions meet present needs and aspirations without endangering the capacity of natural systems to absorb the effects of human activities, and without compromising the ability of future generations to meet their own needs and aspirations.

I believe that this is the challenge and opportunity that we now have as leaders in the planning and use of the coastal ocean. This is the theme that I want to establish, and this is the reason to support the COSU series of symposia, as another small step in a very difficult process of change. A great deal of the problem is the process to change; changes in the attitude of governments and their allocation of financial resources, change in the philosophy of industry in a market driven economy, change in the understanding of the ordinary people to give them a better appreciation of the problem, and changes in the international perception of developing countries versus industrialized countries. Everyone knows the list of problems that will be present. The process is capital intensive; investment must be attracted (and that means return on investment); human resources are required; government/industry/university partnerships must be forged; and dedicated people are needed to influence the policymakers. People, communities, and policymakers are rigid and reject change.

Table 1

Role of Engineering in Sustainable Development

* Remediation technology for existing problems
* Life cycle product design
* Sustainable use of the water column
* Sustainable resource recovery
* Monitoring instrumentation and vehicles
* Environmental compatible structures
* System modeling and risk management
* Transportation and recreation with no environmental insult
* Economic analysis

What can we do to contribute to this very important crusade? Most of us are not politicians or policymakers, but we are scientists and engineers. Therefore we have a better than average appreciation and understanding of the problems involved with developing and utilizing the coastal ocean. At this point in time, we have to develop the information and the technology and, most important, we have to articulate the case for coastal ocean space utilization. Table 1 shows a few of the activities that are of direct interest to the National Science Foundation (NSF) and the programs in our Engineering Directorate. Our long-range planning committees have cited environmental technology and sustainable development as two areas that are high-priority in the next five years. Several other organizations within

NSF, including Ocean Sciences, Marine Biotechnology, and our economics groups, have expressed an interest.

That brings us back to this meeting and the challenge that we face. I believe that most of the people in this room agree with the need for a new approach to our coastal oceans. In addition, we have gathered here the scientists and technologists who understand the problems and are capable of generating realistic plans that can be presented to policymakers at all levels. In my view the key to this task is the realistic and intelligent use of modern, high technology to provide the tools and the systems for sustainable development of the coastal ocean. At the National Science Foundation, we are chartered with the task of developing new knowledge in science and engineering. In my Directorate (Engineering), we are in the process of generating strategic plans and highlighting strategic societal needs. One of these needs is sustainable development and another is civil infrastructure. Each of our programs: electrical, mechanical, materials processing, chemical engineering, manufacturing, and engineering education, will contribute by supporting research that develops the new knowledge to promote the technology needed to develop the coastal ocean. This is a long and difficult task, but we are determined to make a contribution and help get our message across by supporting meetings such as this, along with our Italian colleagues.

Which brings me, in closing, to say that the experience of working with Professor Della Croce has been outstanding. He has been patient and cooperative over the difficult months that preceded this day. I wish to thank him and also Dr. Able for their cooperation and hard work in developing what should be a stimulating and productive meeting. I am looking forward to the next few days, interacting with all of you and learning a great deal.

Opening Address

Greetings from the University of Genoa

Sandro Pontremoli, Rector
University of Genoa, Genoa, Italy

I am delighted to have the honor of opening and hosting this Third International Conference on Coastal Ocean Space Utilization, especially considering that this is the first of the series to be convened outside of the United States.

In view of the myriad of shared problems and opportunities confronting our two great nations, it is most appropriate that Genoa be selected as the site for this Conference. First, the University of Genoa under Dr. Della Croce's inspired guidance has taken a commanding lead in approaching Italy's coastal and offshore issues. Secondly, these issues -- living and mineral resources, environmental protection, aquatic recreation and tourism, to name a few -- penetrate all sectors of Italy's economic growth, cultural enhancement, and general welfare. Third, as it must be quite apparent to all of us here, Genoa and the year 1992 enjoy particular significance in American history.

Thus for those and many more reasons, I am pleased beyond words to welcome you all and hope that you will avail yourselves to the fullest of our famous Italian hospitality. Again, thank you for inviting and honoring me on this most significant occasion.

Keynote Address

Protection and Management of the Coastal Area Among Bordering Countries (Ramoge Agreement)

Dr. Ing. Giovanni Gallino
Assessorship for the Environment, Regione Liguria.

Prof. Norberto Della Croce
Director - Institute of Marine Environmental Sciences, University of Genova.

INTRODUCTION

During the opening session of the 32nd Convention, Plenary Assembly of the Commission Internationale pour l'Exploration Scientifique de la Mer Méditeranée (CIESM), held in Rome in December 1970, Prince Ranieri III of Monaco, Commission Chairman, suggested that a test area for the elimination of pollution be created within the framework of the Etudes en Commun de la Méditerranée (ECM).

Also in 1970, the Italian Commission for Oceanography stated that the correction of pollution discovered in the Upper Tyrrhenian Sea was one of its main goals for 1971 and 1972: this resulted in the proposal of the RIMAT project.

The Monegasque initiative was favorably accepted by the French and Italian governments and the project was called RAMOGE, taking the first syllables of St. Raphael, Monaco, and Genoa; cities located in the test area.

In 1972, the proposal by Prince Ranieri III found response in a meeting held by Italian-French-Monegasque experts, who drew up a report on coastal conditions in the RAMOGE test area.

On May 10th, 1976, the three governments signed the RAMOGE agreement, concerned with preserving the quality of Mediterranean coastal waters, preventing their pollution as much as possible, and improving their current conditions.

The initiative involves an area of considerable tourist and economic importance and it points out the top priority of environmental protection which requires the combined and coordinated efforts of the three, Riviera towns.

First and foremost, the RAMOGE agreement, which was ratified and became effective in 1981, defined its organization, the goals to pursue, and the development of its actions, depending on the methods used.

The time lapse between the agreement's ideation and enactment points out how, in an international situation, operative mechanisms are considerably complex; in this case, this complexity is increased by the fact that the issue is relatively new.

THE AGREEMENT'S STRUCTURE

The institutional body governing the Agreement is the trilateral, international Commission with the help of a Technical Committee and several Work Groups.

Briefly, the Commission consists of three Delegations. Each Delegation is comprised of a Head Delegate and six Delegates. Each Country adds to these Delegates, representatives of the territorial bodies concerned (Regions). The Commission has a Chairman who remains in office for two years; the chairmanship is assigned, in turns, to the Head Delegate of each country. Originally, the Technical Committee consisted of fifteen experts, five from each country. From March 30, 1990, however, the organization of this Committee foresees the presence of four experts from each country who are to be appointed, preferably from among the representatives of the technical services of the local Bodies. After the Commission's consensus, the Technical Committee may benefit from the cooperation of experts who make up part of the work Groups, depending on the initiatives undertaken within the range of its activity.

Since the Agreement's first phases, Secretariat services have been taken care of by the Principality of Monaco.

The Delegations and the Technical Committee members are appointed by the Government; however, the Government does not appoint the experts who are going to be part of the Delegations.

The Commission's regulations mandate that each Delegation has one vote to be expressed by the Head Delegate. All the Commission's decisions must be voted unanimously.

Common interest expenses are divided as follows: 45% France, 45% Italy, and 10% Principality of Monaco, whereas the expenses corresponding to extraordinary research are subdivided depending on the case.

During 1992, the Commission met seventeen times.

GOALS PURSUED BY THE AGREEMENT

At the time of the Commission's creation, its scope was defined as establishing closer cooperation between the existing services of the three Governments in order to fight pollution in territorial and continental shelf waters. This goal must be achieved by means of the following activities:

1. Analysis of all common problems as far as water pollution is concerned
2. Definition of the competent, administrative services of the three countries in order to
   a) point out polluted areas
   b) obtain mutual information on territorial re-organization projects that entail serious pollution risk
   c) analyze, in economic terms, the necessary infrastructures and equipment to fight pollution
3. Promotion of different forms of goal-oriented, scientific cooperation, bearing in mind already existing work and material means
4. Propose to the three Governments, all the suitable measures for water protection by means of special agreements

THE COMMISSION'S ACTIVITY

Since this is an International Commission dealing with problems inherent to the pollution of the waters between bordering countries and therefore, the aspects of the topics being discussed are rather

complicated and susceptible to change, it is easy to understand the confusion that has characterized the Agreement's evolution.

At the initial, informal meetings, the Delegations presented and discussed various topics and tasks, among which the following had priority:

1. Coast reclamation
2. Reclaimed area surveillance
3. Hygienic conditions and cleanliness of beaches
4. Information

Five Work Groups were also planned.

1. Marine environment surveillance
2. Reclamation program
3. Legal matters
4. Fight against accidental pollution
5. Information and enhancement of public awareness

It will be seen that the Work Groups that were finally set up were quite different from those just mentioned.

The Delegations discussed whether or not the Work Groups should be set up from the beginning of the Commission's work, and, above all, highlighted tasks and goals that did not find easy or unanimous approval.

At this point, is seems correct to mention the goals stated and pursued, following the first meeting held by the Commission in February 1982, ten years after the first meeting held by the Italian-French-Monegasque experts.

Having defined the range of its activity, as well as that of the Technical Committee and Work Groups, the Commission established the following priority goals:

1. Mutual information regarding the prevention and fight against pollution on administrative, technical, and scientific levels
2. Inventory of marine environment polluting sources coming directly or indirectly from either the continent or the sea
3. Assessment of marine environmental quality on the basis of the scientific work carried out in various applicable disciplines
4. State of the programs for action against pollution, pointing out already existing and future structures, as well as action programs in case of accidental pollution
5. Comparison between all the regulations concerning marine environmental protection

Furthermore, while the Commission believes that particular attention should be devoted to spreading information in order to enhance public awareness of Mediterranean coastal protection, it recommended that the utmost care be taken to prevent uncontrolled use of collected data exchanged between the countries. The Commission entrusted the Technical Committee with the task of initially overseeing these priority activities.

GOAL 1: MUTUAL INFORMATION

In 1972, the data available on the RAMOGE area were summarized in a general document, presented according to the following outline:

1. Administrative and Legal Aspects

2. Scientific and Technical Aspects
   a) Oceanographic information
   b) Information on pollutants and their origin
   c) Influence of pollution on fauna and flora
   d) Consequences of marine pollution on health
   e) Analysis of maps and documents drawn up by the administrative authorities of the test area
   f) Sewage plants
   g) Comments on coastal reclamation projects

The document drawn up in 1972 by groups of Italian-French-Monegasque experts for the administrative and scientific parts and which represents the basis of the Agreement, was analyzed during the first meeting held by the Commission in March 1982. This document was adequately integrated with notes supplied by the corresponding Delegations.

In order to pursue the defined goals, the Commission entrusted the Technical Committee, helped by several Work Groups, with the task of working in the various fields of research on both technical and scientific levels.

Considering that the activities necessary to achieve the goals stated in Goal 1 may be considered as a compendium of those activities geared towards pursuing the objectives of the following points, the undertaken actions are described below.

GOAL 2: INVENTORY OF MARINE ENVIRONMENT POLLUTION SOURCES

The first activity consists in measuring sewage dumped from public sewers into the sea, regardless of whether it was directly conveyed or arrived through surface waterways.

The inventory of the coast's industrial waste network was postponed.

In the case of the coast's urban sewage being directly dumped into the sea, the following data was collected:

1. Pipeline
   a) Length (in meters)
   b) Cross-section area (in square cm)
   c) Discharge depth (in meters)
2. Polluting Load
   a) Mean flow rate (l/s)
   b) Polluting content in BOD5 (mg/l)
3. Treatment prior to dumping
   a) Primary
   b) Secondary
   c) Tertiary

Concerning the waste directly dumped into the sea through surface waterways, it was deemed adequate to characterize each waterway with a hydrographic basin of a certain magnitude by gathering the data listed in the following diagram. These data give a general idea on the relevance of the polluting contents conveyed to the sea by each waterway.

However, it must be noted that, apart from the date of the last population census (1987 in Italy and 1982 in France), BOD5 calculation does not lend itself to particular comparisons if one considers that for the Regione Liguria the entire population of the emptying basin was considered with the sole exception of cities on the coast, whereas for France and the Principality of Monaco, the calculation failed to include the coast cities and the populations which are already linked to the sewage network that

dumps directly into the sea. The lack of uniformity of the data in this instance makes it difficult to estimate the inputs into the marine system and, therefore, it is hard to assess the environmental impact, should one want to examine other aspects of the emptying basins.

Because of this, the data sheet that groups together emptying basins data shows differences in the Italian and French versions, a fact that underlines how different approaches to the same problem may lead to difficult data interpretation and evaluation. The differences are even more marked when considering the relevance of seasonal population fluctuations in the RAMOGE area, since the Italian and French Rivieras are popular tourist and sea-bathing resorts.

Table 1

Emptying Basin

Physical Aspects
1. Emptying basin maps in 1:100,000 or 1:200,000 scale
2. Resident population estimate
3. Fluctuating population estimate
4. Classified flow-rate curve
5. Flow-rate measuring stations yearly chart
6. Monthly flow rates mean curves
7. Purification plants inventory
8. Localization of direct and indirect sewage sources (optional)

Theoretical Polluting Loads Estimate Expressed in BOD5
1. Produced:
   a) By inhabitants (54 grams/inhabitant/day)
   b) By industrial equivalents

Measurements at River Mouths
1. Flow rates
2. Temperatures
3. Suspended matter
4. Nutrient salts:
   a) Nitrates
   b) Nitrites
   c) Ammonia
   d) Phosphates
   e) Silicates
5. Heavy metals
   a) Cadmium
   b) Copper
   c) Lead
   d) Mercury
6. Anionic detergents

Table 2

Italian and French Questionnaire

General Data
1. Name of the Municipality
2. Resident population
3. Seasonal population
4. Duration of the population fluctuation period

Garbage Collection
5. Number of inhabitants served by garbage collection service
   a) During a normal period
   b) During a population fluctuation period
6. Overall yearly quantity of collected garbage
7. Number of inhabitants served by a bulky garbage collection service
   a) During a normal period
8. Is there a special collection service for other types of waste?

Waste Treatment
9. Household waste destination
   a) Incinerating unit
   b) Composting
   c) Authorized dumping sites
      (1) Public
      (2) Private
   d) Other
10. Purification plant sludge destination
11. Industrial waste destination
12. Bulky garbage destination
13. Existence of illegal dumping sites
   a) Number
14. Existence of programs to eliminate illegal deposit areas
   a) Number
15. Existence of projects for waste-treatment units creation
   a) Type
   b) Deadline
   c) Description

Also within the range of activities concerning pollution sources, the potential quality of solid urban waste dumped into the sea was assessed by calculating the quantity of waste produced by the single user basin involving the RAMOGE area (identifying them with main waterways basins). Guidelines were then drawn up, listing the following parameters for each basin:

1. Emptying basin
2. Surface area in sq. km.
3. Number of Municipalities grouped in the emptying basin
4. Kilometers of coastline of the emptying basin
5. Resident population

6. Maximum population
7. Duration, in days, of population fluctuations
8. Percentage of inhabitants served by the garbage collection service during normal periods
9. Percentage of inhabitants served by the garbage collection service during periods of fluctuations
10. Percentage of inhabitants served by bulky garbage collection service
11. Yearly quantity of collected waste (in tons)
12. Emptying basin specific waste production (in kg/day/inhabitant)
13. Yearly theoretical quantity of produced waste (in tons)
14. Number of incinerating plants
15. Number of composting plants
16. Number of authorized dumping sites
17. Number of other plants
18. Number of projects for the creation of waste treatment units

Part of the data came from a study carried out using the following questionnaire on waste which was especially drawn up for Municipalities, which when completed highlighted the fact that the Italian and French experts adopted slightly different items for the qualification of certain parameters.

In order to gather additional information on the quantity of solid waste that may reach the sea in the RAMOGE area and to study its possibility of shifting towards the above-mentioned area, data were collected on:

1. Beached macro-waste
2. Waste floating in coastal waters

Concerning item 1., observations were made during a campaign where waste found on the beaches of six Italian towns, six French towns, and Montecarlo was collected and analyzed on pre-set days, determining its quantity, origin, source (where possible), and type, as a function of the surface area of the beaches used for the test (Italy was not able to provide an analysis of the origin of the waste collected on its beaches).

As for point 2., an identical type of analysis was carried out on the quantity and quality of floating waste collected at sea by special boats during the summer periods.

Both campaigns took place during the 1986/1988 period.

Data was collected using the following outline that foresees the collection of the listed information and for the campaign on floating waste, the item algae was added.

Table 3

Data on Beached Solid Waste

1. Municipality
2. Date
3. Coast
   a) Length in meters
   b) Surface in square meters
4. Total solid waste (in 100 kg units)
   a) Plastic (in 100 kg units)
   b) Wood (in 100 kg units) and in %
   c) Other (in 100 kg units) and in %

These analyses achieved results that may be considered revealing concerning the type of waste, but were not very accurate as far as quantity and distribution are concerned.

The main conclusions may be summarized as follows:

1. Wastes of manmade origin represent approximately 38% of the total and, generally speaking it consists of plastic materials (approximately 20% of the total).
2. In Liguria, waste of natural origin (wood) adds up to approximately 26% of the total against 47% in the District of the Maritime Alps.
3. Other waste is present in both areas in similar quantities (35 -36%).
4. Beached waste of Italian origin rapidly decreases as one moves along the Monegasque and French territories.

For the time being, maritime traffic has not yet been analyzed, whereas there is a census of the ports where each port's activity and size is specified.

GOAL 3: MARINE ENVIRONMENTAL QUALITY ASSESSMENT

In this case, a joint campaign for data collection on water quality in the sample area of sea between the mouths of the Var and Roja rivers was carried out. Data was collected according to what is described in the following chart and it was interpreted in the report supplied to the Governments by the Member Countries.

During this campaign, marine environment quality was assessed as follows:

Table 4

Marine Environment Quality Assessment

1. Hydrology
2. Marine organisms contamination by heavy metals or enteric bacteria
3. Nutrients distribution
4. Discharge of suspended matter and corresponding heavy metal contamination resent in the suspended matter
   a) suspended matter discharge
   b) metal contamination of suspended matter
   c) comparison between the concentrations of heavy metals dissolved in seawater and heavy metals associated with seawater particles in coastal areas
   d) plankton characteristics and distribution in the RAMOGE seawater

GOAL 4: STATE OF THE ACTION PROGRAMS AGAINST POLLUTION

The assessment of action programs has provided, through the collection of the Region's planning documents, a sense of the existing and planned purification structures for this area.

In particular, information on the existing and planned structures which discharge directly into the sea or into major waterways flowing into the RAMOGE area was collected and the data presented in map form.

Unfortunately, it should be noted that the RAMOGE activity did not sufficiently stimulate Governments to construct purification infrastructures in the area in question, even though during the period of RAMOGE'S activity, relevant works were carried out, such as water-purification plants in Savona, Sanremo, Ventimiglia, Bordighera, MonteCarlo, and Nice.

Among the action programs to be used in case of accidental pollution in the RAMOGE area was a Commission draft of a joint Emergency Plan. This plan, which was about to be implemented during the Haven oil tanker accident, was proposed to the Governments concerned for its expeditious adoption. The three Countries are working to complete all the respective administrative requirements in order to make this plan operative as quickly as possible.

It may be said that this last activity will certainly prove to be the most impactful one from a practical standpoint.

GOAL 5: COMPARISON BETWEEN ALL THE REGULATIONS

One of the Work Groups drafted the following Summary Note which proved to be extremely helpful in comparing the various regulations in force concerning marine environmental protection.

Unfortunately this exercise stressed the differences of the laws and, as a consequence, the adoption of homogeneous regulations in the three countries was not achieved. It is true nevertheless, that there will have to be a form of homogenation, at least as far as Italy and France are concerned, in accepting European Economic Community (EEC) directives.

Table 5

Summarizing Note: Comparison between Regulations

TITLE 1 SAMPLING
TITLE 2 GENERAL DUMPING RESTRICTIONS
TITLE 3 SEWAGE DUMPING REGULATION
- CHAPTER 1 Coming from the coast
  - Sec. 1 General provisions
    - Preliminary authorization
  - Sec. 2 Specific provisions
    - Industrial waste
    - Other waste
- CHAPTER 2 Coming from ships
  - Sec. 1 Dumping of waste and dregging products into the sea, including accidental dumping
  - Sec. 2 Dumping of hydrocarbons and toxic substances
  - Sec. 3 Incineration
  - Sec. 4 Pleasure boats
- CHAPTER 3 Coming from the continental shelf
- CHAPTER 4 Beaches and bathing water
  - Sec. 1 Beach cleanliness
  - Sec. 2 Bathing water quality
- CHAPTER 5 Marine reserves

To supply information and promote environmental protection, the Commission produced an audiovisual document for schoolchildren that was not very successful, perhaps because of the different ways in which schools are organized in the three countries and the different equipment available. Likewise, a text for lower high school teachers was produced, hoping it may be used for short lessons to foster awareness on environmental problems typical of this area.

Additionally the Commission promoted the A. Vatrican Award in memory of RAMOGE'S first Secretary General, for the implementation of a study protocol on marine pollution in the RAMOGE area. This prize was awarded for the first time in 1991.

Currently, the possibility of organizing a contest for compulsory-school students (primary and lower high schools) on marine environment protection is being studied.

GENERAL OBSERVATIONS ON THE ACTIVITIES CARRIED OUT THUS FAR

The essential and decisive activity contemplated by the RAMOGE agreement is the measurement of pollutants in coastal water, originating from household waste dumping which is insufficiently treated or inadequately disposed of into waterways or conveyed to the sea by means of pipelines.

A goal of considerable importance, attained in full, deals with pipeline inventory and localization, thus making it possible to calculate the polluting content. Waterways situations are more complex, such as in the Var and Roja Rivers, whose contents, when dumped into the sea, are the result of the combination of various factors, and are characterized by the great variability of their water volumes and, therefore, the great variability of polluting element concentrations.

Apart from the results obtained by the Work Groups, discussion is still open on the assessment method of the loads carried by basins and waterways into the sea of suspended matter, heavy metals, and nutrients concentrations and on possible quali/quantitative waterways standardization. The organic load, expressed in BOD5, has been theoretically estimated on the basis of emptying basin populations (in the measure of 54 grams/day/inhabitant), bearing in mind the industrial equivalents and rivers' flow rates. In any case, it was found that, notwithstanding the great effort to collect the existing data on basins emptying into the RAMOGE area, the information gathered was deemed insufficient to give a precise idea on their discharged into the sea. In this instance, too, it is being debated whether the collected data ought to be completed by means of systematic reading of certain qualitative parameters of a well-defined series.

Generally speaking, it is believed that information integration would allow for the possible orientation toward actions already marked by a commitment in fighting pollution.

RAMOGE's activity in determining marine environmental quality was carried out through a series of campaigns, initially defined as joint area surveillance campaigns and then as joint campaigns. During these campaigns, a series of analyses was carried out on mussels and sea urchins gathered on the coasts of the three countries, as well as a series of observations in correspondence to the mouths of the RAMOGE area's main rivers (Roja and Var) and along the coast between these two mouths. The specific site of these observations, like the topic dealt with in this report, exclude the possibility of examining the ad hoc technical report which analyzes the results.

The program foresaw the continuation of the study at the mouths of the RAMOGE area's main rivers.

MAIN ACHIEVEMENTS

It was impossible to carry out a global analysis of the state of the three countries' action programs to fight marine pollution as was originally envisaged. Without returning to the pipelines and purification plants issues, it may be more interesting to mention the main achievements, making reference to what is outlined in the notes presented by the individual, participating countries.

The front of the RAMOGE area, as is well-known, is essentially dedicated to activities such as tourism, sea bathing, and pleasure boating.

The French aimed mainly at improving the bacteriological quality of coastal waters and in solid waste management. Concerning water quality control of the waters subject to intense bathing activity, in the District of the Maritime Alps which includes sixteen towns along a 120 kilometer-long coastline (forty of which are beaches), 164 check points have been set up, making it possible to classify hygienic conditions.

The reclamation of the RAMOGE coastal area, i.e., the reduction from 40% to 8% of the beaches classified as no bathing, is linked to the restructuring of municipal waterworks, the creation of purification plants, the recording of dry season flow rates, the elimination of 46% of illegal sewage dumping sites, and the mechanical removal of floating waste from water sheets. Furthermore, during the summer period, coastal surveillance is carried out from the air, thus making it possible to pinpoint, for example, illicit dumping along the coast from ships, to check the working conditions of pipelines, and adequately direct scavenger boats. As for household waste, it is reported that only 3% of the municipalities do not have this type of garbage collection service and that more that 200 irregular dumping sites and deposits have been closed or cleaned up; whereas thirty intermediate deposit units for bulky garbage and for the collection of recyclable waste have been set up.

On the Italian side, the antipollution plan in the RAMOGE area mainly deals with the purification of urban effluents, giving priority to the building of purification plants in the cities close to the French border (Ventimiglia, Bordighera, and Sanremo) and for large urban and industrial centers like Savona and Vado Ligure. Concerning sea bathing in the RAMOGE area, 197 check points to monitor water quality have been set up along an approximately 170 kilometer-long coastal front which includes thirty-eight towns. Coastal strip reclamation has reduced to 14% the number of points where sea bathing is forbidden, according to the standards set by the Italian laws. Scavenger boats for floating waste collection were not used on a large scale.

In the Principality of Monaco, initiatives mainly concentrated on urban effluents and those of peripheral municipalities which were planning pre-treatment and purification plants as well as pipelines directly dumping into the sea. Boats for floating waste removal were also used in the waters of the Principality.

During the 1982-1990 period, apart from press conferences and within the limits of the means assigned for this purpose, the Commission promoted a series of joint initiatives to enhance public awareness on coastal water protection. Along with propaganda events, in order to enact the guidelines outlined during the eighth meeting (1987), the Commission decided to promote the Alain Vatrican Award, in memory of RAMOGE's first Secretary General, for a student or young researcher who is involved, either directly or indirectly, with marine pollution and its consequences in the RAMOGE area. The award, 30,000 French Francs (1990), was given for the first time during the 1990-1991 academic year. The Commission's Report states that the analysis of predicted and already taken actions reveals the inadequacy of the methods and means available, as compared to the importance of enhancing public awareness.

An instructional instrument for lower high school teachers was produced. It will be distributed during the course of the next school year.

Among the initiatives undertaken, the most recent, and certainly most important, consists in the drafting of a joint action Plan in case of accidental seawater pollution and the proposal to make the Governments in question adopt it.

The recently approved extension of RAMOGE's boundaries from La Spezia to Marseille implies, as a consequence, that measurements and data collection must be extended in the near future to the areas that have not yet been investigated.

RECOMMENDATIONS FOR THE GOVERNMENTS

It has been suggested by the Commission that the countries take most seriously the importance of preparing the complete inventory of industrial waste dumping, both direct (coastal) and indirect (waterways), and the inventory of all direct and indirect dumping into waterways on the RAMOGE area's basins.

The three countries are encouraged to disseminate information to the general public to reduce the dumping of objects (particularly plastic ones) into the sea and onto beaches by either boaters or sea bathers. Additionally, they are encouraged to reclaim valleys and to clean up illegal dumping sites.

On the basis of the results obtained from the investigations carried out on emptying basins, it is suggested that the countries take necessary measures to proceed, in a coordinated manner, with measurements at the mouths of the waterways to better understand the importance of pollution draining into the sea from RAMOGE's emptying basins.

As for determining marine environmental quality, the Commission has no recommendations to address to the governments of the three Countries; merely guidelines and encouragements.

The Commission feels that the achievements of the three participants in the RAMOGE area over the 1972-1990 period are important and, therefore, recommends that the countries pursue this effort in terms of purifying both coastal dumping sites and the sewage that flows into the waterways of the RAMOGE area's emptying basins.

Considering the analysis and regulations comparison, the Commission recommends that the following be encouraged:

1. In-depth study of shared information on how to organize prevention and fight against pollution;
2. To look for points in common for regulation compatibility;
3. Formulation of concrete proposals for achieving shared goals as quickly as possible (especially for Italy and France) within the time limits indicated in the corresponding EEC directives.

The Commission, acknowledging the importance of the progress made so far, agrees that this task is far from being completed. And while acknowledging that the inventories, studies, and conclusions produced are important and full of information, the Commission admits that it took too long to achieve them and this limits their relevance and possible use. Likewise, the Commission acknowledges that the outcome of the work carried out by the experts that may be directly exploited by the countries at the end of the studies, is limited.

The Commission points out that the slow progress of the works, mainly caused by lack of ad hoc personnel, may also be partly explained by a lack of clarity in the definition of the goals to be attained, tasks to be carried out, and methods to be applied for their achievement, as well as by insufficient rigor in carrying out the actions and in deadline observance.

CONCLUSIONS

This experience should reveal, more indirectly than directly, the difficulties that arise between bordering countries even when it is clear that they are willing to cooperate when facing shared coastal strip pollution problems.

In its Report to the French, Italian, and Monegasque governments, the Commission points out the need to redirect the efforts of the partners of the RAMOGE project.

Regional Seas and Embayments

1

First Approach for an Integrated Environmental Planning at Regional Level of the Coastal Marine System (Regione Liguria)

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INTRODUCTION

This report is aimed at providing information about the first steps that the Ligurian Region is taking concerning the planning of its activities for the defense of the marine environment; both to preserve it from pollution caused by economic operators and by the Ligurian community which dwells near its banks and to promote improvement of environmental conditions that impact the marine resources of the Ligurian region.

As commonly happens in coastal regions, it is evident that the relationship between the sea and land is not only extensive, but structurally strong due to the morphology of the Ligurian territory which is distinguished by a stretch of harsh mountains reaching down towards the sea along a fine borderline. Additionally, this relationship is fragile, due to the precarious environmental equilibria involved, as it is full of settlements and connecting infrastructures. The most relevant cities and their confused urban sprawl are developed in the sections of the coastline which assume, for a minimum width (several hundred metres), the characteristics of an alluvial plain or a hill with a minor acclivity. This same stretch is also the home of a system of channels of a local, national, and international character. Due to the tourist industry, which in turn is directly related to the environmental quality of the territory, infrastructures and settlements are seasonally burdened by tourists, especially along the narrow stretch of coastline. Moreover, the presence of important harbor outlets sets the stage for further exchange of goods (including very hazardous energy products) which present potential dangers to the marine spaces of access, as well as to the valleys running perpendicular to the coast which flow into the same outlets. The scarce environmental resources of the narrow coastline are utilized apart from any reasonable standard of utilization, by extra-regional energy plants and primary industrial iron and steel factories, clearly incompatible with the environmental equilibriums of the sites and with the presence of inhabited areas.

This outlined view of environmental stress does not, however, hinder one from recognizing the significant quality characteristics of the favorable relationship that exists between the resources of the territorial environment and the resources of the marine environment. It is really the unique qualities of

both which limit the environmental degradation in progress and justify the efforts for a two-fold action of defense and requalification. From a physical point of view, the marine resource has been naturally defended by the depth of the water itself, which is quite considerable right up to the shore; while a large area of the land resource has been protected by the morphological inaccessibility of the mountainous peaks and valley inclinations. All this is true, despite the fact that some sections have been put to harsh tests because of landscape constraints and, for some time, from military constraints.

From these introductory notes, it is possible to perceive the importance which for historical, cultural, and economic reasons, the Ligurian Region intends to bestow upon the marine resource. This is done in the hopes of improving the direct management of its own administrative activities, as well as the understanding and comprehension of the actual phenomena and their evolution, in order to ask other national, EEC, and international bodies to honor their own commitments towards cooperative efforts regarding the coastal zone's fragile environment. This would also include any requests of the scientific community for financial contributions.

"ENVIRONMENT PROJECT" - GUIDELINES FOR STRATEGIC PLANNING

The guidelines for such an approach have been identified as the "Sea-coast sub-project" of the so-called "Environment Project": a coordinated series of relevant, integrated, environmental impact actions which the Ligurian Region intends to carry out in conformity with the regional law 26/91. For the strategic planning, those actions which in the meantime have been initiated and those which were previously envisaged have been pivotal. For definition of this context, requests have been made for support from national and EEC authorities, as well as requests for collaboration with institutions, associations, and public and private enterprises. In the same way, efforts are being made to understand and follow the initiatives regarding other subjects and to attempt to amalgamate wherever possible, their results and investments.

Such guidelines will probably move according to integrated paths among the coast urban-territorial plan, programming of financial activities from a tourist, pleasure craft, fishing and coasting trade profile, and design of defense interventions, by attempting to create a complex preventative evaluation system for environmental impact and continuous monitoring. These efforts are directed towards optimal preservation of the marine resource by keeping alterations to a minimum, especially irreversible ones.

Regarding the major part of the population and economical activity of the sea (or coastline), it is not possible to think in terms of a purely conservational policy; one must envision developing a dynamic control over set transformations, which will afford a rigorous control system to handle the environmental impacts.

Under this aspect, the "environment project" will identify three types of coast:

1. Pure conservation zones, based on their naturalistic and historical-cultural character
2. Zones susceptible to transformation with set utilitarian additions
3. Degraded zones which need to be reclaimed and reused

Among the first type, preference will be given to protected coastal areas and those with marine areas which are to be biologically and physically protected from a naturalistic view point, e.g. Portofino Parks, "Cinqueterre", and areas surrounding Gallinara Island.

Among the second type there are the inhabited coastal areas, tourist and pleasure craft areas, and those used for other economic activities. There are many utilization conflicts and obvious incompatibilities present in these areas, as well as biological and chemical-physical pollution effects which are well above the levels allowed for bathing areas and hazardous, to a certain degree, to the marine life. Particular importance is also given to the problems concerning navigation and the commercial and tourist ports.

In the last type there are the sections of coast involved with industrial buildings or ports which are

partially used or underused, due to the evolution and concentration of specialized traffic. The Genoa Harbor area and the Stoppani area between Arenzano and La Spezia roads are interesting cases to be studied and carefully planned. Involved here are considerable recovery and reuse potentials as well as archaic, unresolved problems of environmental requalification (for the coast as well as the sea floor) which are interesting from a technological, scientific, and economic viewpoint.

It must be pointed out that the natural equilibria of the beaches have been changed due to the altering of the water system of the hydrographic basins, as well as their banks and inclinations, for urbanization of the outlets. Additionally, the sea floor at the coastline, because of the dispersal of all types of waste in the river floors or the wash-out of polluting soils, is subject to aggression of such magnitude that its characteristics are being drastically changed. Accretion of aggregates and harbor or coastal defense works create alterations whose environmental impacts must be understood and channelled to eliminate the inconveniences connected with any profound alteration of the natural assets.

Therefore, a qualitative control of the marine body of water assumes a strategic importance in the regional environmental politics as a means of measuring the:

1. Condition of the internal water which drains into the sea
2. Efficient control of civil and industrial discharges
3. Condition of atmospheric purification
4. Release of pollutants from intensive agricultural areas
5. Impact of maritime traffic
6. Release of hydrocarbons from ordinary discharge and loading cycle, stocking, transport, and distribution
7. Different incidents for events connected with industrial, civil, and natural risks in an urban environment

Amongst the actions and interventions which the "environment project" guidelines have identified, the following mainly involve the marine environment and coastal profile:

1. Conservation of naturalistic interest areas will be pursued by means of actions which favor
   a) Institution of marine and coastal parks
   b) Repopulation and reforestation of the sea floor
   c) Initiative for accretion and conservation of beaches
   d) Diffusion of knowledge for characterization of sea floor
2. For requalification of degraded environments and reconversion interventions such as:
   a) Reutilization of underused harbor areas
   b) Reutilization of unused coastal settlements
   c) Recovery of degraded, industrial coastal areas
   d) Recovery of polluted sea floors
3. To reconcile economic development with the protection of marine resources, specific projects will be formulated (in agreement with competent authorities) for
   a) Support in the form of compatible fishing methods
   b) Reorganization of access channels and safety of traffic
   c) Compatibility of nautical/pleasure-craft activities
   d) Starting up of an ecological vessel for marine monitoring
4. To improve marine-coastal utilization, projects will be developed for
   a) Quantity-quality adaptation for efficiency of purifiers
   b) Maintaining efficiency of purifiers
   c) Development of sea transport as an alternative and integration of coast system

d) Improvement of tourist and leisure activities through
   (1) Creation of nautical berths other than marinas
   (2) Creation of pedestrian and bicycle ways
   (3) Temporary receptivity
   (4) Culture and practice of marine activities

VARIOUS REGIONAL ACTIVITIES IN PROGRESS AND DECISIONS AWAITING THE "ENVIRONMENT PROJECT"

The proposal of the so-called "environment project" will not die from benign neglect because it is being implemented in an area which is already involved with various activities to be developed and reformed. It is therefore of no surprise that during preparation of the guidelines from which the "environment project" is to be produced, certain regional activities in progress and others to be carried out shortly, have not been interrupted. Initiatives may be considered in the manner of anticipation and preliminary control of the "project" itself. These are aimed at defending and safeguarding the sea from pollution and, therefore make up part of the competent, regional office activities for planning and improvement of the water, particularly the bodies of water which are used for domestic, civil, and production purposes as well as for discharge activities.

Census of Bodies of Water in Liguria

In conformity with article 7 of law 319/76 concerning measurement of quantity-quality data for bodies of water, the Ligurian Region has arranged for an update of a census of water masses in Liguria by means of an agreement stipulated with the Genoa Gas and Water Board (A.M.G.A.).

The assignment, which is going through its final stages, plans for several activities, among which is the monitoring of coastal waters by means of sampling seawater at eighty-four stations situated 100 meters from the shoreline and arranged along the entire Ligurian coast.

More than 670 samples are scheduled to be taken in eight different lots within the period of twelve months, including the following assessments:

1. Transparency
2. Nutrient substances (ammonia nitrogen, nitrous nitrogen, nitric hydrogen, orthophosphates, total phosphide)
3. Mineral oils
4. Bacteriological indexes (fecal and total coliform bacteria)

Environmental Engineering Study of Sea Discharge Pipelines Along the Ligurian Coast

The discharge waters of an underground pipeline, due to the amount of motion and lack of density compared to that of the receiving body of water, may cause, notwithstanding the initial mixing, a large concentration of pollutants near to the inlet point.

After the initial mixing, which is limited to the inner parts of the inlet point, the discharge waters are dispersed with the coastal current and the pollutants are further diluted. The study of dispersion of such pollutants is therefore proposed to provide data on their concentration, both near to and at a certain distance away from, the discharge outlet point.

In order to safeguard the marine coastal environment, the Regional Administration has stated the need to arrange for an adequate plant in order to evaluate the impact of numerous manmade discharges into the sea by means of a convention with ENEA at S. Teresa near La Spezia.

The project is, at present, under way and is divided into three phases which are partially overlapping:

1. Preliminary investigations
2. Environmental studies and monitoring
3. Creation of an information system

Preliminary Investigations

Any type of investigation that involves coastal waters requires a complete understanding of the situation enabling researchers to predict the destination of the pollutants emitted into the sea and to properly evaluate their effects.

An investigation of already existing data also allows a more efficient and accurate planning of the envisioned activities and makes it possible to identify known shortages and mark out new environmental studies for further projects.

Identification of the Environmental Situation

An investigation of the coastal waters in order to be accepted as valid and efficient, must take into account the influence of all factors, both singularly and as a multifaceted variable. Therefore, it will be necessary to analyze the large amount of existing information in reference to the chemical and biological characteristics of the marine waters to localize the areas at risk where further pollutant emissions may cause eutrophication, and study the situation of the sea floors in relation to their morphological, sedimentological, chemical, and biological characteristics.

The above existing data (available at Regional, Provincial offices, Institutions, Consortiums, Universities, etc.) will be gathered and reviewed under the following rubrics:

1. Type of sea floors for the marine platform (morphology, granulometry, biology, chemistry, microbiology)
2. Identification of coastal inflows
3. Quality of marine coastal waters (chemical-physical and biological parameters)
4. Benthic population.

Census of Sea Pipelines

During the course of this activity, data and information relative to sea discharge pipelines will be collected. A census will be taken of the operating, underwater pipelines along the Ligurian coast and the data relative to technical and functional characteristics of the pipelines; shore equipment; and the types, quantity, and quality of disposed waste.

Collection and Validation of Existing Oceanographic Information

Data collection will be extended for this activity to meteorological-oceanographic information relative to the Ligurian Sea, which is available from the ENEA databank and other sources to be identified.

In particular, the following data will be used:

1. Hydrographic data
2. Hydrologic data (temperature, salinity, and density) for assessment of the bodies of water and their seasonal variability)
3. Climatic and current data, and above all, summer surface currents when the pollution phenomena are more intense due to stratification of the water, winds, and weaker currents

Environmental Studies and Monitoring Activities

The forecast of initial and successive dispersion of the pollutants from a marine pipeline may be

made by means of hydrographic data relative to a time series aimed at representing the seasonal variations.

Quite frequently it happens that the hydrographic data is not available or it refers to the open sea or an area which is different from that in question. This is true above all for the Ligurian territory where the structure of the coast makes it difficult to describe the circulation of the bodies of water.

From an examination of existing and valid measurements to satellite and aerial photos, and on-site readings tailored for the aims of this project, an adequate knowledge will be acquired during this phase regarding the two selected pilot areas so that operations will be efficient and allow an acceptable level of intervention within the limits of this study.

Identification and Processing of Satellite Images

During this activity, satellite images will be acquired and processed in order to obtain geo-referential maps for surface temperature and turbidity. This will show the time and space evolution of the previously cited parameters which will be useful in identifying local circulation patterns and dispersion of the pipeline discharges. The areas of interest for this study will be those identified in detail by the preliminary investigations.

After analyses and evaluation of the characteristics of the on-board sensors already in operation, it was decided to make use of 4 AVHRR images of the NOAA satellite which should represent a time evolution during the same month of the phenomena on a one month scale.

Moreover, 4 TM images will be used from the LANDSAT 5 satellite since these are more suited in describing small-scale phenomena and therefore capable of identifying the marine areas where certain discharges are present.

Comparisons between the thematic maps obtained by AVHRR and those obtained by TM will depict relations between the conditions at sea and those chosen coastal installations.

For this purpose within the due limits of the cycle times for the satellites and requirements for the on-site measurements, the processed images must refer to the same period. Processing of the images will be carried out by means of algorithms for geometric and radiometric correction of all spectral bands and for determination of temperature and turbidity parameters. During the course of the activity it will also be determined whether it is possible to process the maps for chlorophyll.

Validity and accuracy of the results depends on the algorithms which are used for processing. Therefore, two sets of measurements will be carried out at the pilot sites ("sea verity" lots) at the same time the satellite passes over.

The "sea verity" sets of measurements will make it possible to select algorithms most suited to the Ligurian coastal environment.

Collection and Processing of Images from Aerial Platforms

Since the project also has the specific aim of controlling marine pipelines of a limited capacity, it will be necessary for a more detailed image of the ground than that obtained by satellite. Therefore, an airborne system will be used, supported by a multi-spectral scanner Daedalus, providing for a 4x4 meter pixel.

The system acquires the rays emitted from the body of water over twelve channels, from invisible to thermal infrared, allowing efficient operation for identification of the discharges and areas of influence for each discharge.

By means of an air flight during the summer, images will be acquired for the coastal areas, including the pilot areas which extend for about 15 km along the coast and for about 6 km offshore. During the flight, measurements will be taken from the air as illustrated, in order to validate the algorithms used for processing the images.

Sets of Measurements for "Sea Verity"

In order to validate the results obtained by applying the processing to the distance-measured data and to calibrate the thematic maps, four sets of measurements will be carried out in the marine areas selected as pilot sites.

These sets of measurements will make it possible to acquire from moving naval craft, surface temperature measurements from radiometry and turbidity, and chlorophyll measurements from continuous sampling of water. Moreover, temperature salinity, oxygen, turbidity, and chlorophyll measurements will be carried out for the column of water over a sample grid by means of an appropriate, multiparameter probe correlated with current and meteorological measurements.

Continuous Monitoring of the Sea Level

The level of the sea is an important factor of marine circulation; its trend during time is the result of complex interactions between numerous factors, among which, for marine areas with a low tide ebb effect, meteorological events over a one-month scale and local scale may be the primary factors. The level data collected and validated will be used as input data for mathematical models to simulate the circulation of the marine areas in question.

Regarding the Ligurian Sea, the general trend of the level of the open sea may be described as the overlapping of harmonic functions having considerable amplitude and frequency. Furthermore, for coastal areas, since their level is affected by numerous local factors, i.e., bathymetry of sea floor, wave motion, and the shape of the coast, it is possible to observe oscillations with amplitude and frequency connected with the geometrical characteristics of a particular area. These determine a field of local velocity which influences, in certain conditions in a positive sense and in others in a negative sense, the dispersion of a marine discharge, and it is thus necessary to measure their amplitude and frequency. For this reason, and to integrate and complete an already existing network in Liguria, three marigraph stations will be made operative for the areas in question.

The measurements will be controlled by means of calibration parameters, operational tests, and laboratory calibration operations. The data will be processed in order to identify the amplitudes of the main periodic factors and the amplitudes and frequency of eventual local oscillations connected with overlapping of the fundamental factors. By means of analyzing the level data together with other meteorological-marine parameters, it will be possible to investigate the causes and origins of the oscillations.

Treatment, Analysis and Validation of Measured Physical Data and Utilization in the Database Structure

Interpretation and integration of the measured physical data will be used to do a database structure.

Selection of Area to Be Studied

On the basis of the data and information obtained from previous phases, the zones for investigation and the pilot sites will be identified. Here, sets of measurements will be carried out and at one of these sites, a continuous monitoring system will be positioned.

The criterion of choice must take into consideration the fact that for a study of the impact of a marine pipeline, two different realities must be appraised. First, the study is directed towards a marine area influenced by an elevated polluting load (a situation which is typically caused by the discharge from a large urban center); and second, towards a marine area influenced by a limited polluting load but, due to an elevated touristic-environmental interest, the quality of the water in particular areas, i.e., certain bathing areas, must be safeguarded to the maximum.

Sets of Measurements

The on-site measurement activity is aimed at collecting all information necessary to identify the

zones where a pipeline has its most pronounced effects. The investigations shall deal with the main elements involved in the health of the marine environment, and in particular for the two pilot sites, the chemical and bacteriological quality of the water, sedimentology, and the observation of the biocenolosis of the sea floor.

Continuous Monitoring

A study of the dispersion of urban discharges which have been treated and emitted into the sea by means of suitable channels would be closely linked with the realization of a map showing the field of velocity of the site under examination by means of sea current data. To accomplish these things, continuous automatic measurements will be carried out at these sites for significant time periods. These measurements will be carried out at different depths, in the direction and speed of the currents.

At one of these sites, a mooring buoy fitted with a multiparameter probe, will be positioned. This will be remotely operated from the surface at a given frequency for the accumulation of data relative to temperature, conductivity, dissolved oxygen, turbidity, and pH along the column of water.

Information System

The data collected within the scope of this study will be organized in a manner suitable for computer-based management, compatible with the Ligurian Region environmental information system.

During this phase, a preliminary project, involving the establishment of the marine data bank will be made, taking into account the following:

1. Future requirements for data processing
2. The use of the data for calibration of the information systems used for decisionmaking (management module for the discharges)
3. Requirements deriving from the methods of presentation of information to the user (graphic synthesis, charts, etc.)
4. Possibility of future updates and territorial extensions of the monitoring

During this phase, the management software for the data banks will be developed with reference to the census carried out on the pipelines, as well as the environmental data derived from the bibliographic research and field investigations.

A further objective of this activity is the setting up of the "discharge management module". This module is made up from the preliminary version of a diffusion model for the outflow from a discharge pipeline.

Research Into the Control of the Level of Nutrition in the Gulf of La Spezia

An agreement with Ansaldo Industria S.p.A. has allowed a monitoring program to be carried out, both in manual and automatic, for the Gulf of La Spezia to acquire data for a report describing the condition of pollution in the water, with particular reference to the eutrophication of the bodies of water.

The one-year research period has been divided into eight sectors in order to accurately evaluate the variation during time of the nutritional load and phytoplankton activity at the fifteen stations where the main chemical-biological parameters are measured in order to define the nutritional level of the water. Moreover, at these same stations, sediment samples are taken for their stability characterization and to check for seasonal trends.

The main objectives of the intervention may be summed up as follows:

1. To interpret the ecological dynamics present at La Spezia roads
2. To point out and pinpoint the environmental dangers
3. To suggest rational proposals for management and improvement

Study Concerning Identification of Polluted Areas Along the Ligurian Coast through the Use of Bio-Indicators (Mollusk)

This project, developed within the limits of an agreement between the Region and The National Institute for Cancer Research (IST), is split up into four complementary components designed to evaluate the concentration of organic and inorganic pollutants in the water, particulated material, and mollusk fibers and to study the effects induced by the pollutants on the mollusk.

1. Biological effects of the pollutants on mollusk (Institute of General Physiology - National Institute for Cancer Research)
2. Evaluation of the accumulation of hydrocarbons on the mollusk tissues (National Institute for Cancer Research)
3. Evaluation of the accumulation of inorganic pollutants in the mollusk tissues (University of Analytical Chemistry)
4. Evaluation of the quantity of particulate present in seawater and its content in pollutants (Institute of Marine Environmental Sciences)

At the conclusion of the first year's research by IST, the Region will evaluate the logical follow-up to this research to be performed during the second and third year of the program. These activities will be designed to obtain a low cost tool, (via bioindicators) for evaluation of marine pollution along the coast.

Informative Register Concerning Discharges

The informative register of discharges (competence assigned by law 319/76 to the District Council) allows a detailed understanding of the condition of surface, internal, and marine waters. An update of such a register has been recently started by the District Council with the aid of state financing (Decree by Ministry of Environment 2.10.1990).

Due to the exiguity of state financing, the Region has given the following indications to the District Council regarding priorities to be considered:

1. Productive settlements
2. Public sewages
3. Civil settlements

Within the activities connected with the register, the Region has provided a card which the District surveyors will use for data acquisition and also for the establishment up of the management automation of the register itself.

The dedicated system which is being carried out, will make it possible to acquire on a magnetic support, in accordance with the data base organization, the relevant data on paper cards, thus making sure that results are not lost. The system will also allow a quick management and selection, representation, and print-out, in accordance with defined research methods.

Regional Participation in the "Integrated Management of the Gulf of Paradise Ecosystem"

Within the limits of responsibility at a regional level concerning environmental defense, the Ligurian Region has seen the need to arrange for a detailed study of the marine environment which will allow an integrated understanding of the phenomena at both a local and regional level.

In conformity with a deliberation in November 1992, the regional Council has authorized the financing required for the realization of a part of the research activities envisioned in an ample and articulated project aimed at integrated management of the Gulf of Paradise ecosystem. This project, of approximately two-years duration, has been allowed within the limits of an EEC program called NEDSPA-AO 91-1, at a community financing equal to 40% of its total value, estimated to be about

1635 million ECU. The costs not covered by the EEC financial aid and by the Ligurian Region - as an investment for research - shall be met by a temporary association of Companies which have arranged the research in question. This consortium is made up of Castalia-Società Italiana per L'Ambiente, as the leading group, CLOE, and Klaga and Agroplantec. The Gulf of Paradise Town councils interested in the study will contribute in a nonfinancial manner through dedicated work plans.

Due to the particular morphology of the regional territory and urban development which have engendered a heavy concentration of inhabitants along the coast and, in particular, in the main town, the Ligurian coastal marine environment is subject to a considerable anthropic pressure. This pressure, in the form of both civil and industrial discharges, has over time caused a reduction of the biological species, pelagic and benthic, and is closely linked with the quality of the water, a rarefaction of algae population and above all, a regression of the marine phanerogam grasslands made up from *oceanic Posidonia and Cymodocea nodosa*.

The area of the coast that stretches from the city of Genoa up to Punta Chiappa in the Gulf of Paradise, while having undergone environmental stress, still might be saved. It is therefore necessary to intervene with a specific program of integrated management in order to restrain the expansion of degradation factors as well as to conserve and, as far as possible, to recover its original character.

The marine waters subject to the study are those contained between the foreshore and isobath of about 50 meters for the section of coast close to Bogliasco, Sori, Pieve Ligure, Recco, and Camogli, as well as the area of those towns whose hydrographic basin directly or indirectly lies in the coastal waters mentioned above.

The project in question is divided into three distinct phases, each based upon the results of the previous one: (1) a formation phase for the required basic understanding; (2) an identification phase for the shore improvement interventions, with respective priority and technical-economic feasibility; and (3) a final phase represented by direct actions on the coastal ecosystem for restoration of the conditions required for protection and development of the *Posidonia* grasslands and *Cymodocea n*. These two grass species create the optimal condition characteristic of the Mediterranean for development and growth of numerous marine organisms.

The project's thrust is to provide an overall picture of the territorial environment and a basic knowledge of the existing environmental situation and its evolution over time, other than defining the condition of the sewage and purifying plants.

The following are also planned for this activity: (1) analyses of quality, nutritional condition, and self-purifying power of the coastal waters by means of the marine ecosystem; and (2) research into dynamics and diffusive property of the water, the condition of conservation of the benthic community, quality of water, presence of pollutants in the sediments, and the extension and condition of conservation of the phanerogam grasslands.

The data generated will be used in suitable simulation models for the processes of diffusion and dispersion of effluents emitted into the sea. The results will be used in the planning process to define correct engineering solutions for the verification of the release and treatment hypothesis of liquids which should decrease the risk of euthrophication, and general environmental degradation. This method is also the most economical in terms of management, maintenance and completion costs.

Evaluation of existing and planned purification plants designed to depollute discharges and evaluation of self-purifying characteristics of marine water will allow, during the successive phase proposed by the plan, for the formulation of a program of interventions concerning engineering plant proposals to safeguard the water and minimize the risks of marine environment degradation.

Finally, the program in question foresees biotechnological interventions aimed at restoring the marine environment mainly through the placement of suitable structure capable of allowing the settlement of marine grasslands made up of *Posidonia a* and the *Cymodocea n*. This phase will be carried out in the following manner: (1) multiplication (on land) of the material to be propagated; (2) selection of the sites for thickening-out operations and the new plants; (3) on-site laying of the pre-

planted laths; and (4) verification of the results.

The material to be transplanted, contrary to that which normally takes place, will not be collected in natural grasslands, but propagated in an agamic way in suitable laboratories. The advantages of this procedure are : (1) no existing grasslands will be altered following collection of the plants; (2) unlimited availability of plants; (3) low production cost; and (4) the possibility of intervention through selection programs and genetic improvement. The laths arranged on land shall be laid in a different way for the thickening-out interventions or a new plant.

Moreover, in order to verify the success of the interventions during time and their effects on the surrounding environment, a series of measurements is planned, up to 600 days from the plant, for the main vegetation parameters such as survival of the plants, speed of growth, and that concerning covering of the sea floor.

Development of a Means of Analysis of the Ligurian Coast Based on Bio-Indicators

The study which is projected by a contract between the Region and the Institute of Marine Environmental Sciences at the University of Genoa, intends to develop a means of analyses aimed at characterizing – in an environmental sense – the Ligurian coastal regions using an "experimental module".

This module concerns the benthic ecosystem, starting from the shoreline to a depth of 200 m, the limit of the continental shelf. The benthic ecosystem was chosen because of its capability of "recording' the environmental events which have been verified, not only on the sea floors, but also in the column of water above them.

The experimental module will be structured into four distinct phases.

1. "sampling structure": in which both biological and abiological samples will be taken in the underwater and subair zones, with a greater number taken within 50 m from the isobath, since this is considered to be an area of major environmental variability and therefore more prone to impact from anthropic activities
2. "analyses of samples": in order to acquire the quality-quantity picture of the macrobenthic populations (gathered by cage, basket, and bucket), of benthonic populations (gathered by drag nets), melofauna and microbic communities, as well as the characteristics of sediments as they pertain to situations connected with allochthonous transfer
3. "data processing": relative to benthic and benthonic populations, to draw up biocenelogical maps indicating the presence of rare species to be safeguarded, and to calculate, for the various systematics components and for the community overall, the biomass values, in order to define the main components of melobenthos, microphytobenthonic, and microbic communities
4. "environmental evaluation": through the summation of the results and their processing, the natural resource will be verified, together with the fishing resources and the environmental condition of the coastal area.

Monitoring of the Water to Understand the Marine Ecosystems

In order to understand the marine ecosystems, coastal water monitoring activities will be entrusted to Arcatom S.r.L. by agreement with the Ligurian Region. This arrangement will be done in accordance with the methods established by Sea defense Ministry. The area to be investigated has been identified as the entire Ligurian coastline with monitoring stations situated at intervals of 10 km.

The stations will be located in those areas which are considered environmentally sensitive, due to their proximity to anthropic, industrial, and port settlements, or due to their use for such activities as bathing, natural reserves, and mollusk-culture.

For each station there are three, planned sampling posts at 150, 500, and 1.500 m from the coast. At each post, samples and measurements will be taken at the surface and close to the sea floor.

The seasonal characterization of the parameters will be guaranteed by quarterly sampling.

The following parameters will be measured:

1. Temperature
2. Salinity
3. Dissolved oxygen
4. pH
5. Transparency
6. Presence of tar residuals
7. Presence of film of oil
8. Coloration
9. Chlorophyll
10. Ammonia nitrogen, nitrous nitrogen, and nitric nitrogen
11. Orthophosphates, total phosphides
12. Phenols
13. Hydrocarbons
14. Bacteriological indexes (fecal and total coliform bacteria, fecal streptcocci, and salmonella).

At the same time, oceanographic, and meteorological observations will be reported. Moreover, upon completion of the above activity, it is envisaged to integrate this with the more extensive program planned by the agreement with the Merchant Navy Ministry described in following subsection.

Agreement with the Ministry of Merchant Navy for Marine Ecosystem and Eutrophication Monitoring

This agreement, whose administrative steps are now being completed, was signed by the Ministry of Merchant Navy and the Regional Council. It provides for a three-year survey to monitor the marine ecosystems involved and the area's eutrophication.

This agreement stems from Art. 3 of Law Act n. 979 of 31.12.1982, which sets forth that "oceanographic, chemical, biological, microbiological and commodity-related data and any other information required to fight against all forms of pollution, to manage coastal areas and to protect marine resources also from an ecological point of view" should be collected. In addition, the implementation of such a monitoring system falls within Italy's duties within UNEP (Med-Pol Phase II), in which the member countries undertake to set up a coastal water monitoring network and to forward the results to UNEP.

As provided for this agreement, the survey will:

1. Monitor waters to acknowledge the conditions of marine ecosystems by sampling water at 100, 500, and 1.500m from the shoreline. Sampling will be performed from stations located along transects perpendicular to the coastline and erected at a distance of approximately 10 km from one another along the Ligurian coastlines.
2. Monitor waters to control eutrophication through samplings at 500 and 3,000 m from the shore. Sampling will be performed from transects located in the proximity of polluting sources such as harbors, canals, rivers, or coastal settlements identified in the territory.
3. Monitor bivalves by sampling mollusks as indicators of coastal water pollution levels, with particular reference to the following parameters: total and fecal coliform count, fecal streptococci, salmonella, mercury, cadmium, and high-molecular-weight chlorinated hydrocarbons.

Participation of the Regional Council to a Probe-Equipped Buoy Trial

For 1993, the Regional Council has planned to participate in the trial, automatic, marine water testing system, consisting of a probe-equipped Meda and an already existing monitoring and data collecting system owned by and located within Alenia Elsag Sistemi Navali premises in Genoa.

The sampling and measuring station shall be located in the sea area in front of Cogoleto (1 mile westward of Capo Arenzano, at a distance of approximately 100 m and in approximately 50 m depths).

The station's position was selected based on the following principles:

1. Tourist area with the presence of high environmental risk factories in the surrounding areas.
2. Borderline between an area characterized by a high concentration of anthropical/industrial activities and the western tourism-oriented Riviera.
3. An area which, considering the constant flow due to the Ligurian/Provençal stream, is a transitional check point downstream from the main polluting sources.
4. Proximity to Haven's wreck (undercurrent), as a monitoring station for any residual hydrocarbon leaks.

This system shall consist of a pilot center for integrated, water pollution monitoring made up of:

1. Fixed sampling station including:
   a) A platform equipped with electro-hydraulic services
   b) A probe package
   c) A remote control, special purpose computer
   d) Communication interface devices
2. Communications system
3. Data collecting, monitoring, and control system including:
   a) A display large screen
   b) A workstation
   c) A general-purpose computer
   d) Computing peripherals
   e) Communications interface devices

At least initially, the Meda station will be equipped with the following probes:

1. Hydrocarbon content probe, with particular reference to (soluble) aromatic compounds, sampling in the surface stratum or at 5 m depth
2. Anemometer to determine wind intensity and direction at 10 m above sea level
3. Current meter to determine current intensity and direction at approximately 5 m depth
4. Probe to determine water temperature in the surface stratum

Other Initiatives

Talks are presently underway with International Center for Coastal and Ocean Policy Studies (ICCOPS) to develop through an ad hoc agreement, a qualified involvement of the Ligurian Regional Council on a national and international level, to strengthen the "Sea Technological Pole" in Genoa in order to set up a European Mediterranean policy reference center. As a matter of fact, in the framework of the European FESR Target Two program, the Production Activity Regional Office has launched the setting up of the "Sea Technological Pole" with the participation of various business professionals. In planning the second phase, the construction of a laboratory was designed; this laboratory will be the basis of the regional project for an ecological boat.

The Regional Town Planning Office has approved the coastal management coordination master plan. The "Coast Plan" refers to the "Environment Project" designed to carry out systematic environmental impact assessments relating to the interventions planned. It will also provide important and valuable references for E.I.A. layout.

The active involvement of the Ligurian Regional Council in setting up the "Cetacean Sanctuary" in the Ligurian-Corsica-Provençal sea by Sea and Environment Ministries of Italy, France, and Monaco will be another important drive for heightening the struggle against coastal pollution. At the same time, it will also provide the opportunity to strengthen the role of the Ligurian coastal centers as far as sea access and the localization of any services linked to sea protection and exploitation operations are concerned.

Owing to its historical traditions, to its cultural background, and to the presence of top-grade technological and scientific skills in this town, the wish that Genoa may be the venue of the Mediterranean Marine Environment Agency seems to us to be worth a concrete, political-institutional proposal.

COASTAL REQUALIFICATION INTEGRATED PROJECTS: A TEST-BENCH INTERVENTION INSTRUMENT

Among the firm steps to be taken and submitted to testing on a technical-procedural and financial level, the regional law act n. 28/92 provides a first operating support to be tested and perfected based on previous experience. As a matter of fact, this law act envisages the funding of "integrated projects of water resource requalification". The application field of choice for that instrument can be the closeness of land-based and marine parks with the adjacent surrounding and proximal areas.

For instance, it is clear that though environmental conditions are critical in some areas, (the depths around Portofino's Promontory, those in front of Cinqueterre, or those surrounding the Gallinara Island), by observing the meteo-marine phenomena, one can see that no sea segments can be isolated from the whole, due to the pollution scattering effect produced by streams, winds, and rain along the whole coastline. As is well known, the difference in temperature, hence in density, of superficial waters and the difference between these and deep waters create horizontal, vertical, and combined movements of water bodies which highly affect the preservation of the natural characteristics of the sea, of depths, and of underwater rock walls, the latter being the dwelling of the marine biological world. The preservation of marine environment's vital conditions is strictly connected to a balance within which the various components of its natural world can survive.

The release of organic and inorganic substances into this environment and/or any changes in physical conditions (e.g. temperatures and noise) upsets the natural balance. Thus, these uncontrolled inputs, which fortunately are not generalized, have detrimental effects upon the marine environment by altering its chemical-physical characteristics (including the organoleptic characteristics). It also causes precious fish to move away or to disappear, causes water to become cloudy, and silt, in general, to deposit in the depths.

Besides the sewage waters discharged directly or through pipelines at the distances and depths provided for by the law, it is clear that any substances that cannot be retained by solid, fluid, or gas waste treatment plants end up in the sea. In case of violent rains, the larger-sized garbage left unlawfully near watercourses or in the valleys also ends up in the sea.

Therefore, knowing the quantitative and qualitative aspects of the substances that end up in the sea, the dynamics of moving water bodies, and the changes that gradually affect the sea's biological characteristics become a must for laying down a protection policy against seawater pollution. This should be coupled with a natural environmental protection policy targeted at some interesting areas identified as future "underwater parks".

As a matter of fact, the coastline is a fragile border along and through which very different ecosystems coexist and interface, becoming a single-relation system which has characterized the Ligurian landscape through its history, culture, and development.

The borderline between fresh- and salt water is almost impalpable to nonprofessionals; however, there are clear-cut differences between these two worlds. Any shift in the separation line affects land-

based life and the use of resources. However, as already stressed, all land-based activities add a pollutant load which highly affects the overall balance to the fresh water flowing in the area. Knowing the exchanges and understanding the mutual effects that take place, become important planning and control instruments for all implementation and management activities.

To give another example, the setting up of an underwater park in Portofino would require that the following activities were coordinated in the Golfo Paradiso area which links Genoa's harbor and city area with Portofino:

1. Protection of sewage water
2. Containment of stream pollutant supplies
3. Renaturalizing of water courses and of their catchment areas
4. Reclaiming of illicit dumps
5. Planning of small (diffuse and accessible) aggregate dumps
6. Diversifying access roads leading from the city to the Riviera
7. Alternative coastal, mountain, and seaside ways

Similar examples could be given for Cinqueterre and for the area surrounding the Gallinara Island.

The importance of struggling against coastal pollution through integrated, environmental resource planning instruments is stressed by a stringent requirement which is at the basis of the previous-mentioned "Cetacean Sanctuary". Once again, the large-scale, environmental importance of the area considered stands out - the area where Liguria is and lives both functionally and culturally. If most of the actions and interventions outlined so far were developed with the appropriate national and EC coordinating bodies, they would significantly contribute to safeguarding and protecting the environment.

THE NEED FOR AN INFORMATION SYSTEM: THE REGIONAL SEA DATA BANK

The knowledge and decisionmaking models concerning the marine and coastal environment require a specific vehicle within the regional, environmental information system that must be designed. It will be treated as a regional branch of SINA, the national environmental information system.

Please consider that the Region is operating on two levels to design its own environmental information system.

1. On a local/regional level, jointly with SIR, the Regional Computing Service, and Datasiel, a region-funded company, a sea data bank is being developed that should contain all information collected on waste disposal and on the water body in order to form new registers and carry out new censuses. It will also include data concerning present and future monitoring activities, as well as data on bathing and sea depth characteristics. These data will be geo-referenced. It will be also possible to retrieve and to use such data within knowledge- and decision-making models. The design and implementation of this information system on a local level makes it possible for it to be shared by the Provinces performing activities in this sector.
2. Let us consider now the regional branch of SINA, the national environmental information system, to be designed by Datasiel following the guidelines and under the supervision of the Ministry of the Environment as far as national standards are concerned. In this case, the Region and Provinces will be networked and the latter will increasingly take over the Regions' and Municipalities' role in controlling and governing environmental phenomena and their monitoring on a local level, with particular reference to water resources. Sea data are included in this system because they concern the water body receiving household and industrial waste and, since this will be an open-type system, it will also be possible to access - in principle at least - the whole sea data bank.

The regional meteorological service - presently under study, except for a few special operations that are already underway - may have a positive impact on future developments.

The sea information system will become significant when individual and aggregate data are made available (and also printed out graphically) according to several models that might be accessible to different users; e.g. in the framework of environmental information and education programs (INFEA), or on the tourist telematic network, or to the public in general through Televideo service or similar initiatives.

The INFEA program also includes a first, regional support step targeted at the initiative undertaken by Portovenere Municipality to set up a permanent, environmental education center whose headquarters will be located in refurbished buildings that are presently abandoned on the Palmaria Island. This center could also become a precise reference point to access the Cinqueterre Park and, in general, to make the Ligurian marine environment more widely known.

CONCLUSION

To conclude this brief outline on current and planned activities in the regional environmental field that are targeted at coastal sea resource protection, it is possible to maintain that the present goals considerably support the naturalistic protection of the major scenic and culturally rich areas bordering the sea and of the sea itself. However, one should not forget that these goals are being pursued despite the considerable operating difficulties of Italy's Public Administration and despite the unavoidable defects of the approach, which are still too much sector-oriented and poorly tested.

The development of these models is particularly meaningful, both today and in the future, for Liguria, for by reversing a century-old trend, the Region's health is beginning to be based more on the primacy of life and environmental quality rather than the quantitative growth of territorial modifications.

2

The Baltic Sea

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INTRODUCTION

The Baltic Sea is an area of multiple-use conflicts of more than 20 million people living permanently at its coasts and further millions spending their money there for swimming and sun-bathing. There is an obvious conflict in using the Baltic Sea as a source of fish and recreation and as a sink for nutrients and pollutants.

All this is embedded in a multi-national political arena which has witnessed many changes. For about 800 years, the Baltic has been a trade way between western and eastern Europe, but for the last forty years, it has been divided by the "iron curtain", its eastern and southern coasts belonging to the socialist bloc, the northern and western coasts to a more capitalistic camp. Since 1990 three Baltic states were reestablished while the German Democratic Republic (GDR) disappeared. Now nine independent states are bordering the Baltic, more than at any other sea. Each of the states has its specific interests in the Baltic.

International cooperation in Baltic marine research has a long tradition, and rather powerful international conventions are in force both for pollution control and fisheries management. But with the rapid and still ongoing fragmentation of the "Eastern Bloc", the political and economic framework for the international cooperation in environmental research and monitoring is changing. Along with the number of countries the range of national policies has increased and the economic situation has deteriorated in parts of the region.

NATURAL HISTORY OF THE BALTIC SEA

The nature of the Baltic Sea as the largest brackish water area in the world, puts it in a unique position amongst the large marine ecosystems. It is Europe's only intra-continental Mediterranean Sea. With 0.4 Mio km^2, it has a third of the surface of Hudson Bay and is about the size of the Persian Gulf

or the Red Sea. In terms of surface, the Baltic amounts to 1 per million of the Worlds Ocean, and to one per million in terms of volume.

The Baltic Sea is a series of basins separated by shallow sills. The deepest parts are up to 450 m deep, but the average depth is 55 m. The shallowest sill in the entrance to the Baltic proper (Darßer Schwelle) is only 18 m.

The entrances of the Baltic are very narrow. The Baltic is, oceanographically speaking, a large fjord in a humid climate with a very strong haline stratification and no tides.

The Baltic Sea is a product of the last glaciation of northern Europe. After the retreat of the ice cap, a huge lake was formed about 14,000 years ago. Then it became a sea canal (Yoldia Sea) for a short time. But soon it turned again into a freshwater lake (Ancylus Lake). Only since about 5100 B.C. has the Baltic become linked with the North Sea through the Danish Straits. All those changes in the recent history of the Baltic are related to the retreat of the ice cap, the continuous uplifting of Scandinavia, and the rising of the sea level due to the melting of large amounts of continental ice.

HYDROGRAPHY

The hydrographic budget of the Baltic Sea is determined by the river inputs (430 km^3/a) and the surplus of precipitation over evaporation (45 km^3/a). The inflow of water from the North Sea is of the same order as the freshwater input, but highly fluctuating from year to year. Therefore, the total outflow amounts to about 1.000 km^3/a, i.e., less than 5 % of the volume of 20.900 km^3. The exchange is mostly confined to the upper layer. From the Belt Sea in the west to the Finnish Bight and Bothnian Bay in the northeast the surface salinity decreases from ca $15^0/00$ to less than $3^0/00$. Year round there is a steep, permanent halocline at 40-70 m depth separating the low salinity surface water of about $8^0/00$ S in the central Baltic from the deep water of 10 °/oo or more in the basins. The upper, less saline water is subject to seasonal changes with a thermocline at 10-20 m depth in summer and with a widespread ice cover in winter and spring in the north eastern parts.

The deep water is relatively independent of seasons, and is renewed occasionally after storm events in the North Sea. Only the strongest inflows finally reach the farthest and deepest basins in the Gotland and Åland Seas. For 16 years, from 1976 to 1992, no major inflow took place, while in earlier decades intrusions of up to 200 km^3 per event occured at least every few years (Matthäus, 1993; Nehring et. al. 1993). As a consequence, salinity and temperature of the bottom water decreased.

In early February 1993, a heavy gale in the Southern North Sea resulted in a large inflow of highly saline water into the Kattegat (Matthäus and Lass 1993). It reached the Darß sill at the entrance of the Baltic proper in mid-February and cascaded down into the deep basins, replacing part of the stagnant, less dense bottom water of the central Baltic.

EUTROPHICATION

The deep water stagnation resp. circulation determines the extent of oxygen deficient zones and layers. Their primary cause lies in the recent eutrophication of the Baltic. In the 1970s the concentration of phosphate and nitrate in the surface waters increased sharply and stabilized in the 1980s at a level about three times as that experienced in 1969.

The Baltic drainage area has four times the surface area of the Baltic itself. It is populated by more than 70 million people. Twelve million Russians, Finns, and Estonians discharge into the Gulf of Finland while 2.5 million Swedes and Finns do likewise into the Bothnian Bight. The Riga Bight is heavily polluted by 4 million Latvians, Estonians, and Bjelorussians. The Central Baltic receives the sewage

of 44 million people, mainly from Poland. The narrow entrances of the Belt Sea and the Kattegat are affected by 10 millions Danes, Swedes, and Germans.

The annual input of nutrients is by far the heaviest in the shallow Belt Sea, where about 0,5 t phosphorus and 4 t nitrogen per km^2 (about 7 times more per km^3) are poured into the sea. Nutrient input is also high in the Finnish and Riga Bights where exchange is very poor.

In 1980, all together about 50,000 t P and 500,000 t N reached the Baltic via the rivers. Further 400,000 t N are air borne (HELCOM 1987, 1991). A major part of the nutrients stem from municipal sources and industry. Most of the cities in eastern Europe and Poland have no proper sewage treatment and particularly no third purification step. Paper mills and food industry produce large amounts of organic waste, much of it reaches the sea untreated. Further nutrient inputs, mainly nitrogen, consist of artificial and natural fertilizer. Overfertilization was one of the main characteristics in socialist agriculture but was also common with western farmers.

Only about 10% of the anthropogenic nutrients leave the Baltic through the Danish Straits (Wulff and Stigebrandt 1989). The rest is accumulated in the Baltic ecosystem which is a far more closed system than the arid Mediterranean with its outflow of nutrient rich deep water through the Strait of Gibraltar. Denitrification at low oxygen concentrations is also important in the Baltic Sea.

Originally the Baltic was rather oligotrophic compared with the North Sea. Now the phosphate concentrations in winter are about the same in the Central parts of the North Sea and of the Baltic Sea. Primary production has increased substantially over the past decades, the annual period of algal blooms has been prolonged, and the composition of phytoplankton has changed; cyanophytes becoming more abundant.

Part of the surplus primary production found the "right" path ways in the food web, resulting in increased fish production. Fish catches doubled from 1966 to 1980 (Nehring et al. 1984), but are now stagnant or even decreasing due to deterioration of the oxygen conditions and to overfishing.

Most of the organic production, however, is not harvested by fisheries but finally sedimented - often after one or more rounds of recycling in the food web. Decomposition in the almost stagnant, aphotic deep water and at the sea bed results in oxygen depletion to an extent that major, deep parts are affected by H_2S year round; while in some shallow areas, oxygen deficiencies occur occasionally after heavy summer blooms of phytoplankton, stagnant conditions in the deep water, and after wind-driven upwelling events carrying oxygen deficient water into shallow bays.

Increased abundance of phytoplankton means decrease in photic depth and hence reduction in phytobenthos. Therefore the areas covered by macroalgae along the coasts are shrinking.

The decrease of salinity and the oxygen depletion in the deep water had a serious effect on the cod stocks (BERNER et al 1989). Their eggs are buoyant at salinities of at least $10^0/00S$. In the central Baltic therefore, cod eggs cannot float near the surface, but only in the deep water or may even sink to the bottom where they might die of H_2S. Sprat eggs float at $6^0/00$ S and are therefore less affected. Herring spawn demersally at very shallow depth.

There is another threat to fish due to mass occurence of medusae, mainly of *Aurelia aurita* (Nehring 1992), which consume much of the fish larvae and their copepod food. Possibly the polyp stages of *Aurelia* benefit from the increased productivity of the near shore waters.

TOXIC SUBSTANCES

The Baltic Sea has been and is still a sink for pesticides, chlorinated hydrocarbons, and heavy metals. National and international regulations have drastically reduced those forms of pollution, e.g., the use of DDT and PCB's is forbidden in all riparian countries. The industrial discharges, particularly from the former USSR and from Scandinavian pulp and papermills, are heavily loaded with toxic substances.

The total amount of money spent on pollution control is enormous and will increase sharply if the former Eastern Bloc countries will develop sewage systems similar to the ones existing in western countries. Presently it would be most beneficial to the health of the Baltic if most of the money allocated for new pollution treatment plants would be channelled into the "eastern" countries rather than being used for further improvements in the West. Recent decreases in the pollution load of the eastern rivers are not due to better pollution control but to the closing down of some uneconomic industries.

INTERNATIONAL POLLUTION CONTROL

International combating of pollution started relatively early in the Baltic Sea, in spite of severe restrictions in east-west information transfer. The Helsinki Convention for the protection of the marine envrionment of the Baltic Sea was signed in 1974 and ratified by 1980. The Helsinki Commission (HELCOM) is a powerful organization which advises member states on all questions related to international monitoring and management of pollution in the Baltic. Regular baseline studies and periodic reports on the health of the Baltic are produced. A major part of the marine research of the coastal states are directly or indirectly related to HELCOM and its Baltic Monitoring Programme (BMP). The Programme Implementation Task Force of HELCOM has identified more than 100 'hot spots' of pollution in all regions of the Baltic Sea but mainly in Russia, the new Baltic States, and Poland (Svenson 1993).

The Task Force recommended ways and means for eliminating those hot spots.

LIVING AND NON-LIVING RESOURCES

Nine countries are eagerly fishing in the Baltic Sea which is almost completely split into national EEZs. According to the official International Council for Exploration of the Sea (ICES) statistics, overall fish production per unit area is less than half of the North Sea values. Only a few species of fish were able to adapt to the fluctuating, brackish water conditions. The total catch of about 1 Mio t consists mainly of herring, sprat, and cod. Each of those species reacts in a different way to eutrophication and to shifts in the hydrographic conditions and to fishing pressure from the different national fleets. So far, no well-balanced multispecies management of the Baltic fish population as a whole has been achieved under the International Warsaw Convention which was founded in 1974. This is more a political than a scientific problem.

The nonliving resources of the Baltic Sea are very limited. In some areas gravel and small oil deposits are exploited; formerly extraction amber was productive in certain places.

Sea traffic is an important economic asset of the Baltic Sea. Oil supplied by pipelines from Russia might replace part of the risky sea transport of 100 Mio tons of oil per year. But the Baltic will remain one of the busiest seaways in the world since more than 10% of the world's industrial production takes place in Baltic coastal regions. There are strict international regulations by the International Maritime Organization (IMO) and HELCOM regarding safety and pollution prevention in sea transport, ferry traffic, and yachting.

TOURISM

Far more important than fish and amber are the millions of tourists, mostly concentrating in Germany and Poland at the Baltic south shore and at places outside the cities of the other Baltic countries. Sun-bathers, surfers, and hobby-sailers are a major economic factor and become a powerful pressure group. There is also an increasing conflict between the tourist industry and nature conservation about coastal areas put off-limits to campers or to building marines and summer houses. In the former GDR, the conversion of a primitive mass-tourism, with very little infrastructure, into a luxury, space demanding, highly motorized tourism, accentuates those conflicts with its complex socioeconomic and environmental implications. Hopefully some lessons now learned in eastern Germany can be used in Poland and in the Baltic republics in future.

MARINE RESEARCH

The Baltic Sea has been the subject of some of the early studies in marine science, initiated for both basic scientific curiosity and for the understanding of the fluctuations in fish stocks.

International cooperation in the Baltic Sea research is almost 100 years old. It commenced with the founding of the International Council for the Exploration of the Sea (ICES) in 1902. ICES initiated regular, seasonal oceanographic surveys in the Baltic and in the North Sea, including assessments of fish stocks. ICES has always combined studies of basic science with surveillance of fish stocks. Rather early, it iniated studies of pollution and eutrophication, paving the way for the Warsaw and Helsinki conventions. Both of them still benefit from the scientific advice by ICES.

With several hundred scientists and more than a dozen research vessels, the research potential in the Baltic Sea is presumably the highest in the world-relative to its area. In most countries different institutes deal with fisheries research, with basic marine science, and pollution studies respectively. Until 1990 Baltic research of the Eastern Bloc was fairly well coordinated. Within the USSR, the central authorities in Moscow (Academy, Fisheries, Hydrography) allocated specific tasks to each of the Baltic republics and to the institutes in Kaliningrad and Leningrad. Now each place is developing its own program and each republic wishes to cover most of the fields of Baltic Sea research.

In August 1992 the research vessel of the Institute for Baltic Sea Research in Warnemünde toured all major places of marine research along the coasts of the former Eastern Bloc and found everywhere strong communities of marine scientists. Some, but by no means, all of the institutes were already fairly well equipped with modern instrumentation, but all were in very difficult economic conditions. The libraries in the Baltic states are still lacking most of the modern western literature and the laboratories are very short of glassware and chemicals. Only the Polish and eastern German institutes fare better. Support is mainly coming from Scandinavia and Germany. Some of the research vessels are in good shape and well equipped, but money is short for covering the running costs. In most formerly socialist countries, research institutions are subject to reorganization and reduction in manpower, and all of them look for new international ties and cooperation.

Joint projects are initiated, e.g., in the Gulf of Riga and the Oder-Bight. The European Science Foundation (ESF) and the Commission of the European Communities (CEC) are jointly sponsoring the planning for a major experiment in the Central Baltic in 1994 and the following years.

The experiment is related to the Joint Global Ocean Flux Study (JGOFS) by following the transport from the coastal waters into the open Baltic and there, from the surface to the sea floor. The fixation and release of carbon, nutrients, and pollutants in the sediments will be studied by long-term observations.

Furthermore, in preparation of Global Energy and Water Cycle Experiment (GEWEX), the Baltic Experiment (BALTEX) shall produce reliable figures on the energy and water budget of the Baltic.

All Baltic states have established a joint monitoring and information network for the early identification of saltwater intrusions. The network shall provide a data set sufficient to model and predict the changes in temperature, salinity, oxygen, and nutrients in the different compartments of the Baltic.

OUTLOOK

After a period of political separation and restriction in the Baltic region, there is a strong movement towards close cooperation in marine research between all countries bordering the Baltic. A council of foreign ministers was established in March 1992 which, inter alia, focussed on environmental protection in the region. Changes for a meaningful and productive management of the Baltic marine ecosystem as a whole are rather good - in spite of the multi-use conflicts - provided sufficient international support will be given to those countries which are in need of building up their democratic systems, economy, and science.

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3

Cooperative Ocean Science For Advancing World Peace: An Eastern Mediterranean Example

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ABSTRACT

Egypt, Israel, and the United States are conducting a cooperative program of marine technologies under the auspices of the U.S. Agency for International Development's (USAID) Middle East Regional Cooperation (MERC) Program. The Program, which began in 1980, has encompassed a dozen projects in over twenty laboratories in the three countries. They include fisheries and mariculture, shore processes and shoreline protection, lakes management, climate prediction, seafood toxins, wastewater recycling, and primary productivity of the Eastern Mediterranean Sea. The Program is designed and coordinated by a steering committee which includes representatives from the Egyptian Academy of Scientific Research and Technology, the Israeli Institute for Oceanographic and Limnological Research, Texas A&M University, and the New Jersey Marine Sciences Consortium.

BACKGROUND

Throughout history, man has viewed the ocean - when he's though about it at all - as an infinitely broad highway on which to transport people and things; as a source of food; and depending on the viewer's perspective, as a protective shield or convenient battle zone.

For the past three decades, the world's population has been increasingly sensitized to our surrounding seas through two, additional, major issues

1. Whether recovery of the ocean's mineral resources is economically feasible
2. Whether the ocean's capacity as a garbage repository is really unlimited

Very recently, a new concept has been introduced to peoples in certain parts of the world, i.e., use of the ocean as a persuasive instrumentality for peaceful cooperation. Typically, it was President Harry S. Truman who observed that nations working together were less likely to be attacking one another. At the time, he was referring to the possibility of persuading Israel and her Arab neighbors to cooperate on some major engineering projects of mutual gain.

It took three decades to translate those thoughts into deeds. Then, in September, 1978, the U.S. Congress passed, and the President signed, the International Security Assistance Act of 1978, PL94-224, amending the Foreign Assistance Act of 1961. This legislation included for the first time (Section 48 [C] [5]), establishment of a program and fund for Regional Cooperation in the Middle East. It became known as the "Regional Fund", later, "Middle East Regional Cooperation" (MERC) and was directed to cooperative projects between Israel and her neighbors. Responsibility for the Program's implementation was assigned to the United State Agency for International Development (USAID).

During the period October 1978-August 1980, a small group of American, Egyptian, and Israeli oceanographers, working together very informally, developed a series of projects in science and technology which became known as "The Cooperative Marine Technology Program for the Middle East." The Program was officially accepted by USAID on August 23, 1980, as the first endorsed enterprise under the Regional Fund's auspices. Actually, on that date, a group composed of a dozen scientists each from Israel, Egypt, and the United States was quietly conducting an historic meeting in San Diego.

PROGRAM DESCRIPTION

The group deliberately based their Program on fundamental needs: food, water, and land protection; specifically including, ocean productivity, seafood toxins, mariculture (i.e., seawater aquaculture), wastewater usage, shoreline protections, climate prediction, and lakes management. Teams of scientists and engineers from two dozen institutions in the three countries have arrived at an interrelationship where all projects are conducted cooperatively, either trilaterally with the United States or bilaterally between the Middle Eastern countries. Coordination points are the Egyptian Academy of Scientific Research, the Israeli Institute for Oceanographic and Limnological Research, Ltd., the New Jersey Marine Sciences Consortium, and Texas A&M University.

Tilapia

Tilapia is one of the Third World's two or three most important food fish. It spawns easily, grows fairly quickly, and lends itself to cross-breeding for purposes of regional adaption.

The Israelis and Egyptians began their work on Tilapia at the Program's commencement a dozen years ago. The Egyptians now appear able to grow a Tilapia to market size (125 grams) in four to six months. The implications for the nation's food supply are obvious.

Induced Spawning of Grey Mullet

Mullet is also one of the most important, if not *the* most important food fish in the third world because of its ability to survive on a low protein diet, feeding on phytoplankton. Unfortunately, mullet is difficult to farm, and success has eluded aquaculturists, mainly relating to spawning. The Israelis and Egyptians are conducting intensive sets of experiments to induce mullet to spawn. The Israelis approach the problem through examination of the role of hormones, especially gonadotropin. The Egyptians are studying all characteristics of the eggs as indicators of breeding success.

The groups have now published half a dozen papers on mullet reproduction, illustrating a number of factors which appear to influence the mullets' reproductive processes, the most surprising of which is longitude! The scientists have already made clearly defined gains in influencing the reproductive cycle, and in a closely related project, Brackish Water Fish Studies, have accelerated mullets' growth rates appreciably. For instance, they have discovered that mixtures of egg yolk and rice bran as protein/starch combinations, are more effective as feed than protein products themselves.

The Israelis, by determining the rate at which the mullets can synthesize various acids, and the Egyptians, by the above-mentioned methods applied to various types of enclosures, are close to optimum techniques to turn these enclosures into managed fish farms, with particular reference to Tilapia, mullet, and carp.

Waste Water Reuse

This study addressed two issues of major concern in the Middle East, i.e., the management and possible reuse of waste water, especially as a protein-enhanced medium in which to farm fish. Relating to the Lakes Management project, the project's surveys yielded the first-ever, quantified assessment of the kind and distribution of pollution in the important Egyptian lake, Manzella. This information has been conveyed to the authorities, who are currently in the process of designing and imposing regulatory measures, to bring about the Lake's ecological recovery. This action has achieved national priority status in Egypt. Further, it has attracted the attention of several other governorates in that country.

Construction of the first wastewater recycling plant was completed in 1991, outside of Suez. The pond system in enabling the Egyptians to determine the relative values of the French and American systems. It is estimated that this pilot plant is potentially capable of handling 30% of Suez' wastewater outflow.

Lakes Management

The first series of hydroacoustic assessments has just been completed of the fish stocks at Lake Kinneret. This method quantifies fish stocks more reliably than the classic, catch-and-effort statistics. The technology is currently being transferred to the Egyptian Academy of Scientific Research & Technology for use in Lakes Burullus and Manzellah.

In this regard, the investigations done under the auspices of this Program of these two lakes (which yield more fish than the aggregate of all of the others), have produced more pertinent data than in all previous years combined. For instance, the eight reports on Lake Burullus reflect, for the first time, a truly multidisciplinary ecosystem approach.

The Israelis had achieved meaningful results early in the Program when the Kinneret food chains were delineated with complete accuracy. Further, the prediction techniques achieved during the project, caused the Israeli government to change regulations pertaining to fishing, to ensure the viability of the desirable stocks.

Predictive Model for Shoreline Changes Along the Nile Littoral Cell

Long ago in geologic time, Egypt's Mediterranean coast was determined as the equilibrium between sediment furnished by the Nile River and sediment removed by the sea. Since the Aswan Dam complex reduced the flow of sediment by 90%, Egypt now possesses the fastest eroding coastline in the world. The Israeli coast is also affected, but more so in prospect.

Israeli and Egyptian engineers are concentrating on techniques to predict this erosion, and, in particular, the probable efficacy of structures either planned for installation at or near the shore or structures actually intended to reduce or halt the erosion itself.

In cooperation with the University of California, San Diego, the team has:

1. Determined the wave climate of the Southeast Mediterranean
2. Determined the sediment transport budget from Alexandria to Haifa
3. Constructed the first predictive model for the purpose of the Program

Eastern Mediterranean Circulation

This project was formed for the purpose of constructing a model of air-sea energy interchange and oceanic circulation for assistance in predicting storm surges and current patterns, and ultimately, the climatology (e.g., rainfall) for the surrounding land masses.

This project was delayed for approximately half its contracted lifetime, owing to equipment purchase problems under existing regulations. However, the models are now beginning to take shape and will hopefully be ready for testing in the near future.

SOCIOLOGICAL AND ECONOMIC ACHIEVEMENTS

This Program differs significantly from conventional USAID programs in that social progress (i.e., cooperation between Egyptian and Israeli scientists and institutions) is considered to be at least as important as the economic and intellectual accomplishments. A few highlights of cooperation may serve to demonstrate the Program's objectives.

The Egyptian an Israelis have conducted to date, twenty-four, joint and reporting conferences, mainly in Cairo and Alexandria to begin with, but increasingly, in Haifa. A full-scale workshop is held each year in which all of the project Principal Investigators participate. With a few exceptions, American participation has been limited to the Program coordinators. Planning and operations procedures have been developed increasingly by representatives of the Israeli and Egyptian Institutions vis-a-vis their American colleagues.

At this point in time, fifty Israeli person-trips have been made to Egyptian laboratories and at least seventy-five Egyptian person-trips to Israeli laboratories, where the scientist have cooperated in the research and have assisted with students.

The Israeli aquaculturists have entered an agreement to transfer technology - as it's developed -to a coalition of four kibbutzim (collectives) who have already entered marketing arrangements with French and Italian consumers. An Egyptian entrepreneur is currently exploring the possibilities of a commercial aquaculture venture using the Nile drainage lakes.

More than forty doctors and masters degrees have been obtained under the Program's auspices, and the projects have resulted in over seventy papers. The Primary Productivity, Waste Water Utilization, Management, and Shore Processes Projects produced the first coauthored publications.

In accordance with general agreements between the two countries and under USAID guidelines, the program seeks to balance oceanography with more traditional technologies in food resources and health control.

Perhaps the highlight of the Program, to date, occurred during September, 1983, when Dr. A.R. Bayoumi and Admiral Yohay Ben Nun (original Egyptian and Israeli coordinators respectively) were honored for their contributions to the Program by being designated as the firsts Co-recipients of the International Compass Award given by the Marine Technology Society for distinguished service in international marine affairs. In August, 1985, Dr. El-Sayed received the Distinguished Service Award from the American Institute of Biological Sciences for his role in developing the Program.

November 1988, marked another milestone in the Program's career, when a U.S. Congressional Delegation, led by Representative James Scheuer, met with the Israelis and a large Egyptian delegation in Elat, Israel, to reflect upon the Program's achievements and consider its future. Owing to aquaculture's central role in Middle East technical development, the entire group then inspected Israel's national mariculture center.

Symbolic of the burgeoning Egyptian interest in the Program, the nine-person Egyptian delegation (the largest yet to attend such a meeting) included Dr. Ibrahim Gohar, the pioneering leader of Egypt's marine program. His prominent role dates back to King Farouk's regime. Upon learning of his

impending, eighty-second birthday, the Israelis held a party featuring a gigantic cake, to celebrate. The emotional impact was enormous.

In summary, social gains seem to be self-catalyzing and progress to be exponential. Closer working relationship lead to better results. Better results awaken interest by scientists outside the Program. The consequently improved recruiting opportunity offers more selectivity and more competent participation to the coordinators. Increasing competence leads to closer working relationships, better results, etc. In effect, the social machinery appears to be fueled by its own achievements.

PROGRAM MANAGEMENT

Very early in the Program's development, in fact, nearly from its inception, it became evident that regardless of the manner in which the sponsoring agency, USAID, viewed the Program's management, traditional doctrines of management simply had to be discarded. For instance, while total authority over, and responsibility for, the Program was vested in the Prime Contractor, i.e., the New Jersey Marine Sciences Consortium (Dr. Abel - Corporate President, and the Program's principal investigator for the first decade), the traditional doctrine of authoritarianism would simply not work (this assumption has been amply proved in the intervening years in other projects).

Accordingly, Abel adopted a laissez-faire approach in which his authority was delegated to the two country coordinators to the maximum degree and then, with them and Dr. El Sayed, he formed a Steering Committee. Thus Abel

1. Submitted all planning documents, even including meeting agendas, in draft to Cohen and Eisawy
2. Encouraged maximum review and discussion of the budgets that he introduces for the respective projects
3. Attempted wherever possible to maintain the Consortium's role as sort of service agency

The Program's leaders did not bind themselves to a set technique for developing the Program and its proposal. Israel adopted a methodology early in the tenure which appears to be more or less emblematic of the biennial forging of a Program package.

1. The country issued a call-for-proposals to the major institutions in Israel.
2. Applicants sent idea papers to the coordinator.
3. The coordinator convened a meeting at the Hebrew University in Jerusalem, hosted by a prominent member of that faculty. Dr. Abel attended.
4. Intensive discussion guided adroitly but dispassionately by the coordinator led to consensus, selecting a dozen of the most promising projects. The participants also deputized two additional scientists to accompany the coordinator to the Steering Committee meeting in Cairo, the following week.
5. The Egyptians having completed a similar process, the Steering Committee met to refine the package further, leaving in only the projects in which both Israel and Egypt possessed at least minimal technical capability.

STEERING COMMITTEE

More than any other aspect of the Program, the Steering Committee reflects the spirit of cooperation so central to the Program's success. The Committee's functions include, inter alia:

1. Stimulating thought towards project initiation in the three participating countries.
2. Assisting prospective principal investigators in preparing their projects, including identifying partners in the other countries.