

**Marine and coastal processes
in the Pacific: ecological
aspects of coastal zone management**

**Report of a Unesco seminar held
at Motupore Island Research Centre
University of Papua New Guinea**

14 - 17 July 1980



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9	The mangrove ecosystem: scientific aspects and human impact <i>Available in English and Spanish</i>	1979
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11	Programa de investigación sobre el plancton de la costa oeste de Sudamérica	1981
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13	Enseñanza de la oceanografía en Latinoamérica	1981
14	Marine science and technology in Africa: present state and future development <i>Available in English and French</i>	1981
15	Fishery science teaching at the university level <i>Available in Arabic, English, French, Russian and Spanish</i>	1981

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PREFACE

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INTRODUCTION

The majority of the world's population lives near the coast and in one way or the other depends directly or indirectly on the coastal zone and its resources. This is particularly true for populations on relatively small islands, which often rely on the sea for much of their food, transportation, communication, etc. Unfortunately, increasing misuse and overuse of the coastal zone in recent years has prompted the world-wide need for management and conservation plans, and the acquisition of the scientific data and knowledge required to draw up such plans.

Additionally, many coastal countries are assuming responsibility over the 200 nautical mile offshore area as a result of their participation in the Third United Nations' Conference on the Law of the Sea. This expansion constitutes a major opportunity for economic development, but also puts extra demands on national marine science capabilities and infrastructures to provide adequate advice for policy and management decisions. In this respect, smaller island nations are facing unprecedented challenges in view of the relative extensiveness of the offshore zone, the scarcity of information on their marine and coastal environment, and the present lack of manpower to execute the studies to provide for such information.

In view of these considerations and pursuant to the approval by the Unesco General Conference at its Twentieth Session, Paris, 1978, of programme activities concerning the development of the scientific basis for the understanding of marine systems, especially coastal, and concerning the development of national and regional infrastructures in the marine sciences, the Division of Marine Sciences initiated the organization of the "Seminar on Marine and Coastal Processes in the Pacific: ecological aspects of coastal zone management".

Preparations included a consultation by correspondence of about fifty scientists and administrators in the tropical Pacific region on the subjects proposed to be dealt with at the seminar. Subsequently, a planning meeting was held at Hawaii from 2 to 3 July 1979. The purpose of the seminar was defined as a review of the present status of knowledge of the coastal ecosystems of Oceania and an identification of management problems. Coral reefs, estuaries, lagoons and mangroves were to be included, as was the offshore region where inshore and offshore ecosystems interact. Arising from the reviews it was expected that the seminar should provide an insight into the degree to which the countries of the region require research and management and educational inputs in the marine sciences and thus provide a basis for a set of recommendations to Unesco and other bodies which have an interest in the development of the marine sciences in the region.

During the preparatory phase it became clear that the principal and most basic coastal zone management problems of Oceania relate to the degradation of the marine environment as a result of man's activities on land and his use of the sea for transport and dispersal of effluents. Additionally, the utilisation of coastal zone resources, principally coral reef and lagoon fisheries, but also including coral mining, harvesting of corals and shells for ornamental purposes and other extractive activities

was considered to be a major problem. Thirdly, the development of coastal tourism, both domestic and foreign, was seen as a major problem in that fragile island ecosystems are fundamentally incompatible with large-scale developments.

At the invitation of the Government of Papua New Guinea, through its Ministry of Education and with the support of the University of Papua New Guinea, the seminar was held at the Motupore Island Research Centre, of the University, from 14 to 17 July 1980. Dr. J. L. Munro, Executive Officer of the Centre was nominated as the local organizer.

Fifteen participants, invited in their personal capacity, attended the seminar (see Annex I) as well as many local observers from the Biology and Geography Department and the Motupore Island Research Centre of the University of Papua New Guinea, from the Fisheries Division and the Kaundi Fisheries Research Station, from the National Parks Board, and from the National Museum and Art Gallery. The formal proceedings were opened with a welcoming address by Prof. M. J. Swift, Chairman of the Biology Department of the University of Papua New Guinea (see Annex II). The introductory remarks by the Chairman of the seminar, Dr. J. L. Munro, appear in Annex III.

The seminar was divided into three one-day panel sessions dealing with :

- (i) habitat degradation;
- (ii) coastal zone resource uses and removals;
- (iii) tourism and indirect impacts related to coastal zone management.

Ten invited papers were presented and discussed during these sessions (see Annex IV); these papers are published separately. The fourth day was devoted to discussion of regional research and educational requirements and a set of recommendations.

As a result of last-minute withdrawal of two participants, no review papers are available on the degradation of lagoons and estuaries and of coral reefs. However, the combined expertise of the participants was sufficient to cover these topics and the recommendations pay full consideration to these topics. Also a report on research and degradation problems of the coral reefs of East Asian seas (Gomez 1980¹) was available for consideration together with a paper on the effects of oil pollution upon reef corals (Loya and Rinkevich, in press²).

1. Gomez, E. D. (1980). Status report on research and degradation problems of the coral reefs of East Asian seas, (UNEP/41/INF.15). 68p.
2. Loya, Y., and B. Rinkevich (in press). Effects of oil pollution on coral reef communities. Mar. Ecol. Progr. Ser.

SUMMARY

A number of basic ideas emerged from the formal presentations of the review papers at the seminar and from the resulting deliberations.

Firstly, it is apparent that the basic threats to the coastal marine habitats, the coral reefs, sea-grass meadows, mangrove forests and neritic lagoon waters are quite well understood on a scientific level, mostly on the basis of investigations made outside of the region. Siltation resulting from poor land management and various construction activities, sedimentation resulting from physical modifications to port areas and lagoon passages, interference with natural water exchange by causeway construction, eutrophication of lagoons and coastal waters by sewage and by run-off of agricultural fertilisers, and contamination of the environment by oils, pesticides and other chemicals were all frequently cited and the most direct impacts appear to be well understood. However, in no cases are the most subtle, indirect effects well known and the long term effects of chronic stress upon the communities are largely, if not entirely, unknown.

Additionally, while the basic mechanisms of degradation of the marine habitats of Oceania are quite well understood by the scientific communities, it is apparent that extension activities which enable this understanding to be applied to economic and environmental management have not kept pace with scientific progress. As a consequence there are a number of examples of development activities which destroy the resource bases upon which island economies are founded and create increasing economic dependency upon external sources.

In the marine resources field the review papers highlighted the fact that a strong theoretical and technical base exists for our understanding of coral reef fisheries but there is a lamentable lack of factual information on the biology and ecology of almost all species of exploitable reef and lagoon fish and invertebrates. Likewise, the response of biological communities to different exploitation patterns and strategies are not understood and it is apparent that some large-scale studies and experiments need to be made if future harvesting strategies are to be optimised. Also, it is apparent that even elementary information on the extents of the major habitats is lacking, that charts of many areas are inadequate and that virtually no progress has been made in inventorying the marine resources of the region.

The meeting recognised the value of traditional marine conservation practices and that many Pacific islanders have a profound understanding of marine resource use and biology, and urged that an accelerated programme of studies be undertaken to record knowledge which might become lost and to examine the possibilities and desirability of applying some of the traditional conservation methods in a modern context.

The meeting recognised that the development of coastal tourism was regarded in many areas of Oceania as a highly desirable economic and developmental activity but emphasised that large-scale developments tend to generate degradation of marine habitats, to encourage increased levels of extractive activities and to have hidden social and economic effects

which arise as a result of departures from traditional patterns of resource usage. This is particularly true in those areas which have the greatest aesthetic appeal and recreational potentials.

In addition to suggestions for numerous specific research topics and recommendations for conservation and extension activities, the most important consensus to emerge from the seminar was that there is need for the identification of a regional organisation or programme which could assume responsibility for encouraging the more effective utilisation of the educational and research resources of the region. Such an organisation or programme could be responsible for providing appropriate advice to island nations, for preparing informational materials, for identifying and supporting research projects of regional significance and for accelerating the training of people of the region in the marine sciences and in environmental management.

In the context of the above need, the meeting noted the establishment of the South Pacific Regional Environmental Programme (SPREP). The meeting also suggested that established laboratories and institutions in the region with marine or marine-related activities could form a network which could co-operate to their mutual benefit and the benefit of the peoples of Oceania. Existing laboratories and institutions include the Institute of Marine Resources of the University of the South Pacific at Fiji, the field stations at Tarawa and Kiribati, the marine laboratory of the University of Guam, the Micronesian Mariculture Demonstration Centre at Palau, the Yap Institute of Natural Science, the Motupore Island Research Centre of the University of Papua New Guinea, the Free University of Brussels' laboratory at Laing Island on the north shore of Papua New Guinea, the CNEOX laboratory at Tahiti, the ORSTOM Laboratories in New Caledonia, the Hawaii Institute of Marine Biology, the Australian Institute of Marine Sciences, the Marine Biology Department of James Cook University of North Queensland, and the laboratories at Lizard Island and Heron Island on the Great Barrier Reef.

Finally, the seminar noted the urgent need for synthesis of current knowledge of the ecological aspects of coastal zone management into a series of informative handbooks for non-specialist island administrators, teachers and school-children. Additionally, there is a need for development of materials for the guidance of international and bilateral development agencies which are, on occasions, uninformed of the consequences of well-intentioned development activities which can seriously impair or destroy the resource bases upon which the island economies are founded.

During the closing session, the participants expressed their appreciation to the Government of Papua New Guinea and especially the University of Papua New Guinea for their hosting of the seminar, and to the Chairman and local organizer, Dr. J. L. Munro, for the excellent arrangements.

RECOMMENDATIONS

1. Populations, development and environmental education

The Unesco Seminar on Marine and Coastal Processes in the Pacific,

RECOGNIZING,

that the tropical marine environment is vulnerable to perturbations and that island cultures have developed within ecological limitations;

that development projects which are possible in large countries may not be sustainable on the basis of island resources without serious environmental impacts;

that various activities relating to technological and economic developments and to human population growth result in degradation of marine habitats and diminution of marine resources, and consequently reduce the ability of those resources to meet the needs of human populations;

that a considerable body of information relevant to Oceania could be made available to decision-makers within Oceania as a consequence of scientific information and management case histories from within and outside of the region;

RECOMMENDS

that specific reports on the various forms of coastal zone and marine resource impacts occurring or likely to occur in Oceania be prepared and that such reports describe the effects of impacts and relate these impacts to usage of resources and, as appropriate, identify priority requirements for management, research and investigations, and that government bilateral and international aid agencies and development organisations be informed of the effects of such impacts;

that immediate attention be given to an analysis of the intrinsic biological resources of islands and coastal ecosystems in relation to current and prospective population size and sustainable life style;

that island peoples, particularly officials and teachers, be aware of the threats to their environment and life styles by the provision of informational and educational materials written in concise form, and designed specifically for island conditions;

that opportunities be taken to study the effects of siltation, oil spills, pesticides, nuclear contamination, nutrient eutrophication, dredging and other environmental modifications and contaminations upon the coastal ecosystems and their biological resources.

2. Coastal zone research and management

The Unesco Seminar on Marine and Coastal Processes in the Pacific,

RECOGNIZING

that there is an acute lack of baseline information for future comparisons and for understanding of reef community dynamics;

that the causes of changes in coastal ecosystems and communities are poorly understood;

that further specific research priorities are likely to be identified as a consequence of the South Pacific Regional Environmental Programme;

RECOMMENDS

that basic population studies of the principal components of coastal ecosystems should be undertaken and should include measurements of size, longevity, abundance and relative biomass;

that long-term studies of changes at selected sites, including sites exposed to and sites protected from environmental threats, should be undertaken at the earliest opportunity;

that the effects of large-scale natural or artificial environmental catastrophes should be studied and this should include studies of recovery rates;

that priority be given to developing techniques for resource assessment, monitoring and management which can be applied on a regular or routine basis by the peoples of the Region and that priority be given to investigation of impacts identified by the governments of the Region within the South Pacific Regional Environmental Programme;

that management techniques which apply current scientific understanding to minimizing the impact of essential human activities on the coastal zone be developed at the earliest opportunity and be regularly reviewed in the light of future increases in scientific understanding.

3. Traditional knowledge and management

The Unesco Seminar on Marine and Coastal Processes in the Pacific,

RECOGNIZING

that few studies have yet been undertaken of traditional marine knowledge and that this information is rapidly being lost;

that traditional marine conservation methods, including exclusive tenure, exist in most parts of Oceania but that these methods are being abandoned and traditional rights eroded in many areas;

RECOMMENDS

that the possibilities of retaining and reinforcing traditional marine conservation methods or of incorporating their essential elements and philosophies into new management practices be studied;

that attempts be made to record traditional knowledge of environmental and fisheries biology and of marine resources before this knowledge is lost with the passing of older generations.

4. Resource investigations

The Unesco Seminar on Marine and Coastal Processes in the Pacific,

RECOGNIZING

that the resources of the area are poorly described and charted and that diverse methodologies used for surveys of invertebrates and fisheries make comparisons between areas difficult;

that information on the biology, and ecology of important reef, lagoon and mangrove food organisms is very sparse;

that there is virtually no information on the effects of different exploitative regimes upon the composition and productivity of coastal fisheries and no information on the effects of disruptive harvesting by means of various poisons and explosives;

RECOMMENDS

that the charting of potential fishing grounds be expedited by the acquisition of high quality aerial photographs and satellite images of the shallow marine environments of Oceania;

that investigations be made of the possibilities of standardising survey methods for assessment of stocks of exploitable marine resources and that such methods be utilised in making inventories of the marine resources of Oceania;

that studies should be undertaken of the basic biology of reef food organisms and other exploited species, including basic life history parameters, reproductive biology, distribution and dispersal of larvae and mechanisms of recruitment;

that comparative studies of fish community structure, harvest, recruitment and habitat structure be undertaken in carefully selected analogous areas in order to elucidate the effects of different exploitative regimes or strategies, or of different morpho-edaphic features of habitats.

5. Extension, research and training

The Unesco Seminar on Marine and Coastal Processes in the Pacific,

RECOGNIZING

that island communities have specific problems in environmental management but do not individually have the resources to solve many of the problems;

that coastal zone management problems of Oceania are similar to those of other countries of the Pacific Ocean, Indian Ocean and Caribbean Sea;

that attention to the environmental needs of Oceania are of concern not only to the Member States, but also to the community of nations;

that effective advice requires organisational arrangements which can provide expertise both in management and in more basic research;

that there are few informational materials which pertain to current understanding of the tropical marine ecosystems of Oceania.

RECOMMENDS

that the following activities be given particular attention:

- arranging for the provision of coastal zone management advice and arranging for advice to be available in such form as is most appropriate to the needs of the nations of Oceania;
- ensuring that the results of research and management experience from within and outside Oceania are made available in suitable form to the governments and peoples of Oceania;
- arranging for specific research relating to coastal zone ecology and management;
- arranging for the training of people of the region in research and management of the coastal zone;
- ensuring that as much of the training as possible is undertaken within the region in order to regionalise the marine sciences.

that provisions be made for enquiries and research in satisfaction of needs beyond the resources of individual island states.

that a network be established between the various institutions in the tropical Pacific region with marine or marine-related activities, and that funds be made available to support specific research and research training activities which encompass the environmental problems of Oceania.

SUGGESTED RESEARCH TOPICS

This listing is not comprehensive, but provides an indication of topics related to coastal zone management in Oceania which were considered, by the seminar participants, to require investigation at the earliest opportunity. Additional major topics are implicit in the "recommendations" and are not repeated here. They include suggestions for documentation of the effects of known causes of environmental degradation, such as

- a) sand dredging, filling, coral mining and channel blasting;
- b) chemical contaminants such as herbicides, pesticides, agricultural fertilisers, and industrial effluents;
- c) eutrophication by organic pollution from sewage, canneries and agricultural and forestry industries; and
- d) increased sediment loads caused by mining, poor land management and construction activities.

Specific studies of phenomena or current practices which appear to require urgent appraisal include

- a) mangrove die-back;
- b) the effects of selective harvesting of fish species (particularly bait fish for the skipjack tuna industry) upon community compositions and reef fishery yields.
- c) the impact of Acanthaster planckii plagues upon fishery yields; and
- d) the effects upon fishery yields of disruptive harvesting techniques such as bleach, explosives and traditional fish poisons.

Requirements for reviews and problem identification exercises were noted in connection with

- a) mangrove management, particularly with regard to recovery of mangroves from harvesting;
- b) traditional fishing rights and management methods;
- c) standardisation of methods for assessment of marine communities, particularly visual techniques which can be used in making inventories of the marine resources of Oceania; and
- d) responses to natural catastrophes and rates of recovery.

General areas in which our knowledge is particularly deficient in Oceania include

- a) the basic biological characteristics of exploitable aquatic organisms, including growth rates, population parameters, reproduction, early life history and trophic relationships;

- b) the socio-economic aspects of all facets of coastal zone management, including habitat degradation, resource utilisation and tourism;
- c) hydrography of coastal and atoll lagoons; and
- d) relative extents of various types of shallow marine habitats such as coral reefs, sea grass beds, mangroves, and soft-bottom areas.

ANNEX I

LIST OF PARTICIPANTS

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ANNEX II

Welcoming Address by the Chairman of the Department of Biology,
University of Papua New Guinea

Prof. M. J. Swift

It is my pleasant duty to welcome you all to Papua New Guinea and to the Motupore Island Research Centre. I firstly welcome you in the name of the University of Papua New Guinea but more specifically in that of the Users' Committee of the Research Centre. I should also like to extend a welcome on behalf of the Biology Department. We have a large committment to teaching and research in Marine Biology and other aspects of ecology and environmental sciences. Students from our department will be among your keenest observers during the workshop.

Working in Papua New Guinea sometimes induces a type of schizophrenia: on the one hand, this is a biologist's paradise - there is a wealth of material to work on and many pressing problems that we would like to tackle; but on the other hand we often feel rather isolated and out of the main stream of research and academic progress. I think this is most particularly the case for our young Papua New Guinean scientists and students.

It is thus not only a great pleasure but a source of great interest to us here when people from elsewhere visit and we can enter into the exchange of scientific information which should be a normal part of scientific life. The young men and women you see sitting with you, who include our most distinguished biological students, will cast a critical eye over your proceedings in the coming days. I say a critical eye because not only are we interested in listening to what you have to say from the point of view of our own personal education, but also because this country obviously has a great interest in the subjects you are discussing.

One of the marvellous things about PNG is that the development options are still open to a very large extent. The coasts of PNG are not degraded to the same extent as those in many other parts of the world. The same largely applies to the interior. Many of the people who are here today will probably be in charge of managing these resources in the future and helping to make the decisions that will affect their permanence or change. Thus anything that you have to say which is of relevance to the choice of options is of quite immediate and practical importance to us in PNG.

I will take little more of your time but I would like to offer you one thought which I suggest might be a keynote for your deliberations. That is to state for you what is the fourth of five goals and national objectives which are part of the PNG constitution.

"We declare our fourth goal to be for PNG's natural resources and environment to be conserved and used for the collective benefit of us all and to be replenished for the benefit of future generations".

I suggest that this should be a good stimulus for your discussions. I should like, as I hand you over to the Chairman for the first session, to thank you all for coming so far and to welcome you all again to PNG and Motupore Island.

ANNEX III

Introductory Remarks by the Chairman of the Seminar, Associate Professor of Marine Biology, University of Papua New Guinea, and Executive Officer, Motupore Island Research Center

Dr. J. L. Munro

For the benefit of those who arrived today, I have prepared and distributed a summary of what we are here for and perhaps it is worth recapitulating this so that we keep these objectives in mind. It is possible, of course, to range very widely and lose track of what we are trying to do. However, Unesco has set us a specific task.

Primarily, we are to review the present status and problems of coastal zone research in Oceania. In other words we are to attempt to review where we are research-wise. Secondly, we are asked to study and identify the needs of countries and of the region for promotion of the marine sciences. That means, particularly, the needs for development of marine science educational systems and research facilities. Thirdly, we are asked to provide information and recommendations to Unesco and to any other organisations which are dealing with scientific development plans for Oceania.

The planning meeting which was held in July last year summarised this by agreeing that the seminar should be able to define the priorities in the region for both research and training with emphasis on the means by which these can be accomplished, since the smaller and poorer countries will not be able to sustain any research activities without regional co-operation and international assistance. They suggested that particular emphasis should be given to ways of collecting information on the status of and changes in coral reefs and other coastal resources without waiting for the development of scientific manpower or the development of coastal research facilities. They also narrowed down the priority topics as habitat degradation, removal of coastal zone resources, tourism and indirect impacts related to coastal zone management.

The foregoing are the priority topics but I emphasize that they are not the only topics to be touched upon. For example, the removal of coastal zone resources refer particularly to coral reef fisheries but if we wish to talk about dredging of reefs for limestone we are free to do so, because it will have obvious effects on the reef fish resources.

If we can bear these objectives in mind I think that we will step towards what Unesco is looking for.

ANNEX IV

LIST OF PRESENTED PAPERS

Habitat Degradation Panel

Degradation of Mangroves (by John S. Bunt)

Marine environment impacts of land-based activities
in the Trust Territory of the Pacific Islands
(by Marjorie V. C. Falanruw)

Coastal Zone Resource Uses and Removals Panel

The shoreline fishery of American Samoa -
past and present (by Richard C. Wass)

Effects of exploitation patterns upon reef and
lagoon communities (by James D. Parrish)

Assessment and management of fisheries for
sessile invertebrates (by Robert G. Pearson)

Management of reef and lagoon fisheries
(by Nelson Marshall)

Tourism and Indirect Impacts Related to Coastal
Zone Management Panel

The development of methods for selection and monitoring
of tourist operators and sites (by Richard A. Kenchington)

Coastal tourism development in Oceania
(by Graham B. K. Baines)

Direct and indirect impacts of tourism on the coastal
environment (by Edgardo D. Gomez)

Establishment of marine parks in relation to tourism
development in small island nations (by Alan
H. Robinson).