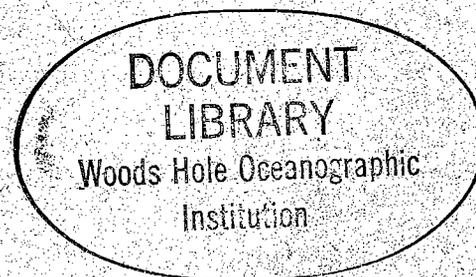
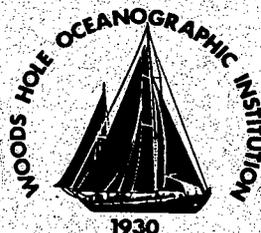


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Woods Hole Oceanographic Institution



Scientific Research and the Galápagos Marine Resources Reserve

Synopsis of a Workshop
April 20-24, 1987
Guayaquil, Ecuador

edited by

Arthur G. Gaines, Jr. and Hernán Moreano Andrade

September 1988
(1991 Reprinting)

Technical Report

Funding was provided by the Marine Policy Center of the Woods Hole Oceanographic Institution (U.S.A.)
and Oceanographic Institute of the Navy (Ecuador) with partial support
from the National Science Foundation.

English edition approved for publication; distribution unlimited.

WHOI-91-41

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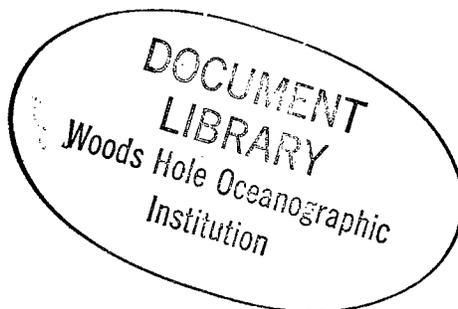
Arthur G. Gaines, Jr.
Marine Policy Center,
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and

Hernán Moreano Andrade
Instituto Oceanográfico de la Armada del Ecuador
Guayaquil, Ecuador

September 1988
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Technical Report



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James M. Broadus, Director
Marine Policy Center



Preface to 1991 Printing

This technical report reprints the proceedings of a conference held in Guayaquil, Ecuador, in 1987. The conference was a joint effort of the Instituto Oceanográfico de la Armada (INOCAR) and the Marine Policy Center of the Woods Hole Oceanographic Institution. The purpose was to explore the role of science and scientific organizations in management of the coastal and ocean assets of the then newly created Galápagos Marine Resources Reserve. Participation in the three day conference involved many Ecuadorian organizations, including some that had not previously played a conspicuous role in the Galápagos. This joint conference represented, in a sense, a capstone for our cooperative project on coastal management in the Galápagos that had begun in 1984 with support from the Tinker Foundation.

To record and disseminate the results of the conference, the collected abstracts were published in Spanish and English within a few weeks by the naval press at INOCAR. One of our purposes in reprinting the proceedings is to replenish the supply of the English version of that early conference draft, now exhausted. We have taken this opportunity to correct some typographical errors and irregularities in graphics and translation that survived the first printing. We are grateful to Ms. Theresa McKee and Ms. Sarah Repetto for their contributions in this regard.

A second purpose for reprinting these proceedings is to re-emphasize a principal conclusion—the need to incorporate high technology into the Galápagos ocean and coastal management context. Since our conference, this conclusion has taken on even greater relevance, given the advances in remote sensing, geographic information systems (GIS), satellite telemetry, and global positioning system (GPS) technology, and in their new commercial availability. Perhaps even more important have been the advances in the integration of high technology systems, such as in the Electronic Chart and Digital Information System (ECDIS) and related vessel traffic monitoring service capabilities. These technologies provide a means to monitor the environment and many kinds of human activities over vast expanses of ocean space; they provide automation and economy in place of mind-numbing and staff-intensive information collection, processing, display and storage. Equally important, this technology comes "hardened" to the rigors of marine applications, providing new levels of reliability along with the miniaturization and user friendliness increasingly characteristic of modern marine electronics. Ironically enough, such advanced technologies may be the most "appropriate" for the remote and harsh Galápagos setting.

The participation at the integrated conference underlined another conclusion we reached in an earlier report—that the basic institutional framework for integrated marine resources management in the Galápagos already exists in Ecuador. We in North America have something to contribute, but Ecuador already possesses much of what is needed to sustain the Natural Heritage of the Galápagos Island archipelago.

James M. Broadus
Arthur G. Gaines, Jr.
Woods Hole, Massachusetts

ABSTRACT

In 1986 the Government of Ecuador established the Galápagos Marine Resources Reserve encompassing the entire Galápagos Archipelago, an area embracing 70,000 square kilometers of the Pacific Ocean and its underlying seabed. A workshop, sponsored by the National Science Foundation, was held on April 20-24, 1987, in Guayaquil, Ecuador, to address the role of scientific information in planning for the management of this new Marine Reserve. The "Scientific Research and the Galápagos Marine Resources Reserve Workshop" was jointly coordinated by the Marine Policy Center of the Woods Hole Oceanographic Institution, and the Oceanographic Institute of the Navy of Ecuador (Instituto Oceanografico de la Armada).

Ten North American scholars and about thirty scholars from Ecuadorian governmental and non-governmental scientific organizations, concerned with issues related to the Galápagos, met to discuss the status of scientific information on marine areas surrounding these islands. The workshop also focused on the role this information should play in crafting a management plan that will, a) recognize and mesh with environmental realities of this complex oceanic setting, b) incorporate new scientific information as it becomes available, and c) accommodate the needs of scientists working in the remote, typically harsh and often unique setting the Archipelago provides the international academic community.

Despite some important gaps, considerable scientific information is available to Reserve managers, and examples of the use of scientific information in other marine reserves is also available. Important areas of innovation are needed in order to gather and use information effectively for the management of this vast ocean area. Remote sensing technology and international cooperation offer promise in this regard.

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LIST OF ACRONYMS

ASFA	-	Aquatic Sciences and Fisheries Abstract
AVHRR	-	Advanced Very High Resolution Radiometer
CDRS	-	Charles Darwin Research Station, Ecuador
CLIRSEN	-	Center for the Remote Sensing of Natural Resources, Ecuador
CONADE	-	National Development Council, Ecuador
CPE	-	Catch Per Unit Effort
CPPS	-	Permanent Commission of the South Pacific
CZCS	-	Coastal Zone Color Scanners
CZM	-	Coastal Zone Management
DCP	-	Data Collecting Platform
DIGEIM	-	National Directorate of Maritime Interests, Ecuador
DIGEMA	-	National Directorate of the Environment, Ecuador
EMC	-	External/Environmental Marginal Cost
ENSO	-	El Nino - Southern Oscillation
ERFEM	-	Regional Study of the El Nino Phenomenon
GMRR	-	Galápagos Marine Resources Reserve
GNP	-	Galápagos National Park
GOFS	-	Global Ocean Flux Study
IATTC	-	Inter-American Tropical Tuna Commission
INAMHI	-	National Institute of Meteorology and Hydrology, Ecuador
INGALA	-	Galápagos National Institute
INOCAR	-	Oceanographic Institute of the Ecuadorian Navy
INP	-	National Fisheries Institute of Ecuador
IUCN	-	International Union for the Conservation of Nature
MICIP	-	Ministry of Industry, Commerce, Integration and Fisheries of Ecuador
MPA	-	Marine Protected Area
MPS	-	Marine Polymetallic Sulphide
MSS	-	Multispectral Scanner
MYA	-	Million Years Ago
NMS	-	National Marine Sanctuaries
NOAA	-	National Oceanic and Atmospheric Association
NROSS	-	Navy Remote Ocean Sensing System
NSCAT	-	Microwave Scatterometer
OCI	-	Ocean Color Imager
PNG	-	Galápagos National Park
SCOR	-	Scientific Community for Oceanographic Research
SSEW	-	Subsuperficial Equatorial Water
SST	-	Sea Surface Temperature
STW	-	Surface Tropical Water
TM	-	Thematic Mapper
TOGO	-	Tropical Ocean and Global Atmosphere
WHOI	-	Woods Hole Oceanographic Institution

FOREWORD

Welcome Address

Lt. Cdr. Hernan Moreano Andrade, Director
Oceanographic Institute of the Navy
Ecuador

It is a pleasure for me to address you this morning; and, on behalf of both the Woods Hole Oceanographic Institution (WHOI) and the Oceanographic Institute of the Navy (INOCAR) I welcome everyone to this Workshop on the Galápagos Marine Resources Reserve, which, under the sponsorship of both institutions, will take place in this auditorium during the next four days.

Problems of coexistence between man and the land and nature of the Galápagos Islands are complex enough to cause constant concern, to the point that an International Botanic Workshop met a few days ago in order to establish future guidelines and patterns for the management of the Galápagos National Park. Coexistence of man and the Marine Reserve area is as, or more, complex than that on the islands. This explains the interest of WHOI and INOCAR in conducting this workshop as a joint effort, along with valuable participation from other Ecuadorian government institutions who are involved in a wide variety of activities in the Archipelago.

The Workshop will support deliberations of the Technical Committee, established by the Inter-institutional Commission for the management of the Marine Reserve, in the analysis of scientific knowledge on the following subjects:

- o Geological, biological and physical oceanography in the Galápagos Islands;
- o Distribution of primary productivity and marine organisms in Galápagos waters;
- o The impact of urban zones on the marine areas;
- o The biological, mineral, tourist-related, scientific and technological resources of the Galápagos and their requirements for management, and;
- o International cooperation through research in the specific case of the Archipelago.

The purpose of these efforts is to provide the Technical Committee with the information they will need in order to establish a basis for the Marine Reserve Management Plan.

I am confident that the highly qualified participants in the Workshop will help to define a wide

spectrum of criteria, and that the conclusions drawn from them will greatly benefit and expedite the job that the Technical Committee is performing.

Finally, I wish to express the great pleasure that we, as members of INOCAR, feel in having you as our special guests. I greatly hope that the talks and discussions of these next few days will produce fruitful results for the benefit of the Archipelago and, of course, for our country.

Workshop Context, Goals and Constraints

Dr. Arthur G. Gaines
Marine Policy Center
Woods Hole Oceanographic Institution
U.S.A.

With his 1986 decree establishing a Galápagos Marine Resources Reserve area (Fig 1) the President of Ecuador has taken an important step toward protecting the unique natural features of the Galápagos. With this action the President responds to a truly unprecedented national and international appeal of increasing pitch over 1 ½ centuries since the island's unusual biota was first revealed to the world.

For purposes of delineating a management process for the marine area, the decree also created an "Inter-Institutional Commission" to enlist the energy and expertise of seven Ecuadorian agencies. The "working arm" of the Commission is a five member Technical Committee that holds the responsibility of crafting a pragmatic plan from the aspirations and abstractions of those whose dreams may not always be practical.

The Technical Committee consists of:

Sr. Fausto Cepeda (Chairman), Galápagos National Park (PNG)
Sr. Fernando Arcos, Oceanographic Institute of the Navy (INOCAR)
Sr. Tito Rodriguez, National Fisheries Institute (INP)
Sr. Jose Villa, Galápagos National Institute (INGALA)
Ab. Efrain Perez (Consultant)

It is our special objective to aid this group in their difficult work.

The Galápagos Marine Resources Workshop originated from a cooperative program between the Marine Policy Center at Woods Hole and the Government of Ecuador, beginning in 1983. The workshop has been jointly planned and hosted by our Center and the Oceanographic Institute of the Ecuadorian Navy; and I am grateful to Captain Hernan Moreano A., Director of INOCAR, for his guidance and help and ongoing attention.

The process of formulating a workable management plan will ultimately involve several different disciplines: law; economics; public administration and others. Our central objective in the workshop is to address only one of these - the place and role of scientific research.

From the composition of the Inter-Institutional Commission and its Technical Committee, it is clear that the importance of science is recognized at the highest levels of the Ecuadorian Government.

An important condition attached to this workshop is that its results be useful to the Technical Committee. This means among other things that the results be provided quickly and in Spanish. I am grateful to all of the workshop participants for accepting the inevitable compromise this urgency places on editorial quality of the manuscripts. I hope critics of the Conference Draft can appreciate the larger purpose we are attempting to serve.

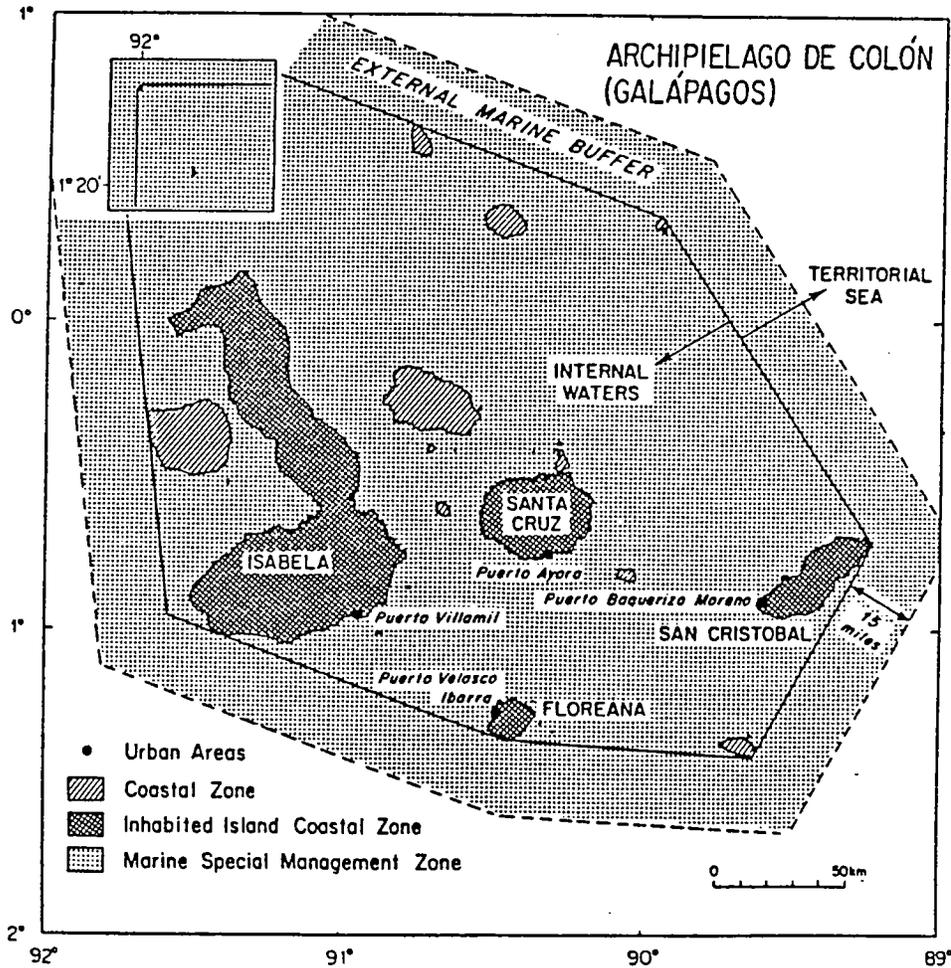


Figure 1. Map of the Galápagos Marine Resources Reserve.

Recommendations

1. Science should influence the framework of the Galápagos Marine Resources Reserve management plan in two distinct ways:

- a) Scientific information and methodologies should serve as the basis for characterizing and understanding the natural and cultural systems addressed by management.
- b) Reserve management strategies should accommodate the needs of Ecuadorian and foreign scientists and scientific organizations for conducting future basic and applied research.

2. National and international scientific cooperation should be promoted as a means to fund and carry out the large number of research, survey, and monitoring studies needed for proper management of the Reserve. The great international appeal for funding of science in the Galápagos Archipelago stems from the union of:

- a) Unusual natural features and research opportunities of the setting.
- b) The history of and future prospects for international collaboration.
- c) Ecuador's rededication to conservation of natural systems in the Galápagos for science, education and low impact use over the long term.

3. Because of the great size and complexity of the Marine Resources Reserve, remote sensing techniques should be used fully to define the environment, its resources and habitats, human impacts, and El Niño variability. More specifically:

- a) Existing imagery should be obtained and made available to Ecuadorian scientists.
- b) Officials at the highest levels in the U.S. and Ecuador should be urged to support the exchange of state-of-the-art remote sensing technology, methodologies and products.
- c) New, large scale aerial photographs (color stereo pairs) of the entire Galápagos coast, needed for many purposes in managing the Reserve, should be obtained by Ecuadorian agencies using existing facilities and expertise.

4. Public participation should be encouraged to help set goals and priorities for management of the Reserve. An enhanced sense of stewardship should be instilled in all Ecuadorians with regard to the Galápagos Archipelago.

5. The focus of these recommendations - - science and technology - - is only one aspect of management formulation. The Government of Ecuador should support the future efforts of the Inter-Institutional Commission and its technical and advisory committees in addressing other management components for the Marine Resources Reserve.

**The Management Plan of the Galápagos Marine Reserve:
Statement of the Technical Committee**

Fausto Cepeda
Galápagos National Park, Ecuador

Fernando Arcos
Oceanographic Institute of the Navy, Ecuador

Tito Rodriguez
National Fisheries Institute, Ecuador

Jose Villa
Galápagos National Institute, Ecuador

Introduction

Because of the Galápagos uniqueness and because of the relationship that exists in these islands between the marine and the terrestrial resources, the Ecuadorian Head of State proposes to protect and conserve the marine and coastal resources of Galápagos islands under a single management process.

The joint report of the Forestry Directorate and the Charles Darwin Scientific Station, "Criteria for the Declaration of the Marine Reserve", was the immediate antecedent to the declaration of the marine reserve, through Executive Decree No. 1810-A. This report was the culmination of several studies, among which the following can be mentioned: "Coastal Environment of the Galápagos" submitted in 1975 by G. Wellington to the Department of National Parks; the seminar for the inclusion of the Galápagos marine area to the National Park, held in San Cristobal, Galápagos in 1978; and the Revision of the Proposal for the Incorporation of the Marine Area to the Galápagos National Park, in 1981, with participation of The Galápagos National Institute (INGALA), Under-Secretary of Fisheries, Charles Darwin Scientific Station, and the Galápagos Forest District.

Terms of Reference

The Galápagos Marine Reserve was created by Executive Decree 1810-A of 29 April, 1986, with a mandate to design a management plan within a 365 day period. Actual work on the plan was delayed until January 1987, due mainly to the complexities of the project and the need for international assistance. The National Forestry Directorate obtained an extension of the term for the delivery of the plan to December 31, 1987.

The following institutions were invited to serve as advisors:

1. The Woods Hole Oceanographic Institution (Marine Policy Center);
2. University of Rhode Island;
3. The Australian Great Barrier Reef Marine Park Authority, and;
4. The U.S. National Oceanic and Atmospheric Administration.

Three commissions were structured in order to formulate the Management Plan:

Inter-Institutional Commission, consisting of several ministries and agencies:

-Ministry of National Defense
National Directorate of Maritime Interests
[Rear-Admiral Alfonso Pinto T.] DIGEIM

-Ministry of Foreign Relation
Directorate of National Sovereignty
(Dr. Ruben Ribadeneira).

-Ministry of Agriculture and Livestock
National Directorate of Fisheries
(Ing. Mario Pescarolo).

-Ministry of Industry, Commerce, Integration and Fisheries
(MICIP) Under-Secretary of Fisheries.

-Ministry of Energy and Mines
National Directorate of the Environment (DIGEMA).

-National Development Council (CONADE).

-Presidence of the Nation - Galápagos National Institute
(INGALA) [Arq. Abdon Guerrero].

The Technical Committee

Composed of Ecuadorian experts whose duty is to design the management plan within a six month span. Members of this group are:

- Msc. Fernando Arcos -INOCAR
- Lcdo. Fausto Cepeda -PNG
- Biol. Tito Rodriguez -INP
- Msc. Jose L. Villa -INGALA

An International Commission

Whose members are the foreign institutions forenamed, with the assigned purpose of advising the technical committee.

