

AGENCY FOR INTERNATIONAL DEVELOPMENT  
WASHINGTON, D. C. 20523  
BIBLIOGRAPHIC INPUT SHEET

FOR AID USE ONLY

Patel # 34

1. SUBJECT  
CLASSI-  
FICATION

A. PRIMARY

Serials

Y-AM00-0000-0000

B. SECONDARY

Agriculture--Fisheries

2. TITLE AND SUBTITLE

Annual report for 1972/1973

3. AUTHOR(S)

(101) R.I. Univ. Int.Center for Marine Resource Development

4. DOCUMENT DATE

1973

5. NUMBER OF PAGES

141p.

6. ARC NUMBER

ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS

R. I.

8. SUPPLEMENTARY NOTES (Sponsoring Organization, Publishers, Availability)

(Activity summary)

9. ABSTRACT

10. CONTROL NUMBER

PN-AAB-911

11. PRICE OF DOCUMENT

12. DESCRIPTORS

Aquaculture  
Research

13. PROJECT NUMBER

14. CONTRACT NUMBER

CSD-2455 211(d)

15. TYPE OF DOCUMENT

ANNUAL REPORT

July 1, 1972 - June 30, 1973

INTERNATIONAL CENTER FOR MARINE  
RESOURCE DEVELOPMENT

University of Rhode Island  
Kingston, Rhode Island



	<u>Page</u>
SUMMARY	1
I DIRECTOR'S STATEMENT	10
II ACCOMPLISHMENTS DURING YEAR--INSTITUTIONAL PROGRAMS	16
An Evaluation of the Implications of Alternative Ocean Management Schemes for Tuna	16
A Research and Development Mariculture-Fisheries Project in Puerto Rico	19
Preliminary Assessment of the Marine Fisheries Development Needs of Latin American Countries in OAS	23
Consortium for the Development of Technology	24
Law of the Sea Institute	27
Master of Marine Affairs Program	30
Certificate Program in International Development	32
Conference on Socio-Economic Research Issues in Fisheries Development	33
Symposium on British Commonwealth Politics	35
Seminar Series	37
III ACCOMPLISHMENTS DURING THE YEAR--PLANNING	38
Planning Workshop at the University of Dar es Salaam, Tanzania	39
Planning Workshop at the Universidad Catolica de Valparaiso, Chile	41
A Prospectus for Planning Workshops on the Development of University Marine Programs	
Seminar and Workshop on Coastal Artisan Fisheries in Central America	47
World-Wide Artisan Fisheries Development Program	48
IV ACCOMPLISHMENTS DURING THE YEAR--INDIVIDUAL PURSUITS	51
Alexander	51
Bergan	53
Chichester and Lee	54
Cobble	59
Constantinides	60

	<u>Page</u>
Cummings	65
Foster	66
Knauss	67
Lampe	69
Landberg	70
Marshall	72
Marston	74
Saila	75
Sainsbury	78
Salomon	79
Shoop	80
Sieburth	83
Wadsworth	84
Weaver	86
FOREIGN STUDENTS IN MARINE ORIENTED STUDIES	87
PROGRAMS FOR THE FUTURE	90
PUBLICATIONS	95

## SUMMARY

This has been a year of transition with the International Center for Marine Resource Development (ICMRD) moving forward under renewed University support, with a revised organization and new leadership, with the re-establishment of interest on the part of the U.S. Agency for International Development in support of fisheries projects, and with broadened support including backing from the National Science Foundation and Resources for the Future.

The present director, Nelson Marshall, took office at the beginning of the year, serving as chairman of a newly founded executive committee. In addition, the University appointed a body of Center Associates from the ranks of the faculty, all--as documented in this report--interested in and committed to fostering the growth of the ICMRD program.

In a reorganizational phase of this magnitude, much of the energy has gone into the planning of things to come. Thus, while the specific accomplishments of the year are listed with some satisfaction, ICMRD can characterize its accomplishments best in terms of activities scheduled for the coming year (at the end of the Summary), including projects started slowly after July 1, 1973.

### PRINCIPAL ACCOMPLISHMENTS OF 1972-73

Of the two research projects handled under the auspices of ICMRD, one, An Evaluation of the Implications of Alternative Ocean Management Schemes for Tuna, was completed; the other, a Research and Development Mariculture--Fisheries Project in Puerto Rico, was recently launched after a year of planning. The tuna study provides the concerned countries preparing for the upcoming Law of the Sea Conference with background data for deliberations relative to the major high seas stock. The study authors (Professors Norton and Salla) suggest the alternative of a global policy combined with regional management.

A document entitled Assessment of the Marine Fisheries Development needs of the Latin American Countries in the Organization of American States was prepared by ICMRD in May. In spite of circumstances compelling a rushed compilation, the draft that was prepared has proven useful in subsequent deliberations.

The Consortium on the Development of Technology, bringing together food technology and related capabilities of five universities (University of California at Davis, Michigan State University, University of Rhode Island, University of Washington and University of Wisconsin at Madison), is now operating on several fronts:

The pilot program continues as a major concern and involves collaboration with the Institute for Technological and Industrial Research in Central America to develop food technology expertise.

CODOT has signed an agreement with Kasetsart University in Thailand to assist in food technology matters.

A larger food technology project is being planned in Brazil with the Instituto de Tecnological de Alimentos.

The central administration of CODOT is handled at URI under ICMRD with Professor C. O. Chichester serving as Executive Chairman for the Consortium. The spectrum of food technology development in CODOT programs include many aspects of marine resource development of interest with respect to the ICMRD participation.

Other programs at URI which relate to international marine oriented endeavors have continued to be quite active:

The Law of the Sea Institute held its eighth annual conference in Kingston in June on the topic The Emerging Regimes of the Oceans. About 190 people representing 35 countries attended. The Institute also held a workshop in May in Nassau on the Hazards of Maritime Transit.

The Master of Marine Affairs program, an overview curriculum for persons contemplating broad-area marine work, had a class of 18, with two foreign students participating. This marked the beginning of a shift of emphasis to create a multinational thrust in this program with support for foreign students forthcoming from URI, UNESCO, foreign countries, and private sources.

The Certificate Program in International Development, a supplementary educational feature available to masters candidates in various fields, enrolled 15 students in its core seminar.

Two conferences were convened with ICMRD backing during the year: one on Socio-economic Research Issues in Fisheries Development, bringing together 20 invited participants from 12 institutions and 3 countries in a workshop format; the other, a slightly larger assemblage with an equally diverse representation, was a Symposium on British Commonwealth Politics. In addition, ICMRD conducted a brief series of seminars featuring the work of URI faculty.

Apart from such programmed activities, several Center Associates and others working individually had been actively engaged in relevant pursuits. Stated by name and subject, these are:

<u>Faculty Member</u>	<u>Assts.</u>	<u>Topic [comments in brackets]</u>
Lewis M. Alexander	2	Marine-related Activities in the Caribbean--Gulf of Mexico Basin
James G. Bergan	1	Stability of Peruvian Anchovetta Oil
Clinton O. Chichester Tung-Ching Lee	5	Development Program Directed toward Infant Food Based upon Indigenous Proteins

[applied to Chile with counterparts working there; includes uses of marine proteins]

James W. Cobble	-	Carbonyl Accumulation during Browning
-----------------	---	---------------------------------------

[completed his second year as Chief of the U.S. AID-funded party on agricultural research in Korea]

Faculty Member                      Assts.      Topic [comments in brackets]

Spiros M. Constantinides              5              Improvements in Marine Food  
Utilization

[included work in residence at the Universidad Catolica de  
Valparaiso]

Ronald G. Cummings                      Water Resources Management

[dealt with problems of seawater intrusion into freshwater  
supplies]

Howard H. Foster, Jr.                      1              Caribbean Resource Develop-  
ment Planning and Admin-  
istration

[projected a system of planning for resource development in  
Antigua and St. Kitts, Nevis, Anguilla]

Harlan C. Lampe

[participated in various advisory efforts in fisheries economics  
in developing countries, also prepared for upcoming study of  
water management as affecting Mexican lagoons]

Leif C. W. Landberg                      2              A Bibliography for the Anthro-  
pological Study of Fish-  
ing Industries and Mari-  
time Communities and an  
Index of Recent Marine  
Research

[completed compilation of annotated references and index]

Nelson Marshall                      2              Food Transfer Studies in  
Support Production in  
Coral Reef Lagoons

[established food chain base for coral lagoon populations,  
including fisheries stocks]

Coral Reef and Reef-Lagoon  
Studies

[mostly devoted to literature review in preparation for study on  
effects of man-induced stresses on reef and associated environ-  
ments]

<u>Faculty Member</u>	<u>Assts.</u>	<u>Topic [comments in brackets]</u>
Scott H. Marston	-	Study of U.S. Oil Interests and Possible International Seabed Controls [suggested that U.S. oil interests will be served and potential conflict with OPEC will be eased by an international regime for the seabed]
Saul B. Saila	2	Fishery Potential of the In-shore Tropical Reef Environment [assessed, in conjunction with N. Marshall, the level and nature of the fisheries potential of coral reef, and adjacent environments]  Mathematical Model of Salmonid Rearing Facilities [high density salmon rearing and American lobster culture, by Professors Meade and Sastry, have also aroused interest, though transferability to developing countries lies in advancing techniques rather than immediate applications]
John C. Sainsbury	-	Advisory Activities in Planning Commercial Fisherman Training Programs [devoted three months to setting up a commercial fisheries training program in Ecuador and about two months advising in an FAO program similar in nature in Indonesia; Prof. Sainsbury also studied the fishing industry as now operating and being developed in New Zealand and Fiji]
Milton Salomon	1	Improvement in the Technology of Traditional Hot Fish-Smoking in West Africa
C. Robert Shoop	2	Mariculture of Sea Turtles [developed rare element tag (europium) for use in natural history research of his key aquaculture species]

<u>Faculty Member</u>	<u>Assts.</u>	<u>Topic [comments in brackets]</u>
John McN. Sieburth		Seaweed as a Habitat for Yeasts
		Economic Structure of the Mexican Shrimp Fishing Industry

[project almost completed with many recommendations which should be of use to the industry]

Thomas F. Weaver

[pursued planning with the Southeast Asian Development Group on inshore fisheries development]

Many of the assistants in the foregoing studies were workers from foreign countries; in fact, close to 50 foreign students were working at URI in marine oriented programs during the past year. By countries, the list includes:

Bangladesh	1	France	1	Kuwait	1
Belgium	1	Greece	1	New Zealand	2
Brazil	2	India	3	Peru	3
Chile	3	Indonesia	1	South Africa	1
China, Republic of	15	Israel	1	Spain	1
Colombia	2	Japan	1	Sweden	1
Ethiopia	1	Korea	2	Thailand	1

By subject areas:

Food Technology and other Food Science categories	17
Oceanography	12
Ocean Engineering and other Engineering areas	4
Resource Economics and Business Administration	9
Fisherman Training	1
Marine Affairs	

The following staff positions were added during the past year:  
executive assistant, research associate in resource economics,

fisheries biologist (established but yet to be filled), research librarian, on-site coordinator for Puerto Rican studies, overseas support officer.

Of the many foreign visitors to URI reviewing marine resources work during the past year special note is made of the following:

Delegation of the People's Republic of China to the United Nations Seabed Committee--one day visit hosted by Provost Knauss as an introduction to marine affairs interests at URI.

The Joint Russian-U.S. Working Group of Marine Pollution and Its Effects on Marine Organisms held its opening meeting at URI in the spring.

PROGRAMS FOR THE FUTURE and, specifically, activities as presently scheduled for the coming year are summarized in Section V of the Report, highlighting:

#### Major Institutional Programs

A plan is being formulated for a coherent, topical program in World-Wide Artisan Fisheries Development, bringing together existing ICMRD work in this area, adding at least one subproject, hopefully in East Africa, relating to the work of the other groups contributing to the upgrading of subsistence fisheries to artisan levels, and supporting conferences and advisory work in the artisan fisheries area.

The Research and Development-Fisheries Project in Puerto Rico is continuing with eight participating investigators from URI and the Puerto Rico Nuclear Center of the University of Puerto Rico, the efforts being aimed at formulating a substantive fisheries development plan.

#### Smaller Institutional Projects

A study is being launched titled Surface Water Management for Irrigation and Lagoon Environmental Modification concerned with conditions

affecting lagoon areas in Mexico which are important in the harvest fisheries and aquaculture.

Green Turtle Research is continuing probing the natural history of the species using a rare element (europium) tag developed here and exploring problems obstructing successful in-hatchery reproduction.

#### Advisory Services

Two Planning Workshops, one at the University of Dar es Salaam in Tanzania and one at the Universidad Catolica de Valparaiso, Chile are scheduled to help universities in developing countries to upgrade their research and education bearing on the marine resources.

A paper on the Resource Potential and Economic Considerations Relating to Development Assistance in Fisheries is being completed.

A Fisheries Bibliographic Search is scheduled on behalf of OAS

At least introductory advisory work will be done on techniques for Upgrading the Azores Fisheries.

#### Consulting

An assessment of the Potential for Coastal Aquaculture in British Honduras is scheduled for early fall.

Further advisory services will be provided on Curriculums for Fisherman's Training Schools probably starting in Ecuador at the Escuela Superior Politecnica de Litoral.

#### Conference and Workshops

A Seminar and Workshop on Coastal Artisan Fisheries is planned for Central America in mid-winter.

A conference on the possible Role of U.S. Sea Grant in the International Field is to be held in Newport, Rhode Island either this spring or the following fall.

In October a one-week program will be held at URI for Foreign Students Participating in the National Oceanographic Data Center Training Program.

#### Individual Pursuits

This is not detailed herein but is destined to be even more diverse and comprehensive than the projects listed for the past year.

DIRECTOR'S STATEMENT

r, International Center for  
Marine Resource Development

In the spring of 1969, the University of Rhode Island, with the help of a 211 (d) grant from the United States Agency for International Development, established its International Center for Marine Resource Development (hereinafter referred to as ICMRD). The premises on which ICMRD was founded are indicated by the following excerpts from the original proposal:

"The University of Rhode Island proposes to strengthen its research, teaching, consultation, and service capabilities in marine resources, especially, to expand current University marine resources capabilities to an international dimension.

"This Center will allow the University to direct to the problems of less developed nations its existing, planned, and proposed integrated strength in development economics, marine resource economics, marine biology, oceanography, ocean engineering, fisherman training, fishing gear research, food technology, marine resource extension work and supporting social science interest.

"Funds requested in this proposal will be used to engage present faculty to enlarge on their interests in international studies, to hire new faculty with these interests, to support domestic and foreign graduate and special students while they pursue their education or training in programs relevant to the purposes of this Grant, to improve library holdings, to help finance visiting lecturers for seminars, courses and symposia and to provide for necessary supplies and travel related to this program."

That the Center has indeed strengthened the University's role and effectiveness in the manner intended is documented by this Annual Report.

While the objectives of the Center have not changed significantly, organizational changes, growing out of the experience of the first year's effort, have been effected. In the main these grow out of an internal reassessment study undertaken during 1971-72, midway in the 211(d) five-year grant period. Originally guidance was given to the Director by a planning and advisory committee. Now (effective July 1, 1972, with the appointment of Nelson Marshall as the new director)<sup>1</sup> the Director reports directly to the Provost for Marine Affairs and chairs an Executive Committee of rotating personnel. Initially, except as specific positions and grants were funded, there was no university faculty recognition of participation and interest in ICMRD. Now (effective July 1, 1972) there is a body of Center Associates committed to the program. While these Associates have their academic homes in appropriate departments, they relate to ICMRD in much the same way as graduate faculty members who, while attached primarily to many departments, serve collectively as members of a Graduate School.

The present roster, updated to apply to 1973-74, of these Center Associates is as follows:

Lewis M. Alexander, Professor of Geography, and  
Director, Master of Marine Affairs Program

<sup>2</sup>Clinton O. Chichester, Professor of Food and Resource  
Chemistry, and Executive Chairman, Consortium for  
the Development of Technology (CODOT)

James W. Cobble, Professor of Animal Science

Spiros M. Constantinides, Assoc. Professor of Food  
and Nutritional Science and Biochemistry

<sup>2</sup>Ronald G. Cummings, Professor of Resource Economics,  
and Chairman of Department

Joel B. Dirlam, Professor of Economics

---

<sup>1</sup>The former director, Lucian M. Sprague, is now Fisheries Specialist at the International Bank for Reconstruction and Development.

<sup>2</sup>Part of faculty salary paid, when not on leave, ICMRD.

- Howard H. Foster, Jr., Asst. Professor of Community Planning and Area Development
- John K. Gamble, Asst. Professor of Marine Affairs, and Director, Law of the Sea Institute
- John M. Gates, Asst. Professor of Resource Economics
- <sup>2</sup>James J. Griffin, Executive Assistant to ICMRD
- Andreas A. Holmsen, Professor of Resource Economics
- Sidney J. Holt, Adjunct Professor of Oceanography, and U.N. Senior Regional Scientific Advisor, International Ocean Institute, Royal University of Malta
- John A. Knauss, Professor of Oceanography, and Provost for Marine Affairs
- <sup>2</sup>Harlan C. Lampe, Professor of Resource Economics
- <sup>2</sup>Tung-Ching Lee, Asst. Professor of Food and Resource Chemistry
- <sup>2</sup>Nelson Marshall, Professor of Oceanography and Director, ICMRD
- <sup>2</sup>James F. McFarland, Asst. Professor of Resource Economics
- Aloys A. Michel, Professor of Geography, and Acting Vice President for Academic Affairs
- Foster H. Middleton, Professor of Ocean Engineering
- <sup>2</sup>Vingil J. Norton, Professor of Resource Economics
- <sup>2</sup>Candace Oviatt, Research Associate, Graduate School of Oceanography
- <sup>3</sup>John J. Poggie, Assoc. Professor of Anthropology, and Chairman, Department of Sociology and Anthropology
- <sup>2</sup>Richard B. Pollnac, Asst. Professor of Anthropology
- William R. Rosegran, Professor of Sociology

<sup>2</sup>See footnote, previous page.

<sup>3</sup>Paid, during leave of absence, from ICMRD funds.

Saul B. Salla, Professor of Oceanography and Zoology,  
and Director, Marine Experiment Station

John C. Sainsbury, Assoc. Professor of Fisheries and  
Marine Technology and Chairman of Department

Milton Salomon, Professor of Food and Resource Chemistry

Robert C. Shoop, Assoc. Professor of Zoology

<sup>2</sup>Irving A. Spaulding, Professor of Resource Economics  
and Sociology

<sup>2</sup>Thomas F. Weaver, Asst. Professor of Resource Economics

On reading the Summary and sections I (Director's Statement), II, III and IV (Accomplishments During Year; Institutional Programs; Planning; and Individual Faculty Activities) respectively, one encounters numerous examples of the participation of these Associates and can sense the give and take between general University growth and program sponsorship by ICMRD. Specifically, of the 30 Associates, 26 are active in international programs. Those not so involved retain their links to the Center through their administrative and teaching roles. On an average, the 26 faculty mentioned are probably devoting about 25% of their time to international work. Typically, each has one to three graduate students working with him on international work; furthermore, the roster of foreign students pursuing marine studies at URI extends far beyond those on ICMRD assistance assignments, totalling over 40 as section V indicates.

Another change, following the mid-way assessment, was the deliberate broadening of the support base. While AID 211(d) continues by all means, to be the largest element of support, funds have now been procured for projects sponsored by the National Science Foundation, by Resources for the Future, and by certain Developing Countries (see the CODOT reports, section II). URI, in addition to its broad backing in the cooperation of faculty members and in space and facilities, has assured the Center funds up to \$25,000 annually.

---

<sup>2</sup>See footnote, page 11.

Additions to personnel, either filled or planned during the current report year are:

Executive Assistant for ICMRD: James Griffin. This appointment provides for assisting the Director in the development of new marine resource ventures, preparing special technical and administrative reports, reviews, and presentations for state, federal and international use, consulting and supervising in organization and management system tasks, conducting interviews and tours, and in general, representing the Director as needed at URI, in the U.S. and overseas.

Research Librarian: Jacqueline F. Alexander. On making this appointment ICMRD is implementing its plan to expand arrangements for a research library on international marine resources material. Since Mrs. Alexander will not assume duties until August, the anticipated accomplishments lie ahead. This effort will be accomplished by a parallel expenditure to publish ICMRD accomplishments more promptly and more adequately. The Marine Advisory Service of URI has agreed to assist in this objective.

Research Associate to Resource Economics: Dr. John G. Sutinen. Dr. Sutinen is assisting faculty members in the Department of Resource Economics in research and advisory activities in the international development field.

Administrator for Overseas Support Office: Thomas S. Estes, retired U.S. Ambassador. By establishing the overseas support office, ICMRD will greatly enhance its capability to handle projects abroad.

Visiting Professor of Fisheries Biology: to be selected. While a commitment has been made to add such a person, the search committee has not filled the opening. If funding permits, this position will be a continuing one and will round out the added roster of faculty contemplated when the ICMRD program was launched in 1969.

Professors Pollnac and McFarland: were appointed to fill open faculty positions in Anthropology and Resource Economics respectively (see listings under Center Associates above).

Of the many visitors received during the past year, of special interest was the one-day on-site portrayal of URI programs arranged by Provost Knauss, for the benefit of the delegation to the United Nations Seabed Committee from the People's Republic of China. Eleven Chinese delegates attended. Also of interest was the first organizational meeting held at URI of the Joint U.S.-Russian Working Group on Marine Pollution and Its Effects on Marine Organisms. There are

ten Russians and ten U.S. scientists in this group, which included Dr. John A. Knauss of URI. The formation of this group reflects recent summit agreements to promote technical exchange between scientists of the two countries.

II. ACCOMPLISHMENTS DURING YEAR--  
INSTITUTIONAL PROGRAMS

AN EVALUATION OF THE IMPLICATIONS OF ALTERNATIVE  
OCEAN MANAGEMENT SCHEMES FOR TUNA

Virgil T. Norton

Professor of Resource Economic  
and Economics

Saul B. Saila

Professor of Oceanography and  
Zoology

Assistant: Deborah T. Westin, U.S.A.

Tuna resources of the ocean are among the most important fishery resources of the world. They represent a significant source of both food and foreign exchange for many countries. Because of tuna's world wide importance as a fishery resource, consideration during the 1973 United Nations Law of the Sea Conference of appropriate management agreements for tuna will be of great interest. A basic problem exists, however, in that many of the countries participating in the 1973 United Nations Law of the Sea Conference do not have a sound base of information concerning the complications of various management schemes for world tuna populations.

To assure for all countries access to crucial information regarding this important species; it was deemed critical that appropriate information be collected, evaluated, prepared and disseminated to nations taking part in decisions regarding this resource. To this end Professors Saila and Norton have performed an evaluative study of the world's tuna resources for the Resources for the Future, Inc. This study has accumulated and interpreted information which:

Identified the geographical distributions of the various tuna populations of the world.

Determined the relative catch by country and groups of countries.

Identified trends in fishing effort and probable effects on tuna stocks.

Determined relative access to tuna stocks by countries or groups of countries as a result of alternative ocean management schemes.

The study, which is being presented at the United Nations Law of the Sea Conference Preparatory Session in Geneva, included the following observations:

The distribution of tunas and related species extends over a vast expanse of the world oceans in the tropical, sub-tropical and temperate zones. The important tuna species are active migrants throughout much of their life span but seem to occur primarily between 35° North and 30° South latitudes.

Tunas are high on the marine trophic web. As a result, their maximum average sustained yield is estimated to be relatively low, in contrast, for example, to herring-like fishes which utilize phytoplankton directly. The tuna fisheries are at present, however, among the most important oceanic resources in the Atlantic, Pacific and Indian Oceans. An estimated 1.58 million metric tons (MT) of tunas, bonitos and related species, excluding the bill fishes, were captured in 1970. This represented 2.3 percent by volume of the world yield of 69.3 million MT of fish and shellfish reported for the same period.

Because tuna species have a high market value, the monetary value of the tuna fishery is proportionately higher than the volume figure indicated. It is estimated that the 1970 ex-vessel value of the world tuna fisheries was about 632 million dollars (U.S.) or 10 percent of the value of the world landings of fish and shellfish for that year.

Although more than 40 countries are actively engaged in tuna fishing throughout the world, Japan and the United States account for over half of the total landings. More tuna consumption takes place in the developed states, with the United States, Japan and the European Economic Community

(EEC) accounting for ninety percent of the world tuna consumption.

Most of the world tuna stocks are heavily exploited. There appears to be only limited potential for increased catches of most of the major species. Due to the absence of appropriate management regulations, the rapidly increasing fishing pressure on tuna stocks will probably continue. This will result in excess fishing effort on the major species which will precipitate lower catch rates and higher harvesting costs for all states involved in tuna fishing.

The extensive migration of tuna, the increased mobility of tuna fishing fleets, and the rapid expansion of world-wide fishing effort on tunas combine to present complex global management problems. It seems likely that the tuna management issues can only be effectively resolved by a global management policy. A global policy need not imply a single world-wide management agency. A rational policy could, for example, include world-wide criteria established to provide guidelines to relatively strong regional agencies in conjunction with economic zones established by coastal states. It is probable that the complexity of the tuna situation will necessitate such a combination in order to allow for appropriate biological, economic efficiency, and distributional considerations.

RESEARCH AND DEVELOPMENT MARICULTURE-FISHERIES

PROJECT IN PUERTO RICO

-A Background Study-

Kenneth W. Watters

Staff, Puerto Rico Nuclear Center

Under the sponsorship of the National Science Foundation Experimental Research and Development Incentives Division a cooperative effort on the part of the International Center for Marine Resource Development, University of Rhode Island and the Puerto Rico Nuclear Center of the University of Puerto Rico is being undertaken. The experimental development program deals with the harvest fishery and mariculture potential in Puerto Rico and envelops the socio-economic, cultural, institutional, and technical aspects of development. This holistic approach focuses on the single geographic political entity of the Island and Commonwealth of Puerto Rico; however, applicability of the effort throughout the tropical reef and lagoon coasts is obvious.

Puerto Rico was selected for several reasons:

A broad range of edible shellfish, crustacea and finfish are endemic nearshore in Puerto Rico.

Productive support environments, which include mangrove shores, sea grass beds and coral reefs, surround the coastline. Favorable temperatures are conducive to expanding production and utilization of these resources.

In addition to the natural environment, Puerto Rico provides a clearly definable geographic unit which can facilitate the study of economic and cultural features which interact with fishery and mariculture.

Puerto Rico also serves as a political and cultural link between the United States and Latin America.

Some of Puerto Rico's critical economic and cultural problems have been met by this fishery improvement program. The

per-capita income of Puerto Rico is approximately one-third the income of the United States. Food is expensive; fish imports are high. Fifty-five million pounds of fishery products are consumed annually in Puerto Rico; however, 95% is imported even though the Island has a 400-mile coastline. Nearshore fishery practices have not changed significantly for over a century. Available mariculture technologists remain relatively untried. Government rights along the coastline are extensive. Accessible nearshore areas could provide needed space and water rights for aquaculture development.

Favorable research areas and cooperative ties between the University of Rhode Island and University of Puerto Rico, along with the desires of the National Science Foundation to pursue an Economic Incentives Background Study have provided the means for this study, which has the following objectives:

- To undertake a comprehensive review of the combined harvest fishery and mariculture potential of Puerto Rico as a geographic political entity and socio-economic unit;
- To identify the socio-economic and cultural-institutional requirements for the fulfillment of this marine resource potential on a continuing basis, paying particular attention to barriers that may be impeding optimum development;
- To identify technology available for, and best suited to, the fulfillment of this potential and to assess problems to be coped with in order to apply such technology effectively;
- To provide background information suitable to the development of a comprehensive cooperative program for fisheries and mariculture in Puerto Rico--an imaginative experimental approach is required which will provide for periodic evaluations of the undertaking, the desired feedback and readjustments of activities, and the identification of the transferable components of the experiment;
- To provide for satisfaction of the detailed objectives of the cooperative research elements of the overall National Science Foundation Experimental Research and Development Incentives Program.

Progress to date on the program's initial phase, a one-year background study, which started June 15, 1973, has included the following items:

An initial coordination session was called by the Director, ICMRD at the University of Rhode Island, with program participants:

Senior Investigator - Kenneth W. Watters, Puerto Rico

On-site Coordinator - J. Kenneth Hutchinson

Investigators - Thomas Weaver, John Poggie, Irving Spaulding

Research Assistants - David Stevenson, Jean Abgrall, Edward Ueber

Initial on-site study and data collection by each of the investigators is underway. On-site activities include:

Artisanal fisheries equipment effects, including pot design and placement;

Mariculture evaluation centering around oyster culture and Macrobrachium shrimp rearing;

Elements of socio-economic study of a highly diverse heavily utilized fishing village;

Economic evaluation of the factors involved in investor, researcher, and industrial participation;

Identification of individual and organizational participants and their respective roles in government-institutional-industrial interacting programs.

A program advisory committee has been established consisting of the following:

Co-Chairman - Frank G. Lowman, Associate Director for Environmental Science, Puerto Rico Nuclear Center

Co-Chairman - Nelson Marshall, Director, International Center for Marine Resource Development

Walter J. Gray, Director, URI Marine Advisory Service

Andreas A. Holmsen, Professor of Resource Economics, URI

Jose Suarez-Caabro, Head, Commercial Fisheries Development  
Program, Puerto Rican Dept. of Agri-  
culture

Harlan C. Lampe, Professor of Resource Economics, URI

Saul B. Saila, Director, URI Marine Experiment Station,  
Professor of Oceanography

An on-site administrative/technical support operation has been established in Mayaguez to assist investigators. Interphasing of the effort with ongoing, Commonwealth-sponsored Fish and Invertebrate Mariculture Survey (Dr. Kenneth W. Watters, Principal Scientist) has been implemented.

The study effort is expected to result in sufficient information collection and analysis to permit submission of a multi-year overall plan dealing with recommended approaches to incentives, non-governmental research and development in the topic area.

PRELIMINARY ASSESSMENT OF THE MARINE FISHERIES DEVELOPMENT  
NEEDS OF LATIN AMERICAN COUNTRIES IN OAS

Nelson Marshall

Director, International Center for  
Marine Resource Development

Two recent requests relating to marine needs of the Organization of American States (OAS) have been acted upon during the report period.

The first was a short-term request through the Agency for International Development (AID), Washington, for development status and needs of member states in the marine fisheries arena. With assistance from Professors Holmsen, Lampe, Weaver and some graduate students, a 112-page draft report entitled "Assessment of the Marine Fisheries Development Needs of Latin American Countries in OAS" was prepared. This report provided approximations of OAS fisheries descriptions, needs and source material including: catch statistics, gear, boat and equipment types and numbers, commercial and artisanal elements, resource marketing distribution data, and food technology status. Hopefully, this information provides a base for a general planning and review session with member states, or alternative detailed country-by-country on-site assessment in areas of special interest.

The second request was for general background material relating to U.S. and international references, bibliographies, reports, institutional and commercial directories in the area of marine food technology, utilization of algae, fishing gear systems, equipment and techniques for in-country OAS National Focal Points. This request has been forwarded to AID, Washington, for consideration.

CONSORTIUM FOR THE DEVELOPMENT OF TECHNOLOGY

Clinton O. Chichester<sup>1</sup>

Executive Chairman, CODOT

Tung-Ching Lee<sup>1</sup>

Assistant Professor of Food  
Science and Technology

Graduate Students:<sup>1</sup>

Hector Mayorga, Guatemala  
Ricardo Garcia, Guatemala  
Ricardo Mollins, Guatemala  
Bradley Bernstein, U.S.A.  
William Lesser, U.S.A.

The food science departments of five universities participate in the CODOT consortium. These universities involved are the University of California at Davis, Michigan State University, the University of Rhode Island, the University of Washington, and the University of Wisconsin at Madison. The group is chaired by Professor C. O. Chichester of the University of Rhode Island who maintains an executive office for the group through the International Center for Marine Resource Development.

Central America

The Consortium is now operating on several fronts. An initial project utilizing the Consortium concept was started in November, 1971. This pilot program continues as a major concern on the Consortium, and involves the development of food technology expertise in Central America through the joint efforts of CODOT and the Institute for Technological and Industrial Research in Central America (ICAITI). The Institute serves to disseminate information throughout Central America. Some specific areas in which CODOT has been instrumental include the following:

---

<sup>1</sup>URI participants; participation by other members of the Consortium not listed.

During the year a number of site visits were made to Guatemala under the direction of CODOT. Mr. James Breeling of the American Medical Association served as an advisor on communications and management. Professor Harlan Lampe assisted in a market survey. Professor John Sainsbury served as an advisor on the establishment of fishing schools and Professor Thomas Weaver assisted in organizing the results of the economic portions of food industry surveys.

The exchange of students and trainees is an important part of the overall program. Currently two Guatemalans are enrolled in United States universities. They are both studying food technology, one at the University of California at Davis and the other at the University of Rhode Island. As part of the extension program at Michigan State University, one Guatemalan attended courses on methods to facilitate the transfer of research results to industry. In addition, two American students were sent to ICAITI, one to do research in fruit processing and the other to work on the economics of artisan fishing.

During the early months of 1973, a series of short courses were offered in Central America as a joint undertaking on the part of CODOT and ICAITI. The following topics were dealt with during these courses:

Food Processing Plant Sanitation--Dr. Davis Stuibler,  
University of Wisconsin (Madison)

Dairy Product Technology--Dr. Robert L. Bradley and Dr.  
Norman F. Olson, University of Wisconsin (Madison)

Meat and Poultry Products Processing--Dr. James Price,  
Michigan State University and Dr. A. W. Brant, Uni-  
versity of California (Davis)

Food Processing Plant Sanitation--Miss Sheryl Schneider,  
ICAITI

In the area of technological advancement there have been significant developments in the processing of tropical fruits. Research is well underway with fruit and jelly products which should soon be on the market. Efforts are also being made to discover new

ways to process avocados. In particular, freezing and other preservation techniques are being studied. Further research is centered on juice and nectar products and processes.

The efforts of CODOT in Central America are flourishing. The initial support for this substantial project was through the Office of Science and Technology of International Development (AID); however, the project has now been assigned to the Latin American Bureau of AID with an increase in support.

#### Thailand

The Consortium has signed an agreement with Kasetsart University in Thailand to assist in the area of food technology. Further development of this program is expected in the fall.

#### Brazil

Recently the Consortium has submitted a proposal to upgrade the technology expertise in the State of Sao Paulo, Brazil. The particulars of the program involve sub-projects in the areas of fish, meat and tropical fruit processing as well as sections on economics and quality control. The effort outlined in this proposal will be effected in cooperation with the existing food technology institution in Sao Paulo, Instituto de Tecnologia de Alimentos (ITAL). Negotiations are nearing completion and it is anticipated that work on this substantial program will begin in the fall.

LAW OF THE SEA INSTITUTE

Lewis M. Alexander

Director

The Law of the Sea Institute was formed in 1965 at the University of Rhode Island to serve as a means for exchanging knowledge and ideas concerning the sea and its resources, principally through conferences, workshops, and publications. The Institute takes no stand on issues, but makes every effort to encourage free and open participation, exchange of ideas and information, and expression of divergent points of view.

The major activity of the Institute is an annual four-day conference in June, attended by an international group representing a wide range of interests and occupations. The conference focuses on timely topics and problems related to the exploration, exploitation and control of the world's oceans. Proceedings of each conference are published early in a single volume containing all papers, remarks and discussions.

Other activities of the Institute include specialized regional workshops dealing with problems of the marine environment; compilation and publication of an extensive bibliography on marine policy, law and economics; distribution of a series of Occasional Papers on timely topics on law of the sea; and maintenance of an extensive mailing list of interested persons from all parts of the United States and abroad.

The Institute's Eighth Annual Conference convened on the University of Rhode Island campus June 18-21, 1973 to discuss the general topic "The Emerging Regime of the Oceans." Sessions of the 1973 Conference included the following:

"Bloc Thinking about the Oceans: Accelerating Pluralism?"

Paper: John K. Gamble, Jr., Assoc. Director, Law of the Sea Institute

Panel: Leigh Ratiner (Chairman), Advisory Group on Law of the Sea,  
U.S. Department of Defense

Kaldone G. Nweihed, Simon Bolivar University, Caracas

Arvid Pardo, Ocean Studies Program, Woodrow Wilson Inter-  
national Center for Scholars

Duke Pollard, Perm. Mission of Guyana to the United Nations

"How Will the Deep Seabed Regime Be Organized?"

Chairman: John A. Knauss, Provost for Marine Affairs, UKI

Paper: Andres Aguilar, Ambassador of Venezuela to the United States

"Technology Transfer"

Chairman: Giulio Pontecorvo, Director, Ocean Research Management  
Program, Columbia University

Paper: Surendra Patel, Transfer of Technology Branch, United Nations  
C. Weiss, Jr., International Bank for Reconstruction and De-  
velopment

Panel: Warren Wooster (Chairman), Scripps Institution of Oceanography  
Dahmouche Amar, Mission of Algeria to the United Nations  
Emmanuel Bello, Consultant, International Oceanography  
Herman Franssen, Woods Hole Oceanographic Institution  
Nelson Marshall, Director, International Center for Marine Re-  
sources Development, URJ

"International Organizations and Technology Transfer"

Chairman: Giulio Pontecorvo, Director, Ocean Research Management Pro-  
gram, Columbia University

Paper: Ivan Silva, Indian Ocean Programme, FAO, Rome

"Regimes for Special Situations"

Chairman: Richard Young, Attorney and Counsellor at Law

Papers: "Islands"--Robert Hodgson, Geographer, U.S. Dept. of State  
"Semi-Enclosed Sea"--Lewis Alexander, Law of the Sea Inst.  
"Superports"--Allen Hirsh, Marine Ecosystems Analysis Program, NOAA, U.S. Dept. of Commerce

Panel: Albert Koers, Institute of International Law, Univ. of Utrecht  
H. Gary Knight, Louisiana State University Law Center  
Richard Young, Counsellor at Law, Van Hornesville, N.Y.  
John Bailey, Law of the Sea Section, Government of Australia

"Consequences of Intensive Ocean Utilization"

Chairman: Thomas A. Clingan, Jr., University of Miami School of Law

Papers: "Flow of Ships"--Charles Bates, U.S. Coast Guard  
"Insurance Companies' Perspectives"--George W. Handley, Marsh  
and McLennan, New York  
"Offshore Oil"--John Albers, U.S. Geological Survey

"The Scientific Aspects of Ocean Pollution"

Chairman: William T. Burke, University of Washington School of Law

Paper: John A. Knauas, Provost for Marine Affairs, URI

Panel: John L. Hargrove (chairman), American Society of International  
Law

Earle E. Seaton, Puisne Judge, High Court, Bermuda

Branko Sambrailo, Yugoslav Academy of Science and Arts

Raul Bazan, Permanent Mission of Chile to the United Nations

Bernard Oxman, Office of the Legal Adviser, U.S. State Dept.

Closing Speaker

The Honorable Edmund S. Muskie, United States Senate

The enthusiastic response with which the Institute's programs and publications have been met and the increasing interest in its activities continue to confirm both the need for, and the value of, the Law of the Sea Institute.

MASTER OF MARINE AFFAIRS PROGRAM

Lewis M. Alexander

Director

The Master of Marine Affairs Program is one of several innovative programs developed at the University of Rhode Island to meet the challenge of the Commission on Marine Science, Engineering and Resources report--"Our Nation and the Seas - A Plan for National Action" published in 1969 and commonly known as the Stratton report. The Commission recommended that the United States undertake far more effective management of its ocean environment. The program was begun in September 1969 to educate professional interest in the complex problems of marine decision-making.

Unique in the United States, the Master of Marine Affairs Program focuses on marine policy problems at the local, state, regional, national and international levels. In considering the formulation of specific policies, students analyze factors central to the decision-making process; these include interest groups, shared jurisdictions, the decision-making agencies, bureaucratic obstacles, the formulation of viable alternatives, and the rationale behind final choices. With respect to implementation of policy, students consider the roles of laws and institutions, the economic and social costs of implementation, and criteria for effective ocean management.

The Master of Marine Affairs degree (MMA) is not a professional specialty degree in the sense of master of science degrees and other professional degrees. Rather the program fills a gap left by such specialization.

To an increasing extent students from foreign countries have become interested in this curriculum. In 1972-73 Sophia Professorsky of Israel and Abraham Alemaychu of Ethiopia were enrolled. There are now two fellowships available to attract such students: one funded by

ICMRD, one by UNESCO. In addition, the Latin American Scholarship Program of American Universities and the Janns Foundation are supporting visiting students in the MMA studies.

CERTIFICATE PROGRAM IN INTERNATIONAL DEVELOPMENT

Josephine F. Milburn

Associate Professor of Political  
Science

Harlan C. Lampe

Professor of Resource Economics

In the spring of 1971, the departments of Economics, Geography, Political Science and Resource Economics instituted a five-course, fifteen-credit program leading to a Graduate Certificate in International Development. The department of Sociology and Anthropology also participated in certain aspects of this program, which is sponsored by the International Studies Committee. The program provides supplemental interdisciplinary concentration on the problems and processes of modernization and international development. It offers persons going to and coming from various parts of the world the opportunity to view problems to development from international and interdisciplinary perspectives, thereby gaining new insights into these societies. Participants concentrate on the disciplinary approach to specific problems or an interdisciplinary study of a specific geographic area.

The interdisciplinary seminar was warmly received by the fifteen participating masters students. Inquiries about the program continue to be received, resulting in part from letters and brochures sent to AID missions overseas, cultural attaches, and educational offices in American embassies in various countries of Asia, Africa and Latin America. The administrative committee for the program has recommended increased flexibility in the masters' degree requirements to stimulate participation. These changes are to become effective in the fall of 1973.

CONFERENCE ON SOCIO-ECONOMIC RESEARCH ISSUES  
IN FISHERIES DEVELOPMENT

Harlan C. Lampe

Professor of Resource  
Economics

Thomas F. Weaver

Associate Professor of  
Resource Economics

Twenty-two university and government personnel met from October 25 to 27, 1972 at the University of Rhode Island to identify socio-economic research issues in fisheries development in the developing nations. Participants were divided into three working groups as shown at the end of this section. Each group considered a particular development issue chosen from the following areas: commercial fisheries, artisan coastal and inland fisheries, and the special relationship between fisheries and agriculture. Commercial fisheries were defined as the special circumstances of deep-ocean fishing, artisan inland-coastal fisheries as including the remainder of fishing activity. The conference was designed to identify socio-economic issues related to the total fishery resource.

Observations resulting from the Conference included the following:

A continuum of economic activity in fishing exists, ranging from the most primitive efforts in coastal and inland waters to very capital-oriented, deep ocean fishing fleets with global capability. There is a need for investigation of a number of socio-economic issues associated with the modernization and development of the fisheries sector. In the developing countries information is scarce and less reliable regarding fishing and fishermen than it is for other non-urban sectors. This may reflect the fact that past fisheries development research efforts have concentrated on locating and identifying ocean stocks, design of capture gear and techniques and

training fishermen in their use, rather than on social-economic issues. With the increasing awareness of limitations on natural fishery stocks and aquaculture, the realistic possibility of solving the world protein shortage with fishery products has receded.

---

In areas of the world where incomes are rising, increased demand and higher prices for fish and fish products can be expected as well as rapid population growth. These forces make the issues raised by the workshop both timely and important. Concentration on market development and modernization, a systems management approach to river and coastal lagoon development, and the integration of fisheries with agricultural enterprises seem particularly critical. In order to help solve employment and equity problems in many nations more concentrated attention and research efforts on economic aspects of fisheries development are necessary.

Research of some aspects of fishery development issues would identify special-problem fishermen groups within a given country's fishing sector. In the future, when a greater body of material is available, it may be useful for a workshop to be held on the special problems of more narrowly defined fishing communities.

The resultant detailed reports of the working groups predictably overlapped with respect to interrelated areas and topics. This was particularly true for inland and coastal artisan fisheries, and fisheries and agriculture. These reports are now being considered for publication in an integrated form by ICMRD.

On the last day of the workshop a plenum has held on the subject of "Fisheries Education in United States Universities, Its Applicability for Students from LDCs." Several speakers stressed the flexibility needed in an educational program for foreign students due to the very different academic backgrounds possessed by students from different nations. Participants seem generally concerned about the cost of Ph.D. programs and particularly the cost of educating foreign students. Many felt that the Masters degree would give a better education per dollar spent.

SYMPOSIUM ON BRITISH COMMONWEALTH POLITICS

Josephine F. Milburn

Associate Professor of  
Political Science

The Symposium "British Commonwealth Politics: The Transfer of Institutions" was held November 11-13, 1972. It consisted of an introductory panel at the University of Massachusetts (as a part of the Northeast Political Science Association session) followed by five panels convened at the University of Rhode Island. The participants represented the fields of political science, history, anthropology, education, and literature. Among the participants were persons who have spent considerable time in, or who were from, various sections of the Commonwealth, including countries in Asia, Africa, Australia, and the Americas.

The themes of the symposium were the delineation of institutions inherited from the British colonial experiences and the evaluation of their significance in the development of national institutions in various Asian, African and American Commonwealth countries.

One reason for interest in political institutions among the British Commonwealth countries is the similarity of certain political elements among the different countries. This common heritage can help us to see more clearly how political institutions have reacted to various situations. A detailed understanding of the transfer of political patterns within such similar systems can also have wider implications, as our attention is turned to countries outside the Commonwealth. One of the long-range goals of such deliberations is to explore a more general methodology for comparing political institutions in different countries at various stages of development.

An outline of the Proceedings of the Symposium is as follows:

The Problems of Institutional Transfer--Josephine F. Milburn  
(University of Rhode Island) with a contribution by Larry  
B. Hill (University of Oklahoma)

Political Integration--Donald Rothchild (University of  
California)

Representation--Geoffrey F. Engholm (Lakehead University)

Executive and Administrative Continuity--Larry B. Hill and  
Hugh G. MacNiven (University of Oklahoma)

Military-Civil Relations--Claude E. Welch, Jr. (State Uni-  
versity of New York, Buffalo)

Processes in Foreign Affairs--Robert L. Stephens (Fletcher  
School of Law and Diplomacy, Tufts University)

Concluding Section--Ralph J. Braibanti (Duke University)  
and Josephine F. Milburn (University of Rhode Island)

SEMINAR SERIES

Nelson Marshall

Director, International Center for  
Marine Resource Development

This series, sponsored by ICMRD, was shifted from the previous emphasis in which guest speakers were featured and, instead, stressed the activities of University of Rhode Island workers. In this way we promoted a consciousness of our faculty interests and competencies. The program, including one outside speaker, Dr. Enos, was as follows:

<u>Date</u>	<u>Speaker</u>	<u>Topic</u>
20 October 72	John Enos, Prof. of Economics, Oxford University, England	Experiences in Economics Development Projects in South east Asia
6 December 72	William Rosengren, Prof. of Sociology & Anthropology	Some Social Implications of the Latirization of Shipping
7 February 73	Harlan C. Lampe, Prof. of Resource Economics	Water Management as It Relates to a Lagoon: A Preliminary View
11 April 73	C. Robert Shoop, Assoc. Prof. of Zoology	The Potential of the Green Turtle for Mariculture

### III. ACCOMPLISHMENTS DURING THE YEAR--PLANNING

Nelson Marshall

Director, International Center for  
Marine Resource Development

Considerable energy has been expended during the past year in the planning of future programs. In a sense this should fall under the Programs for the Future (Section VI) of this report; however, since substantive materials have been assembled in many instances, pertinent background write-ups are presented as work of the 72-73 period.

PLANNING WORKSHOP AT THE UNIVERSITY OF

DAR ES SALAAM, TANZANIA

Two planning efforts during the past year directly reflect the University of Rhode Island interest in technological transfer,<sup>1</sup> and the belief that the university's greatest impact can be attained through inter-university relationships. It is suggested, in any given area, that the first step toward this end is to conduct a Planning Workshop involving the University of Rhode Island and the selected or host university in the developing country. The concept of such a workshop is presented in the prospectus appended to the end of this write-up. In keeping with this approach ICMRD has been invited by the University of Dar es Salaam (the national university of the Republic of Tanzania) to participate in a workshop presently scheduled for January 1974. The committee for setting up this workshop is as follows:

Vice Chancellor of University of Dar es Salaam  
The Dean, Faculty of Science, University of Dar es Salaam  
The Head, Department of Zoology, University of Dar es Salaam  
The Principal Secretary, Ministry of National Resources  
The Director of Fisheries, Ministry of National Resources  
The Chairman, National Scientific Research Council  
The Director, National Scientific Research Council  
The Director, Tanzania National Parks  
The Head, UNESCO Mission, Tanzania  
Professor Nelson Marshall, University of Rhode Island  
Professor Dale C. Krause, Chief, Division of Oceanography, UNESCO

---

<sup>1</sup>Of late, the importance of technological transfer has been stressed repeatedly by representatives of developing countries, for example, at the Law of the Sea Conference at URI in 1972. The U.S. Department of State has taken note of and expressed a willingness to meet this need, for example, in a speech by Ambassador Donald L. McKernan to the Law of the Sea Conference preparatory sessions August 11, 1972.

Four interrelated considerations have given impetus to this projected planning effort:

- (1) The coastal resource potential of Tanzania is impressive (one aspect of this evaluation is given in a following statement titled "Some Notes on the Potential for an Expanded Coastal Fishery along the Coast of Tanzania").
- (2) Considerable bilateral and multilateral assistance is being directed to Tanzania.
- (3) Upon receipt of this assistance the people of Tanzania are generally highly dependent on outside expertise to execute the development undertakings.
- (4) At the same time the Republic of Tanzania is ambitious to develop the needed competency at home; recognizes the importance of its national university in this regard; and, specifically for the marine sciences, is willing to support marine resource programs in the University of Dar es Salaam.

A base document prepared by ICMRD and titled "Cooperative Plan for Marine Resource Development in Tanzania" is being used as a resource statement in setting up the planning workshop. In addition a paper was prepared based on catch data and recent research on coral reefs and adjacent environments, suggesting the potential for at least a four-fold increase in yields based on capture fisheries and mariculture along the Tanzanian coast.

While such background material and the workshop concept as expressed in the accompanying prospectus will serve as guidelines, the coverage and specific character of the Planning Workshop will depend on the deliberations of the committee mentioned above.

PLANNING WORKSHOP AT THE UNIVERSIDAD CATOLICA DE VALPARAISO, CHILE

In March 1973 Raul Allard Neumann, Rector of the Universidad Catolica de Valparaiso, requested that we give serious consideration to inter-university cooperation in marine sciences involving our respective institutions. His representative in this matter, Professor Andres Couve, has visited URI for preliminary discussions. More definitive arrangements, including provisions for a planning workshop very much as indicated in the previous statement on the University of Dar es Salaam, should follow.

A PROSPECTUS FOR PLANNING WORKSHOPS ON THE  
DEVELOPMENT OF UNIVERSITY MARINE PROGRAMS

The Area of Concern

Just what are the marine resources of your country or region? What is their value? What is their potential? Finally, what is being done to realize, to develop and to manage this resource potential? For those of us concerned with education and research, these questions must be asked in terms of the role of higher education in support of marine interests. We must ask just how education is and should be responding to these needs. How can university education and research programs interact most effectively with both government and commercial enterprises bearing on the marine resource potential?

In the United States these questions have been probed intensively over the past decade. As a result university marine resources efforts have expanded substantially beyond the marine science, fisheries, biology and oceanographic work of earlier years. Several universities have developed a total marine resources outlook which involves a comprehensive approach to marine problems, interrelating the input from the social sciences with the more familiar contributions of the natural sciences. In addition, engineering, technology and vocational training, also law, policy and advisory services collectively play a substantial role in modern university marine resource programs.

The University of Rhode Island, starting with its Marine Resources Program in 1960, subsequently building its capabilities with support from the federal Sea Grant Program and more recently with funding from the U.S. Agency for International Development, has been the pioneering U.S. institution developing this broader approach to marine resources.

A sense of the University's overall involvement in marine work can be gained from the listing on the last page. For countries or regional organizations wishing to share the insights gained through this experience, the International Center for Marine Resource Development of the University of Rhode Island can arrange for a team to make an advanced study of the country or region, to visit the area, and to join in a workshop focusing on developing an integrated university marine program. Topics to be covered in the lectures, panels, discussion sessions and illustrated presentations of such a workshop include:

The scope and nature of the marine resources--What is meant by marine affairs?

The scope of a comprehensive university marine resources program--What can be done in programs of lesser scope: through division of effort, through inter-institutional cooperation?

The harvested fisheries as a marine resource.

Mariculture as a marine resource.

Technology and engineering in relation to marine resources development.

University interaction with industry concerned with marine resources, including liaison with the fishery.

University relationships with other government agencies concerned with marine resources.

Faculty, students and research in the following fields in support of marine resource interests:

Oceanography

Resource Economics

Biological Sciences

Geography and Law of the Sea

Fisheries

Food and Nutrition

Engineering

Sociology, Political Science,  
and Planning

Levels and kind of education: graduate, undergraduate, vocational.

Overseas visiting student arrangements in relation to the development of a university program.

Marine advisory or extension services.

Education in marine subjects for children and for teachers of children.

University administration provisions for a marine resources program.

Funding a university marine resources program.

Preferably such a workshop would only be the first step in a series of contacts with educational programs in your region. Later steps could include more prolonged advisory visits by personnel from the University of Rhode Island dealing with selected disciplines. Other follow-up steps might include short or extended visits to the University of Rhode Island by personnel from your country who wish to study or do research here. Still other patterns might unfold but follow-up, as important as it is, can best be handled after an initial workshop.

#### Participants in a Planning Workshop

The Planning Workshop would be designed to aid decision makers who are responsible for government and national educational planning and to provide background information for those responsible for program planning within universities. Personnel with such responsibilities are selected for participation in such workshops, together with the team from the University of Rhode Island. Leaders representing economic interests in marine resources may be added to the roster of participants.

The visiting team from the University of Rhode Island would represent the entire scope of the University interests and more specifically, the following areas: oceanography and ocean engineering, resource economics, nutrition, vocational education, law, and marine advisory work. On each team there would be at least one contributor well versed in matters of academic administration and funding and one having first-hand experience with ties between universities, industry and government

agencies. For a broadened perspective we would select one or two representatives from other U.S. universities having comparable programs. Selected additional observers from the United States or from the world community (United Nations Development Program or World Bank, for example) would be encouraged to attend. Before traveling to your country the visiting team from the University of Rhode Island would spend the equivalent of one week studying source materials to acquire an introductory familiarity with the area. The first week in your area would involve further study and observation before the final comprehensive workshop session ending with the preparation of summation information.

The Scope of Faculty Participation in Marine Programs  
at the University of Rhode Island

The following chart shows the multi-disciplinary setting that exists at the University of Rhode Island for the study of marine resource problems. Numbers represent full-time equivalent faculty members and graduate students active in marine-oriented programs. (Technical assistants and supporting administrative staff are not included.)

	<u>Faculty</u>	<u>Graduate Students</u>
Biological oceanography, including estuarine, coastal, and reef ecology	9	50
Physical, chemical and geological oceanography	16	65
Fisheries biology and aquaculture	4	15
Supporting biological disciplines	5	20
Ocean engineering and allied engineering fields	10	85
Vocational education for fisheries and marine technology	8	***

---

\*Not applicable

	<u>Faculty</u>	<u>Graduate Students</u>
Food chemistry and nutrition	5	15
Resource economics	9	31
Geography, marine affairs, law of the sea, community planning and public administration	5	25
Sociology applied to fisheries and marine enterprises		10
Marine advisory services	***	NA*

\*Not applicable

\*\*Chiefly staff, non-faculty appointments

SEMINAR AND WORKSHOP ON COASTAL ARTISAN FISHERIES  
IN CENTRAL AMERICA

Planning is currently underway, with encouragement from AID, Washington, to convene a seminar on coastal zone artisan fisheries and aquaculture in a Central American country, as yet unspecified. The potential for high food productivity from world-wide coastal reefs, mangrove and lagoon areas can be realized through improvements in harvest fisheries and the implementation of simple aquaculture. The purpose of the seminar is to consider and plan the steps necessary to upgrade the marine food output of the millions of tropical and sub-tropical coastal zone artisan fishermen in the study area. A holistic, multi-disciplinary approach to this resource development is essential to incorporate the socio-cultural, economic, technical, production and institutional considerations.

Representatives of interested nations of Central America, the Caribbean and elsewhere in Latin America will be invited to participate. The prospects for meaningful results are greatly enhanced by the fact that the Inter American Development Bank is currently backing artisan fisheries in this area and contemplates an expansion of such support.

WORLD-WIDE ARTISAN FISHERIES DEVELOPMENT PROGRAM

(Planned as a group of existing and proposed subprojects  
brought together in a coherent topical program)

The need and the potential for upgrading subsistence fishery practices, thereby developing artisan enterprises engaging many fishermen and increasing food returns, are among the most complex of the world's resource development and socio-economic challenges, as shown in a summary recently prepared by Lampe, Marshall and Vidaeus (1973).<sup>1</sup> This potential has been largely neglected in the past as pressures to increase food output as expeditiously as possible have compelled concentration in the past on heavily capitalized, large-scale, highseas fishery operations. Thus we have overlooked, in fact we have by-passed, the more vital and more difficult task of upgrading endeavors of the many millions<sup>2</sup> of subsistence fishermen. With this group supplementary returns in food products could be realized through improvements in fishery techniques, aquaculture, handling, processing and marketing, all with associated financing provisions. Such efforts would also necessitate a greater knowledge of, and improved management of, resources available to these fishermen.

It should be noted that the subsistence fishermen referred to herein are a far-flung group calling for attention in an almost endless variety of settings. This constitutes a unique challenge in conceiving representative projects and in providing for the transfer of attainments from one setting to another. The results of specific

---

<sup>1</sup>Lampe, H. C., N. Marshall and L. Vidaeus. 1973. Resource potential and economic considerations relating to development assistance in fisheries.

<sup>2</sup>Averaging in the order of 90% of the world's fishing population according to spot checks we have made of available data.

projects undertaken should be critically assessed and, through advisory measures, the basic information gleaned from these results should be applied as broadly as possible.

### Objectives of the Projected Coherent Program

The objectives of the coherent program are to focus attention on and maximize the development of artisan fisheries through a multidisciplinary institutional program involving both technical and socioeconomic considerations, and to be organized so as to:

- 1) Participate in the planning and guidance of representative fisheries assistance and development projects designed to upgrade subsistence fisheries. (This would include the Puerto Rico Fisheries-Mariculture project and the Mexican Lagoon Water Management study--both presently supported--plus proposed work in East Africa.)
- 2) Collaborate (on a consortium, subcontract or other functional basis) in additional programs so as to enrich projects by directing increased attention to the artisan fishery aspect thereof. (Examples include work through CODOT, also the potential for the University of Rhode Island to play a complementary role in projects under the auspices of Auburn University and other projects currently being advanced for an expanded aquaculture effort.)
- 3) Maintain informational and cooperative contacts with fisheries development projects which, though operating independently of the University of Rhode Island program, can contribute general and broadly applicable insights into artisan fishery development needs. (Various FAO projects and bilateral assistance projects fostered by other countries in support of artisan fisheries and aquaculture would come under this heading.)
- 4) Conduct conferences and handle research, editing, publishing and, finally, fisheries advisory services, bringing out the common denominators of all the foregoing and making the conceptual advances of specific artisan projects available to other locales. (This would perpetuate a pattern, started at URI in 1971, of conducting workshops on the artisan fisheries problem; the next such workshop is being arranged for Central America, early in 1974.)

All of the foregoing would be so handled as to promote the education of a cadre of investigators, advisors, and administrators in the developing countries, who would be more capable of fostering a continued improvement among their people.

The full scope of this coherent topical program is being formulated in greater detail.

IV. ACCOMPLISHMENTS DURING THE YEAR--INDIVIDUAL PURSUITS

Lewis M. Alexander

Professor of Geography

Marine-Related Activities in the Caribbean--Gulf of Mexico Basin

Graduate Students: Priscilla Ross, USA  
Vincent Morgan, USA

The primary objective of the current research is to define the interaction among countries of the Caribbean-Gulf of Mexico Basin in activities relating to the marine environment, particularly fisheries, scientific research, pollution control, offshore mining, and marine recreation.

An extensive bibliography on marine-related activities in the Basin has been compiled. Identification of marine resource potentials and a beginning survey of institutional barriers to cooperation within the area are being pursued.

The establishment of an overall model of marine-related activities in semi-enclosed seas, and the elucidation of the needs for special rules and regulations regarding such water bodies are planned as elements of this effort as it relates to the new Law of the Sea.

The study is of importance to the educational activities of the Master of Marine Affairs Program and to the interests of the Law of the Sea Institute.

Other research under Dr. Alexander's cognizance includes:

The Nature and Distribution of Semi-Enclosed Seas of the World.  
Partially funded by the Office of External Research, Bureau of Intelligence and Research, U.S. State Department. A survey of semi-enclosed seas, scheduled for completion by December, 1973.

Freedom of Transit through International Straits. A study undertaken for the Marine Technology Society and completed in May, 1973.

Proposals for Future Regimes of the Seabed. Research carried out under the auspices of the British Institute of Internal and Comparative Law and completed in February, 1973.

Indices of National Interests in the Oceans. A private study, leading to publication of an article in the first issue of Ocean Development and International Law Journal, March, 1973.

National Interests in the Continental Shelf in the Year 2000. A paper prepared for the Fourth Pacem in Maribus Convocation, Malta, June, 1973. Research on the project is still continuing.

JAMES G. BERGAN

Assistant Professor of Food Nutritional  
Science and Food and Resource  
Chemistry

Stability of Peruvian Anchovetta Oil

Graduate Student: Francisco ly Sanchez, Peru

Under the overall direction of Dr. Bergan, Mr. Francisco ly Sanchez investigated the stability of Peruvian anchovetta oil by determining the fatty acid composition and the anti-oxidant content, particularly alpha tocopherol, of said oil. Furthermore, he examined the relationship between these components during oxidation.

Mr. Francisco ly Sanchez, whose studies were encouraged through the Latin American Scholarship Program of American Universities (LASPAU), successfully completed all requirements for the degree of Master of Science in Food and Resource Chemistry in January, 1973, and has since returned to Peru where he is teaching at the Universidad Agraria-La Molina.

CLINTON O. CHICHESTER

Professor of Food Science and Resource  
Chemistry

TUNG-CHING LEE

Assistant Professor of Food Science  
and Resource Chemistry

Development Program Directed toward the Development  
of Infant Food Based upon Indigenous Proteins

Chilean counterparts--Professor Fernando Monckeberg

Professor E. Yanez

(Pediatric Research Laboratory, University of Chile)

Graduate Students: Jaime Amaya, Colombia

Munehiko Tanaka, Japan

Chong Min Lee, Korea

Anthony Cheng, Republic of China

The project, funded by a grant from the United States Agency for International Development (AID) concerns the development of high-protein, low-cost food products based on the utilization of legumes in combination with other vegetable protein sources such as sunflower meal, e.g., Leche Alim and Fortesan. It is also concerned with 1) the development of marketing information and promotion of the previously developed products; 2) the development of low-cost co-precipitants of legume protein cereals containing marine proteins; and 3) the training of Chilean nationals in protein processing problems and market development.

The principal accomplishments of the period from June 30, 1972 through June 30, 1973 included:

The testing in a Chilean population of Leche Alim. It was shown that Leche Alim (a combination of legume, fish and vegetable protein) was readily acceptable to a representative sample of the lower socio-economic level population of Chile. In a 12-month testing period of supplemental feeding of pre-school children, significant increases in the height of children receiving Leche Alim were observed.

The development of Fortesan, which is an extruded, instantly re-hydratable material based upon a wheat-soya blend.

The training of Chileans in the area of communication.

These accomplishments, in conjunction with those previously reported, indicate that the team which has been evolved in Chile is capable of undertaking product development, nutritional investigations acceptability trials, and development of marketing data.

Wider distribution of some developed products is anticipated in the present contract.

Work on other protein sources has continued over the period and will continue in an effort to reduce production costs.

#### Carbonyl Accumulation during Browning

Graduate Students: Jaima Amaya, Colombia  
Munehiko Tanaka, Japan  
Chong Min Lee, Korea  
Anthony Cheng, Republic of China

Research studies under a grant from the National Institute of Health (HEW) on the nutritional effects of the Maillard (Browning) reaction on marine foods were continued. Extractables from isopropanol and ethyl acetate, as browning mixtures, were tested biologically in rats, using casein as a control. The extractable materials were added to a casein based diet. In a second control, an equivalent amount of solvent was evaporated and added to the control diet. A third control was used which contained a normal casein based diet.

Data indicated that the solvents themselves were equivalent to the control. The extract, however, when added to the diet at the 1% level, decreased growth rates in all cases. Examination of body organs indicated that the isopropanol extract significantly influenced liver weight. Individual components of the extracts are now in the process of being analyzed to determine the nature of the components contained in them. It is expected that the identification of the major components of the extracts will be completed in the forthcoming year. These components will then be tested individually to determine which is responsible for the growth effect.

#### Planning for a Research Program on Carotenoids

Graduate Student: Ishan Lui, Republic of China

A proposal has been submitted by the University of Rhode Island and the Institute of Agronomy, Department of Biochemistry, Cluj, Rumania to the National Science Foundation, International Programs Office. The duration of this project is planned for three years.

Carotenoids are naturally occurring pigments (red, yellow, orange) found in plant flowers and seeds, as well as in yeast, mold, and bacteria. While animals cannot make the basic carotenoid molecules, they are able to make certain transformations which allow the body to utilize carotenoids. Carotenoids have been used as sources of provitamin A (essential in man for vision) and as natural colorants of food and feed. The overall objective of this research project would be to establish the biosynthetic pathways and mechanisms by which the carotenoids are formed and used.

Of particular significance to this proposal is the isolation and identification of new carotenoids, establishment of their structures and delineation of pathways for their synthesis for a number of aquatic organisms. In conjunction with continuing research on salmonid pigmentation, tests will be made using a number of compounds on trout. These compounds will be tested for pigmentation and toxicity.

The research project is important both from a theoretical and practical point of view. Determination of the carotenoids having a pro-vitamin value affords the possibility of calculating the quantity of vitamin A which is formed from these pro-vitamins in plants and animals. Thus, sound scientific information will be available for a suitable use of these organisms in feeding man.

Professor C. O. Chichester and Tung-Ching Lee are listed as Co-principal Investigators, while the research group at Cluj is directed by Professor C. Bodea. The two groups have published separately approximately 250 papers on carotenoids over the last 20 years. When Professor K. L. Simpson visited Cluj in September 1972, it became apparent that each group has established itself in areas of research that are not duplicated elsewhere. With the two groups working together, a number of significant problems could be attacked that neither could solve independently.

Professor Chichester received the Institute of Food Technologists' Babcock-Hart Award at its annual meeting in Miami Beach, Florida, June 10-13, 1973. This award is presented to an individual who has distinguished himself by contributions to food technology which have resulted in improved public health through more nutritious food.

Dr. Chichester acted as General Chairman at the American Medical Association Symposium on Environmental Quality and Food Supply, Washington, D.C., October 18-20, 1972 and as Chairman of the Institute of Food Technologists' Convention, Symposium on Technology Transfer in Development, Miami, Florida, June 10-13, 1973.

Dr. James Bergan, Dr. Lee and Anthony Cheng participated in the Collaborative Study on Protein Quality with the Harvard Medical School in the spring of 1973.

Dr. Chichester's extension of his leave-of-absence status for the 1973-74 year is to enable him to continue in his position as Vice-President for Science at the Nutrition Foundation, Inc., in New York City. The Foundation thereby has gained an individual on its staff who is cognizant of the academic programs and is involved in on-going nutrition and food technology research. The University has benefitted by

Dr. Chichester's interaction with private and governmental organizations through the access afforded URI to enlarge and develop food programs.

Dr. Tung-Ching Lee, formerly Senior Food Technologist with the Research and Development Department of Hunt-Wesson Foods, Inc. of Fullerton, California, is serving as Dr. Chichester's replacement during his leave. Dr. Lee's research experience is in the areas of carotenoid biochemistry, nutrition and food processing. His applied experience in the area of product development offered industrial expertise valuable to current international projects and allowed for an integration of the academic areas of food biochemistry with industrial needs and practices.

JAMES W. COBBLE

Professor of Animal Science

Professor Cobble is completing his second year as Chief of the U.S. AID-funded Party on Agricultural Research in Korea arranged by the New England Center for Continuing Education. He is expected to return September 1, 1973.

SPIROS M. CONSTANTINIDES

Associate Professor of Food and  
Nutritional Science, and  
Biochemistry

### Improvements in Marine Food Utilization

The University of Rhode Island's strength in the marine food resource area has been enhanced by efforts in utilization, handling and preservation of marine food resources. URI has also become known for its interest and participation in the area of marine food science and its involvement in developing nations.

All the projects below are of great interest to LDCs with rich marine food resources. With the preliminary work done at URI, information and guidance is supplied to other institutes, in developing nations which are initiating research programs of a similar nature. Graduate students working on these projects at URI return home to apply their knowledge in developing marine food science programs to meet the needs of their countries.

### Marine Food Science Program in Chile

The Organization of American States (OAS) granted a visiting professorship to the principal investigator to further develop the academic and research program in Chile at the Universidad Catolica de Valparaiso, School of Fisheries and Food Science.

During his six month stay (March, 1972 to September, 1972):

- (1) Research projects in the field of Marine Food Science were instituted of interest to that region of South America. All the projects dealt with the utilization and handling of marine species for human consumption.
- (2) Students who are later expected to become the fisheries experts in Chile, received training under this program.

- (3) Many seminars were held at various universities in Chile, and advice was given to many agencies and industries in the field of fish processing and utilization.
- (4) Meetings were held to discuss current marine issues in Chile with government officials and other participants. These conferences contributed to a better understanding of policies to follow concerning the sea food resources and their utilization.

This program in Chile is now being continued by Chilean scientists working with the plans set by Professor Constantinides. Continuous support is required to keep this work progressing.

Similar academic and research programs could be initiated on a university-to-university basis in Latin American countries and other geographic areas with rich marine resources.

#### Deterioration in Fish Muscle and Molluscs Due to Proteolytic Enzymes

Graduate Students: Miss Stephanie Brina, USA  
Mrs. Jiasie Horng Chen, Republic of China  
Mr. Pavlos Karakoltsides, Greece

Marine food science and technology hardly exist in most developing nations. Marine food resources are not properly used, though there is a great abundance of fish and molluscs near the coastlines of these countries. One reason for poor utilization of fish and molluscs is their relatively rapid spoilage rate, accentuated in tropical countries, due to microbial and enzyme activity.

Study objectives include investigation of the deteriorative enzyme system in fish and molluscs as well as exploration of new ways to control this deteriorative activity and lengthen the fresh state in marine foods.

The endogenous proteolytic enzyme system (cathepsin) found in the flesh of fish and molluscs paves the way for the microbiological onset of deterioration evident in every marine food. To study the physical and chemical properties of this enzyme system a relatively pure sample was isolated from fish liver. The sample evidenced activity at low pH's and actually was composed of a family of enzymes which function as

catalysts for the breakdown of proteins. Other physiochemical properties such as the multiple form pattern, molecular weight of the species of enzymes, effect of various inhibitors, etc. were studied. Salt was found to have a drastic effect on the enzymes, checking their activity completely. The enzyme system was shown to be rather heat stable, withstanding temperatures of about 80° for ten minutes.

The initiation of this study in the U.S. has encouraged similar studies in Chile under the direction of the principal investigator. Graduate students from overseas familiarize themselves with methodology and problem approaches while working on aspects of this project. The experience gained will hopefully be used in their native countries: Pakistan, Ghana, Taiwan and Greece.

#### Utilization of Underutilized Species of Shrimp

Graduate Student: Nelson Yeh Limin, Republic of China

Shrimp, a highly nutritious protein marine food, is caught in many regions of the world. Shrimp species of small size are not generally used often because conventional processing methods are uneconomical. This study seeks to devise methods by which small shrimp may be efficiently utilized for human consumption.

Presently a method is being worked out by which a high yield of shrimp flesh can be extracted and converted to a paste-like product. This method, when refined, would be of great importance in the utilization of the krill, a very abundant, small shrimp-like Euphasid found in the area south of Chile and Argentina as well as other regions.

The method is still experimental and requires improvement before it reaches the pilot plant stage. Products made from shrimp flesh must be developed to satisfy the food preferences of different developed and developing nations.

### Utilization of the Crab

Graduate Student: Nelson Yeh Limin, Republic of China

Another rich source of protein is found in the crab. Man, however, has not learned to fully and economically utilize crab meat. This is most important in developing nations where great crab resources exist. In this effort, ways are being sought to extract crab meat in an efficient, simple and economical manner.

A practical extraction process has been developed by which the yield can be increased by 100% over hand-picking or other semi-automated methods. The study will continue to improve the method. Various parameters will be studied and plans will be made for application at the industrial level.

### Utilization of the Mussel

Graduate Student: Mrs. Bettye Gold, USA

Mussels and other edible molluscs exist abundantly in many regions of the world; however, the processing of mussels is inefficient and involves the loss of many nutritious ingredients, especially the water soluble constituents. The investigators are studying ways to use the flavorful water soluble residue by testing the possibility of mixing with other cheap sources of protein, such as soya and various other products.

A thorough literature search, leading to a review manuscript, is currently being done on the utilization of the mussel. No such information compilation is now available.

An output of this project, still in its initial stages, will be non-conventional or non-traditional methods of mussel utilization, including the use of various newly developed solid products and the water soluble mussel residue.

Non-Conventional Use of Fish Flesh and Waste

In many fish producing countries, such as Peru, preferred eating patterns do not generally include fish. To alleviate this situation and make better use of available protein, new methods of fish utilization are being investigated. One such is the Japanese technique of preparing fish paste and fish pulp. Various fish species would be tested for their feasibility in forming such products, including shelf-life and fish flavor. Additional flavors such as beef and chicken might be added to determine whether flavor enhancers might produce higher acceptability.

A fish pulp was also produced which, when kept frozen, maintained all the qualities of undenatured protein. This advance is of significance in cases where fish is to be retained in frozen storage for long periods of time.

The parameters determining the quality of the final product are to be further investigated. Different species of fish will be tested alone and in combination with one another. Edible fish waste, such as trimmings usually used to prepare fish meal, will be used to produce a fish pulp or paste for human consumption.

Hopefully, products using these pulps and pastes will be acceptable to people living in fish-producing countries.

RONALD G. CUMMINGS

Professor of Resource Economics

Water Resource Management

Professor Cummings has been actively consulting with colleagues in foreign countries on questions involving seawater intrusion into freshwater supplies. In March he visited associates in Argentina, Chile, Peru, and Colombia for discussions of URI collaboration with research groups dealing with water management questions in these countries. He has had similar contacts with workers at the Hebrew University, Rehovot, Israel.

HOWARD H. FOSTER, JR.

Associate Professor of Community  
Planning and Area Development

Caribbean Resource Development Planning and Administrative

Graduate Student: Ivor Jackson, Antigua

The valuable natural, marine oriented resources of the small Caribbean Island States are especially vulnerable to the pressures of human and economic resource development. The basic objective of this study is to assist Caribbean governments in setting up and operating internal systems for policy evaluation and analysis with respect to the development of these resources. The yield from such systems will be improved coordination in the utilization of resources. In other words, central development planning will be pursued within the framework of the critical natural resources of the state, the beaches, lagoons, ocean, and harbors.

Prior to the current year, both field and library research were conducted. With this as a background, the investigator during the current year wrote a plan jointly with the governments of Antigua, St. Kitts-Nevis-Anguilla and with the Island Resources Foundation of St. Thomas, V.I. This plan describes a three-year project to institute a system of policy planning and analysis geared to human resource development within the States. Agreement has been gained from both governments and it is now being redrafted in final form for submission to selected foundations.

Several trips were made to the Caribbean to confer with local government officials. In addition to the Chief Ministers of the participating states, visits were made to the UNDP Projects Headquarters office in St. Lucia, Island Resources Foundation, St. Thomas, and the Economic and Commercial Officer, American Embassy, Barbados.

JOHN A. KNAUSS

Dean of the Graduate School of  
Oceanography, Provost for Marine  
Affairs, and Professor of Ocean-  
ography

Law of the Sea: Freedom of Scientific Research and Technology Transfer

During the current year, most of Dean Knauss's effort was centered around his role as an adviser to the State Department in preparing for the United Nations Law of the Sea Conference (LOS). Late last year a Freedom of Science Task Group, of which he became a member, was established under the Ocean Affairs Board of the National Academy of Sciences. This year the National Science Foundation contributed adequate funding to assist in this work, allowing him to attend the Fourth LOS Preparatory Meeting in July and August, 1972, and the Fifth in March/April, 1973. At the latter, he was an official member of the delegation representing the science community.

This group has helped advise the State Department on strategy and tactics relating to maximizing freedom of scientific research in the forthcoming United Nations Law of the Sea negotiations. One primary objective during the past year has been an attempt to educate the delegations of many of the developing countries to the true nature of scientific research and its value.

Dean Knauss prepared and delivered a paper on behalf of the U.S. delegation on August 2, 1972 in Geneva.

During the meeting in New York this spring, he assisted in the preparation of an exhibit of the Deep-Sea Drilling Project at the United Nations, and a speech given by Philip Handler, President of the National Academy of Sciences. Dean Knauss also attended a reception held for all members of the U.N. Seabeds Committee on the Woods Hole research vessel KNORR. He chaired a meeting, May 2 through 4, at which members of the U.S. scientific community discussed in depth various possibilities

concerning scientific research as it relates to the Law of the Sea negotiations. He also chaired a meeting of the American Association for the Advancement of Science (AAAS) in Washington, D.C., December 28, 1972, the subject of which was "Current Policy Making Issues in Oceans Research."

Closely coupled with the facilitation of scientific research issues in the Law of the Sea is the problem of technology transfer and the question how best to spur the growth of fishery expertise in developing countries. Dean Knauss has worked and continues to work with the State Department and others on this issue. Coupling scientific research and technical assistance would appear to be one of the more significant developments in future years.

Dean Knauss plans to continue working closely with the U.S. delegation on the Seabeds Committee. During the next year he hopes to do more than has been done concerning the problem of technical assistance as it relates to the Law of the Sea.

HARLAN C. LAMPE

Professor of Resource Economics

Professor Lampe directed much of his energy to planning for the study of water management in relation to the ecology and fisheries development in coastal lagoons in Mexico. He spent several weeks in Mexico in the summer of 1972, laying the groundwork for this project.

He was also deeply involved in several fisheries advisory efforts including the resource economics input relative to fish culture work in the Philippines.

Professor Lampe was the major professor for Peter Wadsworth who is completing the research work for his Ph.D. (see separate write-up below).

LEIF C. W. LANDBERG

Instructor in Anthropology

A Bibliography for the Anthropological Study of  
Fishing Industries and Maritime Communities  
and an Index of Recent Marine Research

Graduate Students: Edward C. Yang, Republic of China  
Dinny Huang, Republic of China

In one of the Center's early AID 211(d) contract reviews (February 1971), the funding agency noted the lack of convenient systematic sources for sociological literature relevant to fisheries development and expressed a desire for ICMRD to encourage the instigation of services and aids in that area. Toward that end, Mr. Landberg has participated as bibliographer for the Human Marine Adaptations Study Group (HMASG), social scientists organized for the encouragement of theoretical and applied research in problems of marine resource exploitation and conservation.

At the time of HMASG's founding, members of the study group expressed a desire for a worldwide bibliographic survey of the literature available on what has come to be known as "maritime" anthropology. Mr. Landberg thus undertook a compilation of sources on maritime anthropology, reflecting both the predominant interests of the HMASG's members --many of whom generously contributed reference to the bibliography--and the ICMRD's mission. The bibliography is focused on fishing industries, fishing communities, and social aspects of fisheries development. This work, A Bibliography for the Anthropological Study of Fishing Industries and Maritime Communities, is now completed. A very limited number of copies have been printed in mimeographed form for in-house use and

distribution to contributors; the bibliography is being considered for publication by the Center.

In addition to the compilation of the bibliography, Mr. Landberg also cooperated with Professor William R. Rosengren, Department of Sociology and Anthropology, University of Rhode Island and with Mr. Peter H. Fricke, Department of Maritime Studies, the University of Wales Institute of Science and Technology, Cardiff (UWIST), in the development of an index of current maritime social research. The first section of the index, covering research in progress between the years 1960-1970, was published in 1971 by UWIST as the Index of Current Maritime Research. The second half of the index, covering bibliography relevant to the research projects reported in the first half of the index, was compiled by William R. Rosengren and Leif C. W. Landberg, and is now being published by UWIST as the Index of Recent Maritime Research. After this first cooperative effort for the development of an index of maritime social research, Mr. Fricke, with the support of UWIST, has assumed responsibility for the compilation and continuation of this index which is to be published on an annual or biennial basis.

Mr. Landberg currently is completing his Ph.D. dissertation, "Socio-economic Networks of Ngalawa (Double Outrigger Canoe) Fishermen of Tanzania, East Africa," for the Department of Anthropology, University of California, Davis. After the completion of his Ph.D., Mr. Landberg plans to continue anthropological research in fisheries development with special emphasis on East African fisheries and Tanzania.

NELSON MARSHALL

Professor of Oceanography

Food Transfer Studies in Support of Production  
in Coral Reef Lagoons

Graduate Student: Ray Gerber, USA

The objective of this work is to better understand productivity pathways and thus expedite assessment of fisheries production around coral reefs and adjacent waters. The work performed and the interpretation thereof can be summarized as follows:

Detritus, mostly amorphous in appearance, amounted to 95% and 85% of the food of two representative zooplankton forms in Eniwetok Atoll. The balance of the diet included fragments from organic sources plus phytoplankton and other micro-organisms. Plankton feeding fishes were found to have consumed a substantial amount of detrital algal fragments in addition to their diet of zooplankton.

As expected in a setting where particulates are largely detrital and where phytoplankton is sparse, chlorophyll a and phaeopigments in the Atoll lagoon were small,  $0.098 \text{ mg/m}^3$  and  $0.085 \text{ mg/m}^3$ , compared to the total particulate carbon of  $20.5 \text{ mg/m}^3$ . Over and behind the reef, levels of particulate carbon and nitrogen are higher and the ratio of carbon to nitrogen is lower than in the oceanic water, indicating a substantial input of organic matter from the reef to the lagoon. Zooplankton is more abundant in the lagoon than in the incoming oceanic water, apparently benefitting from this reef input.

These observations confirm the hypothesis that detritus flowing from the reef is being utilized as a pseudoplankton in the food chains of the pelagic community of the atoll.

Coral Reef and Reef Lagoon Studies

Graduate Student: Thierry G. Jacques, Belgium

This work has consisted largely of a literature review in support of research planning on the subject of man-induced stresses damaging to coral reef coastlines. The topic is particularly practical in view of the extent of such coastlines in developing countries, the importance of the coast to the fisheries, and the extent to which development undertakings repeatedly subject these areas to damaging impacts. Examples of these stresses include: high siltation and flash flooding from agriculture; pollution, both from domestic sewage and industry; and direct destruction as the consequences of shoreline and port development.

We are anticipating a study of this topic in conjunction with colleagues at the University of Puerto Rico. Planning sessions have been held with the following participants: Dr. Seppo Kolehmainen of the Puerto Rico Nuclear Center, University of Puerto Rico, Dr. Candace Oviatt, Dr. Scott W. Nixon, Dr. Marilyn M. Harlin and Mr. Thierry G. Jacques of the University of Rhode Island, and Dr. Juan Gonzales of the National Marine Water Quality Laboratory, Narragansett, Rhode Island.

SCOTT H. MARSTON

Master of Marine Affairs Student

Study of U.S. Oil Interests in Possible  
International Seabed Controls

This study offers the following impressions:

U.S. Oil interests view an orderly law of the sea regime as a mechanism which, if applied to future offshore development, will help stabilize U.S. foreign investments considerably. Offshore oil provides a small but rapidly increasing percentage of the total. There are a number of politically stable offshore environments to be exploited before the U.S. must meet face-to-face with the Organization of Petroleum Exporting Countries (OPEC). Thus there could be a couple of decades before the U.S. will have to produce alternative sources of energy. In the meantime, if progress can be made in the Law of the Sea negotiations, and some sort of stable regime can be established for the seabeds, this will work to the oil companies' advantage.

SAUL B. SAILA

Professor of Oceanography and Zoology

Fishery Potential of the Inshore Tropical Reef Environment

Graduate Student: David K. Stevenson, USA

Though little has been published, some tentative conclusions can be derived from available literature concerning coral reef fishery resources and their utilization. Harvests from five island reef fisheries range from 0.4 to 4.7 gms wet weight per square meter per year, comparing favorably on a per-unit-area basis with demersal fishery harvests from North Atlantic grounds. Yield per unit effort may reach 5000 kgs per man per year. Low reef harvests seem to reflect incomplete fishing effort, often coupled with poor management practices.

Although reef crop and harvests may be substantial, the development of the fisheries is encumbered by the diversity of species, the relative abundance of small fishes and the restrictions imposed on gear by the environment. It is not clear how resistant reef fish populations are to fishing pressure nor what types of management schemes are called for to prevent resource depletion.

It appears that underdeveloped but heavily populated Pacific atolls can be supplied with all necessary protein by relatively low effort fisheries. Atoll lagoons apparently support sparse fish populations compared to the oceanic slope of the atoll, but it appears that imports of organic detritus from the reef could provide a substantial base for lagoon food chains.

Progress in assessing the reef area fisheries includes:

Compilation of size frequency distributions and conversion of tag and recapture data to statistically significant growth rate coefficients from data in the literature.

Fact-finding trip to Puerto Rico (three weeks in February, 1973) to explore possibilities for a gear research management study of the local trap fishery.

Formulation of specific plans for research in Puerto Rico.

Preparation of a general literature review assessment of the problem incorporated in a publication entitled Generalizations on the Fisheries Potential of Coral Reefs and Adjacent Shallow Water Environments with Professor Nelson Marshall (see section VII of this report).

The recruitment of a significant body of information and first-hand experience on which to base the proposed study of the Puerto Rican trap fishery.

#### Mathematical Model of Salmonid Rearing Facilities

Graduate Student: James J. Griffin

Under the guidance of Dr. Saila, Mr. J. Griffin is formulating a mathematical model of salmonid fish rearing operations based on parametric data and formulations derived from available research on both the organisms and physical and financial operations of the hatcheries.

Linear programming is being applied where alternate choices of variables and their values can be reasonably considered over calculated ranges of the non-linear variables. In the final analysis, biological, physical and financial parameters can be derived for diverse operating strategy scenarios and technological options within the rearing facility. Upon successful operation of the base model planned for summer 1973, attempts will be made to describe start-up costs, profitability crossover, and steady state operations under a variety of potential expected operating modes.

Coupling of this type of effort with resource and marketing studies for particular applications could make a contribution to quantitative decision-making on the practicality of options, in applications

involving not only salmonid culture but also fish and invertebrates. Value and relative ranking of needed research efforts in terms of production operating economics can also be postulated.

#### General

In addition to the foregoing there has been considerable interest in the high density salmonid rearing being developed by Professor T. D. Meade of the Department of Animal Science and Professor A. N. Sastry of the Graduate School of Oceanography. The salmonid culture is probably too sophisticated for immediate transfer to developing countries and the lobster work applies to a species of NE United States; nevertheless the studies enrich staff and student capability for work elsewhere. Both programs are supported by Sea Grant.

JOHN C. SAINSBURY

Associate Professor of Fisheries  
and Marine Technology

Advisory Activities in Planning Commercial  
Fisherman Training Program

Professor Sainsbury spent a total of three months for O.A.S. in Ecuador setting up a comprehensive fisheries training program at the Escuela Superior Politecnica del Litoral.

Later, during a three day stay in Central America consulting with ICAITI, he defined ideas appropriate for the organization's plans for training programs for artisan fishermen.

Much of the remainder of the year was spent in New Zealand working with the Fishing Industry Board and making a comprehensive study of the nation's fisheries. He made a similar, though briefer, review of fisheries in Fiji.

Toward the year's end he consulted for FAO in Indonesia relative to the reorganization of the Academy of Fisheries in Jakarta.

MILTON SALOMON

Professor of Food and Resource Chemistry

Improvement in the Technology of Traditional  
Hot Fish-Smoking in West Africa

Graduate Student: Matthew Caurie, Ghana

Under the direction of Professor Milton Salomon, assisted by Professors T. C. Lee and C. O. Chichester, Mr. Matthew Caurie is investigating fish smoking technology as a method of alleviating protein lack. Traditional West African systems of fish smoking by wood fires produce hot smoked fish of poor quality. Mr. Caurie's research proposes to fabricate the smoking oven from existing barbecue machines and to develop a method for fish smoking based on the traditional West African wood firing techniques. This technique would produce smoked fish with higher nutritional and physical qualities.

The success of the project will be assessed by running a number of Protein Efficiency Ratio (PER) tests, using fish smoked by methods developed in this study as the sole source of protein, against the control casein sample.

Initial research is presently underway. Equipment for the laboratory studies is either on order or already received and in use. It is expected that during 1973 progress will be made on a detailed overall research proposal. Mr. Caurie plans to complete degree course work by mid-1974 and aims at completion of the overall research project, including publication, during the following year.

C. ROBERT SHOOP

Associate Professor of Zoology

Mariculture of Sea Turtles

Graduate Students: Philip Iskan, USA

The objectives of the Sea Turtle Mariculture project include:

- (1) The development of a suitable tag for hatching green sea turtles to define the survival rates and homing to breeding grounds of natural, breeding populations (both presently unknown);
- (2) The assessment of the practicality of small investment sea turtle mariculture in tropical areas;
- (3) The development of breeding stock in hatcheries.

Efforts toward objectives (1) and (2) have progressed well during the past year. Objective (3) is potentially obtainable in the near future.

The major problem in dealing with the endangered status of the green sea turtle is the lack of data on survivorship under natural conditions. Exploitation of eggs and adults cannot be assessed unless a permanent method of marking is developed. Marking by mutilation, metal or plastic tags, or tattooing have been unsuccessful in the past because of rapid growth rate of young turtles and the subsequent loss or obliteration of the tags or marks. Radioactive tags are inappropriate for a number of reasons. Consequently, we have worked on a metabolic tag, non-radioactive and non-toxic to potential predators, including humans.

Hatchlings are injected with europium, a rare element not accumulated by turtles. This element is deposited in various tissues of the body and can be identified by neutron activation analysis of the tissues at a

later date. Laboratory studies at URI have established the basis for this technique.

Toxic limits, safe doses, methods of injection, chemical preparations of the europium solutions, and methods of identification were completed this year. A dose of 40 mg Eu/Kg will mark turtles safely for a period of at least six years, and probably for the entire lifetime of the animal.

A paper was presented at the annual meeting of the American Society of Ichthyologists and Herpetologists, San Jose, Costa Rica (1973) concerning this technique.

A series of injected animals will next be prepared by Professor Richard Wolke, Animal Pathologist at URI, to determine if there are tissue changes. A large series of hatchlings will be injected at the major commercial sea turtle culture facility (Grand Cayman Island) to verify the technique. The first field test should take place in the fall of 1974.

During the past year, two new tanks with heaters, circulators, and filters have been assembled. The arrangement allows for group or individual culture and is sufficient to maintain at least 20 turtles up to 35 lbs. in weight. Favorable diets, temperatures, and feeding schedules have been determined and disease problems reduced or eliminated. Under the present conditions, successful maintenance of laboratory stock is assured.

Two graduate students in the Department of Zoology have developed thesis projects with sea turtles. One project involves a behavioral catalogue and the other concerns perception of magnetic fields. Both projects should contribute substantially to the basic knowledge of the biology of these animals.

An effort to determine the present effectiveness of mariculture attempts and the potential for low-capital culture methods was made during a series of visits to several locations in the Caribbean region during the past year. Contacts included:

Mr. William Rainey of the Island Resources Foundation, St. Thomas, U.S. Virgin Islands, concerning the biology of green turtles and potential for small scale farming;

Dr. Kenneth W. Watters of the Puerto Rico Nuclear Center, Mayaguez, P.R., who is currently engaged in developing URI-related aquaculture projects at the facilities of the P.R. Nuclear Center of the University of Puerto Rico;

Mariculture, Inc., green turtle farm at Grand Cayman Island.

Related present and future available facilities, potential experimental sites and activities were reviewed and a request for a joint research proposal with Professor Peter Woodhead of the University of West Indies, SUNY Biological Station, Discovery Bay, Jamaica, who has a strong interest in developing aquaculture projects, was made.

Professor Shoop's plans for the coming year include:

Continuation of the europium studies at URI with special attention to any associated tissue changes and turnover rates in previously marked turtles;

Experiments on cage design useful for potential small-scale culture in tropical waters;

Development of a proposal for small scale culture effort in cooperation with Puerto Rico Nuclear Center;

Preparation of a specific research plan regarding contributions to reproduction biology to be evaluated and integrated into the overall artisan fishery and mariculture effort described elsewhere.

JOHN McN. SIEBURTH

Professor of Oceanography

Seaweeds as a Habitat for Yeasts

Graduate Student: Raja Seshadri, India

With the guidance of Dr. Sieburth, Raja Seshadri studied seaweeds as a habitat for yeasts. Sieburth and Seshadri had developed procedures for the cultivation and estimation of yeasts on seaweed. Working with this laboratory technique Seshadri completed his Ph.D. thesis on yeast cell production on seaweed hosts from Narragansett Bay. He found maximal yeast populations occurring on chlorophytes and rhodophytes. Lower yeast populations on pheophytes were attributed to the release of inhibitory polyphenolic materials.

PETER T. WADSWORTH

ICMRD Fellow

Economic Structure of the Mexican Shrimp  
Fishing Industry in the Gulf of Mexico

This study, by Mr. Wadsworth with guidance by Professor Harlan C. Lampe of the Department of Resource Economics, is nearly finished. Selected statements from the conclusions and recommendations offered are as follows:

It appears that the Mexican fleet has been able to maintain its per-boat catch rate at about 22 metric tons per year in the Gulf, despite a rapid expansion of the fleet, due to increased fishing power and the gradual retirement of American effort from the Campeche banks. Since American boats are more expensive to operate, chiefly due to higher labor costs, they require higher catch rates in order to be profitable. Thus, when average catch rates fall to levels unprofitable for American boats, Mexican boats can still fish quite profitably.

Competition with Cuban boats, however, is likely to continue for some time. While fishermen's earnings on Cuban shrimp trawlers are not known, they can, with some degree of assurance, be assumed to be in the vicinity of those on Mexican boats (or possibly lower). The danger is that, due to lower costs, it will soon be profitable to fish down to levels which could damage the resource base.

There is no reason that Mexicans should not export cattle and/or shrimp to whomever will pay the incredibly high prices they fetch in the market, as long as part of that high price is used to

increase the supply of cheaper but equivalent protein sources within the country. For example, suppose that an export tax of five pesos per kilo were levied on shrimp. This would have the immediate effect of lowering the domestic price of shrimp by five pesos per kilo. It would have the further effect of eliminating some marginal boats from the fishery. These boats would probably fish for other, more abundant, species. And to guarantee the diversification of the fleet, the revenue from the tax could be partially used to subsidize the production of table-fish and partially used to import either machinery to raise productivity in other food industries, or foodstuffs themselves. Alternatively, and better in the long run, the industry itself could establish a similar trust fund which would foment the diversification and modernization of Mexican table-fisheries.

Many of the remaining points deal substantively with the character of the fishery, with comments as to features that are most successful, and with changes that should be considered.

THOMAS F. WEAVER

Associate Professor of Resource Economics

Professor Weaver consulted with Fisheries officers in Singapore, Malaysia and Thailand on artisan fisheries development during a visit in September 1972. These discussions were a follow through on issues in fisheries development raised at the Southeast Asian Development Advisory Group (SEADAG) meeting in Singapore. A topic outline, as follows, was developed to serve as a basis for a monograph on Inshore Fisheries Development in S.E. Asia to be written in 1973-74.

1. Characteristics of the Inshore Fishery
2. Contributions of Inshore Fisheries to Economic Development
3. Comparative Costs of Protein from Alternative Sources in S.E. Asia
4. Strategy for Fisheries Development

Professor Weaver organized and chaired two seminars for the Rural Development Panel of SEADAG held in Singapore (September 1972) and New York City (July 1973). They were titled, respectively, "The Commodity Approach to Sectoral Planning for Rural Development" and "Allocative and Distributional Issues in Rural Development". In both of these seminars, fisheries development was discussed at some point in its relation to the total problem of rural development.

Professor Weaver continued assistance to ICAIT in Guatemala through the CODOT program in the area of institutional program development. He assisted in the planning for the Central American Food Industry survey and contributed to the written report. Research in fresh fish marketing in Guatemala employing a U.S. graduate student was begun and is presently nearing completion.

### V. FOREIGN STUDENTS IN MARINE ORIENTED STUDIES

In addition to the students directly participating in studies of interest to the Center, there are close to 50 foreign students pursuing graduate degrees and research tasks in marine resource areas.

The table below is a listing of these students studying at URI during the report year. The students were variously supported by URI, federal funding, their parent countries and private sources.

<u>Nation</u>	<u>Student</u>	<u>Specialty</u>	<u>Degree Sought</u>
Bangladesh	Md. Mohsin Ali	Food and Resource Chemistry	Ph.D.
Belgium	Thierry G. Jacques	Oceanography	M.S.
Brazil	Roberto Aropillo	Oceanography	M.S.
Brazil	Valemiro Sgarbieri	Food and Resource Chemistry	Ph.D.
Chile	Luis Adriosola	Resource Economics	Ph.D.
Chile	Andreas Marchant	Resource Economics	Ph.D.
Chile	Alfredo Sfeir	Resource Economics	Ph.D.
China, Republic of	Anthony H. Cheng	Food and Resource Chemistry	Ph.D.
China, Republic of	Huei Guang-Horng	Food and Nutrition Science	M.S.
China, Republic of	Jiasie Horng	Food and Nutrition Science	M.S.
China, Republic of	Dinny Huang	Business Admin.	B.S.
China, Republic of	Hsui-Chin Kuo	Food and Nutrition Science	M.S.

<u>Nation</u>	<u>Student</u>	<u>Specialty</u>	<u>Degree Sought</u>
China, Republic of	Shui Jin Kuo	Ocean Engineering	Ph.D.
China, Republic of	Yao Chun Lee	Ocean Engineering	M.S.
China, Republic of	Fu Tanng Liao	Resource Economics	M.S.
China, Republic of	Yi-Yih Phillis Liao	Food Science	M.S.
China, Republic of	Ke Yee Christina Lui	Food and Nutrition	M.S.
China, Republic of	I-Shan Lui	Food and Resource Chemistry	Ph.D.
China, Republic of	Roseanna (Shung) Ting	Food and Nutrition Science	M.S.
China, Republic of	Suzanne Ting	Food and Nutrition Science	M.S.
China, Republic of	Tze-Chui Teng	Oceanography	Ph.D.
China, Republic of	Edward C. Yang	Civil Engineering	M.S.
Colombia	Jaime Amaya	Food and Resource Chemistry	Ph.D.
Colombia	Cesar Rizo	Resource Economics	B.S.
France	Jean Abgrall	Resource Economics	Ph.D.
Ethiopia	Abraham Alemayehu	Marine Affairs	M.M.A.
Greece	Pavlos Karakolt- sides	Food and Nutrition Science	M.S.
India	Asaf Ashraf	Oceanography	M.S.
India	Raja Seshadri	Oceanography	Ph.D.
India	C. K. Unni	Oceanography	Ph.D.
Indonesia	Danel Mon'ntja	Fisherman Training	A. Sci.
Israel	Sophia Professor- sky	Marine Affairs	M.M.A.
Japan	Munehiko Tanaka	Food and Resource Chemistry	Ph.D.

<u>Nation</u>	<u>Student</u>	<u>Specialty</u>	<u>Degree Sought</u>
Korea	Jil Seung Kim	Oceanography	Ph.D.
Korea	Chong Min Lee	Resource Economics	M.S.
Kuwait	Abdul Hameed Quabazard	Resource Development	B.S.
New Zealand	Edward Durbin	Oceanography	Ph.D.
New Zealand	Paul Vella	Oceanography	M.S.
Peru	Jose Daniel Figueroa	Food and Nutrition Science	M.S.
Peru	Julio Gianotti	Ocean Engineering	Ph.D.
Peru	Francisco ly Sanchez	Food and Resource Chemistry	M.S.
South Africa	Betty Mitchell- Innes	Oceanography	Ph.D.
Spain	Maria Tapia	Oceanography	M.S.
Sweden	Lars Vidaeus	Resource Economics	Ph.D.
Thailand	Mann Bhovichitra	Oceanography	Ph.D.

## VI. PROGRAMS FOR THE FUTURE

The overall plan for the future calls for continued attention to the need for general or base level program funding. Hopefully, the university's present 211(d) support will continue through a renewal grant and with growing project support from AID, possibly supplemented later by an international outreach dimension of the National Sea Grant Program, now receiving consideration as requested by the U.S. Congress, and perhaps supplemented through increasing foundation backing.

The unfolding activities of ICMRD<sup>1</sup> are categorized and briefly described below. Since many anticipated undertakings are still in preliminary planning stages, the total program for the year will probably be significantly expanded.

### 1. Major Institutional Projects

a. ICMRD, noting that a strong interest in artisan fisheries is the common denominator of many of its activities, is formulating and proposing for project funding, a coherent, topical project on World-Wide Artisan Fisheries Development (see Section III). The Puerto Rico Fisheries-Mariculture (1.b below) project, the current Mexican Lagoon study (2.a), the green turtle aquaculture research (2.b), some of the work of CODOT, a program to be suggested for East Africa (especially for Tanzania), and participation in collaborative efforts relating to aquaculture, will be incorporated as elements of this coherent World-Wide Program.

b. Though some funds were spent on lead-in-work, the Research and Development Mariculture-Fisheries Project in Puerto Rico, carried out cooperatively with the Puerto Rico Nuclear Center of the

---

<sup>1</sup>Exclusive of CODOT programs presented separately in the Consortium write-up in Section II.

University of Puerto Rico, was fully launched on June 15, 1973. The effort, which includes the direct participation of eight investigators, is funded for twelve months by the National Science Foundation to formulate an on-going development structure on which to build future fisheries development efforts.

## 2. Smaller Institutional Projects

a. Effective July 1, 1973, ICMRD launched a survey entitled Surface Water Management for Irrigation and Lagoon Environmental Modification, which is scheduled for completion in approximately 18 months. This study will focus on the ultimate impact of water management practices on coastal lagoons at the downstream end of the management system. Too often the concern for water supplies, irrigation, and run-off control overshadow this downstream impact which is extremely significant in areas such as the Mexican coast where the lagoons are the nursery for important fisheries and offer a substantial aquaculture potential. Professor Harlan C. Lampe of the Department of Resource Economics is the principle investigator, aided by Dr. Candace Oviatt of the Graduate School of Oceanography plus several assistants, and involving collaboration with a number of counterparts in Mexico.

b. Research on Green Turtle Mariculture is expected to continue focusing on the application of the trace metal tag, europium, developed by Professor Robert Shoop of the Department of Zoology, also on techniques for reproduction in captivity. Both efforts relate to the fact that it is now necessary to "rob" nesting beaches for eggs to culture this endangered species, and without a marker one cannot tell whether hatchlings released from culture pens return to the beaches to breed again. An additional effort will involve assessing the practicality of small scale (low capital investment) sea turtle mariculture.

## 3. Advisory Services

a. In an advisory capacity ICMRD is helping universities in developing countries to plan research and education programs in

support of the marine sciences. As a result of groundwork carried out in 1972/73, two university workshops are scheduled for the coming year, as follows:

A Planning Workshop is scheduled for the first week in January 1974 at the University of Dar es Salaam (the national university of the Republic of Tanzania).

A preparatory meeting is scheduled for early October, with a Preparatory Committee for the workshop comprised of:

Vice Chancellor, University of Dar es Salaam

Dean, Faculty of Science, University of Dar es Salaam

Head, Dept. of Zoology, University of Dar es Salaam

Principal Secretary, Ministry of Nat'l Resources, Tanzania

Director of Fisheries, Ministry of Nat'l Resources, Tanzania

Chairman, National Scientific Research Council, Tanzania

Director, National Scientific Research Council, Tanzania

Director, Tanzania National Parks

Head, UNESCO Mission, Tanzania

Professor Lewis Alexander of the Master of Marine Affairs Program; James Griffin, Executive Assistant of ICMRD; and Nelson Marshall, Director of ICMRD, representing the University of Rhode Island

In addition, the Division of Fisheries of the Food and Agriculture Organization of the United Nations (FAO) is interested in cooperating in this endeavor.

In response to a request from the Rector of the Universidad Catolica de Valparaiso, Raul Allard Neumann, a three-man team consisting of Professor Spiros M. Constantinides of the Department of Resource Economics, both at the University of Rhode Island, and Professor Andres Couve of the Universidad Catolica, will prepare a prospectus for inter-university cooperation. This will be the basis for a Planning Workshop at the Universidad Catolica de Valparaiso. The workshop date has not been set.

b. A paper on the Resource Potentials and Economic Considerations Relating to Development Assistance in Fisheries is scheduled for

completion by the end of September. This is being prepared for U.S. AID by Professor H. C. Lampe, Department of Resource Economics, and Nelson Marshall, Graduate School of Oceanography, with the assistance of Lars O. Vidaleus.

c. It is proposed that a Bibliography of Pertinent Fisheries Reference Materials be prepared for the Organization of American States. This will be handled by Spiros M. Constantinides of the Department of Food and Nutritional Science.

d. Fisheries Advisor Service to the Azores is contemplated in conjunction with the interest expressed by the College of Resource Development at URI to help the island in both agriculture and fisheries. Professor Andreas Holmsen of the Department of Resource Economics will make a brief fisheries reconnaissance in July. Further plans are indefinite, though it is obvious that an improvement in fishing methods is urgently needed.

e. Professor Herman C. Lampe expects to participate in a one-month Fisheries Evaluation Study Program in the Republic of Vietnam under the sponsorship of International Development Center Economic Research Service of the U.S. Department of Agriculture in cooperation with U.S. AID.

#### 4. Consulting Services

a. Arrangements to assess the Potential for Coastal Aquaculture in British Honduras have been finalized with the University of Illinois. The undertaking, which is expected to involve approximately two weeks, will be carried out in September by personnel from the University of Rhode Island (Professors Lampe and Marshall) in cooperation with the Marine Research Foundation (Professor George C. Matthiessen). Professor Matthiessen's organization has been handling the contractual arrangements for this undertaking.

b. Advisory services to FAO and other groups on the establishment of fisheries schools in developing areas are being provided

by Professor John C. Sainsbury of the Department of Fisheries and Marine-Technology. In view of pending inquiries it seems likely that Professor Sainsbury will return to the Escuela Superior Politecnica de Litoral in Ecuador for further guidance to their program.

#### 5. Conferences and Workshops

a. A Seminar and Workshop on Coastal Artisan Fisheries is scheduled to be held in Central America in mid-winter. This will highlight artisan fisheries problems and needs in Central America and neighboring areas and about three-quarters of the participants will be from the region. The prospects that this will have a beneficial impact are greatly enhanced by the fact that the Inter-American Development Bank is now funding artisan programs in several Central American countries and is contemplating enlarging this program support.

b. A conference on the possible Role of the U.S. Sea Grant Program in the International Field will be held either this spring or the following fall in Newport, R.I. The conference will follow preparatory studies focusing on the implications of H.R. Bill 5452 which calls for an appraisal of the possibility of Sea Grant assuming a significant international role.

c. Foreign students participating in the National Oceanographic Data Center six-month training program will be spending one week at the University of Rhode Island in October to Gain an Insight into Comprehensive Marine Resource Work. Where appropriate, added arrangements will be made for students to be assisted by URI faculty.

#### 6. Individual Research Pursuits

No attempt is made here to elaborate on individual programs which are bound to be numerous and varied as evidenced by Section IV of this report.

VII. PUBLICATIONS

Alexander, L.M. 1973. Indices of the national interest in the oceans  
Ocean Develop. & Int'l Law J., Vol. 1(1): 21-51.

\_\_\_\_\_, 1973. Where do we draw the line in the world ocean?  
Maritimes, Univ. R.I., May.

\_\_\_\_\_, 1973. National interests in the continental shelf.  
Proc. Pacem in Maribus IV, Malta. Calif. Center for Democratic  
Insts., Santa Barbara, Calif.

\_\_\_\_\_, 1971. The nation state and the law of the sea. Marine  
Tech. Soc. J. 5(6): 6-9.

\_\_\_\_\_ and R. Hodgson, 1972. Towards an objective analysis of  
special circumstances. Law of the Sea Inst. Occ. Paper No.13,  
Univ. R.I.

\_\_\_\_\_ (ed.), 1973. The law of the sea: needs and interests  
of the developing countries. Proc. 7th Ann. Law of the Sea Inst.,  
Univ. R.I.

\_\_\_\_\_, in press. Future law of marine resource development..  
Proc. Oceanogr. Law Comm. Mtng., Fed. Bar Assn., Wash., D.C., 1972.

\_\_\_\_\_, in press. Proposals for future regimes of the seabed.  
Proc. New Dimensions Law of the Sea Conf., British Inst. Int'l  
and Comp. Law, 1973.

\_\_\_\_\_, in press. Coastal state competence to regulate traffic  
in straits and other areas near their coasts vs world community  
trends to maximize vessel mobility. Proc. 3rd Ann. Law of the  
Sea Inst. Workshop, 1973.

\_\_\_\_\_, in press. Alternatives for the future status of  
Int'l straits. Proc. 8th Ann. Conf. Marine Tech. Soc., 1972.

\_\_\_\_\_, in press. Semi-enclosed seas of the world. Proc.  
Int'l Geog. Union, Montreal, Canada, 1972.

\_\_\_\_\_ (ed.), in press. Gulf and Caribbean maritime problems.  
Proc. 2nd Ann. Law of the Sea Inst. Workshop, Caracas, Venezuela,  
1973.

\_\_\_\_\_ and T.A. Clingan (eds.), in press. Hazards of mari-  
time transit. Proc. 3rd Ann. Law of the Sea Inst. Workshop,  
Nassau, 1973.

- \_\_\_\_\_, in press. Semi-enclosed seas. Proc. 8th Ann. Law of the Sea Inst. Conf., Univ. R.I., 1973.
- Chichester, C.O., 1973. Nutrition in food processing. pp. 318-333 IN M. Rechcigl (ed.), Food, Nutrition and Health, World Rev. Nutr. Diet., Vol. 16, S. Kerger, Switzerland.
- \_\_\_\_\_, 1973. Microbial safety of fishery products. Academic Press, New York.
- \_\_\_\_\_, in press. FPC processes: perspectives. Proc. Int'l Conf. Fish Protein Concentrate, Cambridge, Mass. June, 1972.
- \_\_\_\_\_, in press. Evaluation of the effectiveness of national and regional institutes of research and training in nutrition, food science and technology. Proc. 20th Mtng. Protein Adv. Group of the U.N., Paris, France, June, 1972.
- \_\_\_\_\_ and T.-C. Lee, in press. New food sources: potentials and problems. Proc. AAAS-CONACYT Meetings, Mexico City, June, 1973.
- Constantinides, S.M., 1973. A food scientist visits Chile and looks at the fishing potential. Maritimes, Univ. R.I. 17: 6.
- Cummings, R.G. and J. Lakman, in press. Formulation and use of optimization models for water management in arid zones. IN H. Quashu and C. Kisiel (eds.), Modelling of arid land systems, Univ. of Arizona Press.
- \_\_\_\_\_, 1972. Water resource management in northern Mexico. Johns Hopkins Press, Baltimore, Md.
- \_\_\_\_\_, 1971. Optimum exploitation of groundwater reserves with saltwater intrusion. Water Resources Res., Vol. 8(6): 1414-1424.
- \_\_\_\_\_ and D.L. Winkelmann, 1970. Water resource management in arid environs. Water Resources Res., Vol. 6(6): 1559-1568.
- \_\_\_\_\_ and O. Burt, 1970. Production and investment in natural resource industries. Amer. Econ. Rev. Vol.60(4): 578-590.
- \_\_\_\_\_ and \_\_\_\_\_, 1969. The economics of production from natural resource industries: a note. Amer. Econ. Rev. Vol. 59(5): 985-990.
- \_\_\_\_\_, 1969. Some extensions of the economic theory of exhaustible resources. Western Econ. J., Vol. 7(3): 201-210.
- \_\_\_\_\_, 1971. Water resource management problems in northern Mexico. Ford Found. Workshop: Probs. Agric. Develop. in Latin America., Caracas, Venezuela, May, 1971.

- \_\_\_\_\_. 1970. Economic aspects of water resource management in arid environs. First World Symp. on Arid Zones, Mexico City, Mexico, 1970.
- Dirlam, J.B., 1973. An introduction to Yugoslav economy. Merrill Co., Columbus, Ohio.
- Gates, J.M., 1972. Appraising the feasibility of fish culture. pp. 327-348 IN Proc. Symp. Fisheries Economics: Economic Aspects of Fish Production, Paris, France, 1972.
- Gerber, R.P. and N. Marshall, in press. Reef pseudoplankton in lagoon trophic systems. Proc. 2nd Coral Reef Symp., Australia, June, 1973.
- Griffin, J.J. and S.B. Saila, in press. The FASTRR concept (Facility for Atlantic Salmon Technological Research and Restoration) - a status report. Proc. Int'l Atlantic Salmon Foundation, St. Andrews, N.B., Canada, 1972.
- Holmsen, A.A., 1970. Management of the Peruvian anchovetta resource. Int'l Marine Fish. Serv. Spec. Sci. Repts., U.S. Dept. Commerce, Wash., D.C.
- \_\_\_\_\_, 1969. Remuneration systems and ownership patterns in the fishing industry and their relation to investment decisions. FAO, Rome.
- Karakoltsides, P.A., S. Brina, and S.M. Constantinides, 1973. Cath-  
eptic activity mollusca. Proc. Mtng. Comp. Physiology & Biochem. of Mollusca, Amer. Zool. Soc., Univ. R.I., 1973.
- Knauss, J.A., 1973. Developing the freedom of scientific research - issue of the Law of the Sea Conf., Ocean Development and Int'l Law Vol. 1(1): 93-120.
- Lampe, H.C., in press. A fisheries development program for Barbados. Inter-American Devel. Bank, Wash., D.C.
- \_\_\_\_\_, in press. A fisheries development program for Costa Rica. Inter-American Devel. Bank, Wash., D.C.
- \_\_\_\_\_ and M. Achurra, 1971. The export potential for fisheries products from Latin America. Inter-Amer. Devel. Bank, Wash., D.C.
- \_\_\_\_\_, 1970. A development program for fisheries development in the Dominican Republic. Inter-Amer. Devel. Bank, Wash., D.C.

Landberg, L.C.W., 1973. A bibliography for the anthropological study of fishing industries and maritime communities. Univ. R.I. mimeo.

\_\_\_\_\_ and Pamela L. Weaver, in press. Maendeleo: economic modernization in a coastal community of northeastern Tanzania. IN J.J. Poggie, Jr. and R.N. Lynch (eds.), Rethinking modernization: anthropological approaches. Greenwood Press, Westport, Conn.

\_\_\_\_\_ and W.R. Rosengren, 1973. The index of recent maritime research. Dept. of Maritime Studies, Univ. of Wales, Inst. Sci. and Tech., Cardiff, Wales.

Lee, T.-C. and C.O. Chichester, in press. The influence of harvest time on nutritional values. Proc. Symp. Nutritional Qualities of Fresh Fruits and Vegetables, Amer. Med. Assn., Chicago, 1973.

Marshall, N., in press. Oceanography: the new frontier of the 21st century. 21st Nt'l Conv. NSTA, Detroit, Mich., Mar. 1973.

Monckeberg, F., E. Yanez, D. Ballester, V. Gatta, M. Araya, M. Rutman and C.O. Chichester, in press. Fish protein concentrate as a protein source for human consumption. Proc. Int'l Conf. Fish Protein Concentrate, Cambridge, Mass., 1972.

Nikkila, E., S.M. Constantinides, H. Dymsha and T. Meade, 1972. Fortification of Arabic and Indian bread with fish protein concentrate. Proc. IXth Int'l Cong. Nutr., Mexico City.

Norton, V.J., 1969. Some potential benefits to commercial fishing through increased search efficiency - a case study - the tuna industry. Res. Rept. Geol. Survey, U.S. Dept. Interior.

Poggie, J.J., Jr. and C. Gersuny, in press. Fishermen of Galilee: The human ecology of a New England coastal community. URI Sea Grant Bull. No. 13.

Saila, S.B., 1972. Systems analysis applied to some fisheries problems. pp. 331-372 IN B.C. Patten (ed.), Systems Analysis and Simulation in Ecology, Vol. 11. Acad. Press, N.Y.C.

\_\_\_\_\_ and C.E. Williams, 1972. An electric trawl system for lobsters. Marine Tech. Soc. J. 6(5): 25-31.

\_\_\_\_\_ and W.H. Mowbray, 1972. Trawl studies based on bottom current measurements. Marine Fish. Rev. 34(11-12): 32-40.

\_\_\_\_\_, S.D. Pratt and T.T. Polgar, 1972. Dredge spoil disposal in Rhode Island Sound. Marine Exp. Station, Sea Grant Marine Tech. Rep. No. 2, 48 pp.

\_\_\_\_\_ (coordinator), 1973. Coastal and offshore environmental inventory, Cape Hatteras to Nantucket Shoals, Marine Publ. Ser. No. 2, Univ. R.I., 720 pp.

Saila, S.B., T.T. Polgar, D.J. Sheehy and J.M. Flowers, 1972. Correlations between alewife activity and environmental variables at a fishway. Trans. Amer. Fish. Soc. Vol. 101(4): 583-594.

Sgarbieri, V., J. Amaya, M. Tanaka and C.O. Chichester, 1973. Nutritional consequences of the Maillard reaction. Amino acid availability from fructose-leucine and fructose-tryptophan in microorganisms and the rat. J. Nutr., Vol. 103(5): 657-663.

\_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_, in press.  
Nutritional consequences of the Maillard reaction. Growth response to "complete" essential amino acid supplementation of brown ovalbumin. J. Nutr.

Stevenson, D.K. and N. Marshall, in press. Generalizations on the fisheries potential of coral reefs and adjacent shallow-water environments. Proc. 2nd Coral Reef Symp., Australia, June, 1973.

Wadsworth, P.T., 1973. La congelacion a bordo. Tecnico pesquera 6(66): 17-21.

SUPPLEMENT  
to the  
ANNUAL REPORT

July 1, 1972 - June 30, 1973

INTERNATIONAL CENTER FOR MARINE  
RESOURCE DEVELOPMENT

University of Rhode Island  
Kingston, Rhode Island

## CONTENTS

	Page
INTRODUCTION .....	1
I. ANNUAL REPORT SUMMARY .....	2
A. Statistical Summary .....	2
B. Narrative Summary .....	2
II. OBJECTIVES OF THE GRANT .....	4
III. ACCOMPLISHMENTS .....	4
IV. IMPACT OF GRANT SUPPORTED ACTIVITIES IN DEVELOPING INSTITUTIONAL CAPABILITIES .....	4
V. UTILIZATION OF INSTITUTIONAL RESOURCES IN DEVELOPMENT .....	4
VI. OTHER RESOURCES FOR GRANT RELATED ACTIVITIES .....	5
VII. NEXT YEAR'S PLAN OF WORK & ANTICIPATED EXPENDITURES .....	5
VIII. OTHER .....	5
IX. REPORT OF EXPENDITURES .....	5
Distribution of 211(d) Grant Funds & Contributions from Other Sources of Funding (Estimated) .....	7
Expenditure Report (Actual & Projected) under Instit- utional Grant #AID/csd-2455 .....	8
Detailed Expenditures (Actual & Projected) under 211(d) Grant AID/csd-2455 .....	9
Salaries & Fringe Benefits .....	10
Student Fellowships .....	11
Foreign Travel .....	12
Supplement - Detailed Cost Breakdown by Investigator and Task .....	13
L. Alexander .....	13
C.O. Chichester .....	14
S. Constantinides .....	15
R. Cummings .....	16
H. Foster .....	17
J. Gates .....	18
A. Holmsen .....	19
H. Lampe .....	20
L. Landberg .....	21

N. Marshall.....	22
S. Marston.....	23
J. Milburn.....	24
S. Saila.....	25
M. Salomon.....	26
R. Shoop.....	27
J. Sieburth.....	28
L. Sprague.....	29
P. Wadsworth.....	30
T. Weaver.....	31
Director's Office.....	32
Curriculum Development.....	33
Visiting Lecturers.....	34

INTERNATIONAL CENTER FOR MARINE RESOURCE DEVELOPMENT

University of Rhode Island

211(d) ANNUAL REPORT FY 72/73

Supplement

INTRODUCTION

In 1969, the University of Rhode Island founded the International Center for Marine Resource Development upon receipt of a five-year grant of \$750,000. from the U. S. Agency for International Development. As of June 30, 1973, at the end of four years under this 211(d) grant, it is very much to the point to take stock of what this grant has meant in the development of the University's interest, capability and orientation toward service in developing countries.

To avoid repetition, this supplement is to be read with and is cross-referenced to the Annual Report of the International Center for Marine Resource Development for the year 1972-73. Six Center activities were funded in part by 211(d) funds as were fifteen faculty activities. An additional ten faculty members have been involved in internationally oriented activities which have either been partially stimulated by 211(d) funds or which feed back into 211(d) supported efforts in the mutual building of interests.

211(d) Annual Report Supplement

FY 1972/73

I. Annual Report Summary  
211(d) Grant AID/CSD #2455

Title: International Center for Marine Resource Development

Grantee: University of Rhode Island

Director: Nelson Marshall

A. Statistical Summary:

Period of Grant - May 7, 1969 to May 6, 1974

Report Period - July 1, 1972 to June 30, 1973

Amount of Grant - \$750,000.

Expenditures for Report Year - \$172,644.

Accumulated Expenditures - \$456,135.

Anticipated Expenditures - for next year - \$293,864.

B. Narrative Summary

The principle accomplishments during the past year include:

- 1) Continued expanding food technological research and assistance activities of the Consortium for the Development of Technology (CODOT) in Central America through the Instituto Centroamericano de Investigacion y Tecnologia Industrial (ICAITI), and newly developing programs with the Instituto de Tecnologia de Alimentos (ITAL) in Brazil and with Kasessart University in Thailand.

- 2) Research and study projects concerning An Evaluation of the Implications of Alternative Ocean Management Schemes For Tuna, A Research and Development Mariculture-Fisheries Project in Puerto Rico, Surface Water Management For Irrigation and Lagoon Environmental Modification, Mariculture of Sea Turtles, Preliminary Assessment of the Marine Fisheries Development Needs of the Organization of American States, Potential for Coastal Aquaculture in British Honduras, and Fishery Advisory Service to the Azores. Expanded individual research and study activities in the countries in the Caribbean, South and Central America, the Far East, Africa and the Balkans.
- 3) International conferences held on Socio-Economic Research Issues in Fisheries Development and/or British Commonwealth Politics.
- 4) Continued URI operation of the Certificate Program in International Research, International LOS Institute, Master of Marine Affairs program.
- 5) Implementation of reorganization plans for ICMRD.
- 6) Initial development of a program in World Wide Artisan Fisheries Program including upcoming conferences in Central/South America and East Africa.
- 7) Continued encouragement of approximately 50 International Students in Marine-oriented studies.

C. Detailed Report

(Page numbers refer to Annual Report of the International Center for Marine Resource Development for the year 1972-73, unless otherwise noted).

I. General Background and Purpose of the Grant

See I. Director's Statement (p. 10)

II. Objectives of the Grant

See I. Director's Statement (p. 10)

III. Accomplishments

See Summary (p. 1)

II - Accomplishments during Year--Institutional Programs (p. 16)

III - Accomplishments during Year--Planning (p. 38)

IV - Accomplishments during Year--Individual Pursuits (p. 51)

VII - Publications (p. 95)

Two copies of publications and 211(d) sponsored research abstracts are being provided under separate cover.

IV. Impact of Grant Supported Activities in Developing Institutional Capabilities

See - I - Director's Statement (p. 10)

V. Utilization of Institutional Resources in Development

See - I - Director's Statement (p. 10)

- II - Accomplishments during Year--Institutional Programs
  - Law of the Sea Institute (p. 27)
  - Master of Marine Affairs Program (p. 30)
  - Certificate Program in International Development (p. 32)
- IV - Accomplishments during Year--Individual Pursuits (p. 51)
- V - Foreign Students in Marine-Oriented Studies (p. 87)
  - Table I (attached)

VI. Other Resources for Grant Related Activities

- II Accomplishments during the Year--Institutional Programs (p. 16)
- IV Accomplishments during the Year--Individual Pursuits (p. 51)
- VI Programs for the Future--(p. 90)
  - (See Table I, attached)

VII. Next Year's Plan of Work and Anticipated Expenditures

See - VI - Programs for the Future--(p. 90)

- Table I (attached)
- Table II (attached)

Note--Proposals for follow-on 211(d) program and World Wide Artisan

Fisheries effort, entitled World Wide Artisan Fisheries Development Program, are presently in preparation and project follow-on funding for the three years (1975, 1976, 1977) subsequent to expiration of the

VIII. Other

IX. Report of Expenditures

- Table I Distribution of 211(d) Grant Funds and Contributions from other sources of Funding (Estimated)
- Table II Expenditure Report (Actual and Projected)
- Table III Detailed Expenditures (Actual and Projected)
- Table IV Salaries and Fringe Benefits

- Table V Student Fellowships
- Table VI Foreign Travel
- Supplement - Detailed Cost Breakdown by Investigator and task.

TABLE I  
DISTRIBUTION OF 211(d) GRANT FUNDS AND CONTRIBUTIONS FROM OTHER SOURCES OF FUNDING (ESTIMATED)  
REVIEW PERIOD 1 JULY 1972 TO 30 JUNE 1973

	211(d) Expenditures				Non 211(d) Funding Amount
	Period under review	Cumulative total	Projected next year	Projected to end of grant	
<b>Research Support</b>					
C. Chichester	\$ 17,569.11	\$ 76,913.57	\$ 25,000.00	\$101,913.57	AID/csd-3646: \$109,706; ICAITI-ROCAP 598-15-290-553: \$59,915.
L. Landberg	14,788.16	42,571.13	2,000.00	44,571.13	
S. Sails	4,267.50	8,519.42	5,500.00	14,019.42	RFF Ocean Mgmt.-Tuna: \$9,833.
J. Sieburth	1,564.98	16,005.14	--	16,005.14	
N. Marshall	6,042.93	11,345.44	10,700.00	22,045.44	NSF CA-35782: \$26,300; NSF DI-39552: \$99,500
A. Holmsen*	311.75	6,062.50	--	6,062.50	
S. constantinides	3,088.20	7,604.43	8,200.00	15,804.43	
H. Lampe	11,760.09	22,575.20	25,300.00	47,875.20	
P. Wadsworth	4,008.60	18,672.26	--	18,672.20	
T. Weaver	20,342.82	34,687.21	23,000.00	57,687.21	
L. Sprague (J. Arnold)*	554.00	5,907.31	--	5,907.21	
H. Foster	68.15	181.07	--	181.07	
R. Shoop	4,931.70	4,931.70	7,000.00	11,931.70	
R. Cummings	5,818.90	5,818.90	6,000.00	11,818.90	
M. Salomon	4,096.15	4,096.15	5,500.00	9,596.15	
L. Alexander	7,104.13	7,104.13	4,500.00	11,604.13	
S. Marston	310.10	310.10	--	310.10	
J. Milburn	395.19	395.19	--	395.19	
J. Gates	300.00	300.00	--	300.00	
<b>New Awards</b>			23,400.00	23,400.00	
<b>Preparatory Research</b>					
Artisan Fisheries	--	--	25,764.00	25,764.00	
Fisheries Biologist and Sociologist Anthropologist	--	--	28,500.00	28,500.00	
Research, prior years*	--	1,411.00	--	1,411.00	
Director's Office - (Administration & prog. devt.)	57,657.92	153,449.94	85,000.00	238,449.94	URI ICMRD Development Fund: \$25,000.
Curriculum Development	5,201.80	12,408.90	5,000.00	17,408.90	
Visiting Lecturers and Professional Visitors	2,462.68	14,864.94	3,500.00	18,364.94	
<b>TOTALS:</b>	<b>\$172,644.86</b>	<b>\$456,135.63</b>	<b>\$293,864.00</b>	<b>\$749,999.63</b>	

\* These figures represent closeout costs from prior years.

TABLE II  
 EXPENDITURE REPORT (ACTUAL AND PROJECTED) UNDER INSTITUTIONAL GRANT #AID/csd - 2455  
 REVIEW PERIOD 1 JULY 1972 TO 30 JUNE 1973

	Expenditures to date		Projected expenditures				Total
	Period under review	Cumulative total	Grant year				
			2	3	4	5	
Personnel Costs	\$109,672.28	\$314,577.90				\$178,736	\$493,313.90
Graduate Fellowships	33,491.47	73,180.30				48,091	121,271.30
Travel:							
Domestic	9,477.41	19,277.18				10,000	29,277.18
Foreign	6,789.75	15,370.46				7,500	22,870.46
Other:							
Equipment	2,955.00	7,560.14				3,000	10,560.14
Supplies	1,909.46	3,939.02				2,500	6,439.02
Publications	933.29	1,702.43				1,200.	2,902.43
Communications	672.99	2,980.76				1,000	3,980.76
Library	226.04	1,069.27				1,000	2,069.27
Misc. (xerox, rentals, etc.)	6,517.17	16,478.17				15,073	31,551.17
Artisan fisheries prep.	---	---				25,764	25,764.00
<b>TOTALS:</b>	<b>\$172,644.86</b>	<b>\$456,135.63</b>				<b>\$293,864</b>	<b>\$749,999.63</b>

TABLE III  
 DETAILED EXPENDITURES (ACTUAL & PROJECTED) UNDER 211(d) GRANT AID/csd - 2455

	Expenditures to date		Projected expenditures				Projected 5 year Total
	Period under review	Cumulative total	1974	197	197	197	
<b>Salaries:</b>							
Academic	\$ 75,758.57		\$106,434				
Library	---		10,500				
Secretarial	10,347.66		18,300				
Adm. Staff	11,307.66		29,500				
Hourly P/R	1,660.80						
Fringe Benefits	13,506.23		14,002				
<b>Student Fellowships:</b>							
Stipends	26,931.83		42,011				
Tuition	3,651.00		6,080				
Consultants (a) (J. MacFarland)	552.75						
Guest Lecturers (b) (Holt & Enos)	950.00		1,200				
<b>Travel Expenses:</b>							
Domestic	9,477.41		10,000				
Foreign	6,789.75		7,500				
Equipment (c)	2,955.00		3,000				
Library Acquisitions (d)	226.04		1,000				
Other (e) (Telephone, postage, supplies, etc.)	8,530.16		44,337 <sup>1/</sup>				
<b>TOTALS</b>	<b>\$172,644.86</b>	<b>\$456,135.63</b>	<b>\$293,864.</b>				<b>\$749,999.63</b>

<sup>1/</sup>Including Artisan Fisheries preparation.

For the 12 month report period:

(a) Number of consultants used - 1

(b) Number of guest lecturers - 2

(c) Items of equipment purchases (over \$100) - IBM typewriter: \$310; HP 35 Calculator: \$395; fiberglass tanks for Shoop's turtle project: \$2,250.

(d) Misc. periodicals & bibliographies

(e) Supplies: \$1,909.46; postage: \$312.87; communications: \$672.99; copying charges: \$2,108.70; publications: \$933.29; secretarial assistance: \$1,146.59; repairs & service: \$658.46; rental: \$96; computer: \$95.72; conferences, meetings & services: \$233.15; and freight, misc. etc.: \$362.93.

TABLE IV  
SALARIES AND FRINGE BENEFITS

Name and position	Salary	Benefits
N. Marshall, Director, ICMRD	\$ 18,692.28	\$ 2,018.77
L. Sprague, former Director, ICMRD	385.06	41.59
J. Griffin, Asst. to the Director, ICMRD	11,307.66	1,221.23
E. Tefft, Secretary	2,336.58	252.35
S. Fitzpatrick, Secretary	4,122.89	445.27
C. Latos	3,594.78	388.24
A. Holmsen	281.36	30.39
C. Chichester	211.86	22.86
T. Weaver	18,359.95	1,982.87=
H. Lampe	10,613.95	1,146.29
L. Landberg	12,671.87	1,368.56
T. Lee	10,247.61	1,106.74
J. MacFarland	700.00	75.60
D. Durocher, Secretary	3,846.19	415.39
R. Seshadri, Grad. Assistant	1,399.98	151.20
R. Gerber, " "	1,733.98	187.27
J. Arnold, " "	500.00	54.00
O. Kenerson, " "	1,099.98	118.80
P. Wadsworth, " "	3,450.00	372.60
J. Horng, " "	2,150.00	232.20
M. Caurie, " "	2,997.43	323.72
D. Stevenson, " "	1,958.00	211.46
T. Jacques, " "	2,940.00	317.52
L. Vidaeus, " "	3,150.00	340.20
S. Professorsky, " "	3,639.96	393.12
P. Ross, " "	1,912.50	206.55
G. Telek, Hourly - Puerto Ri	45.00	2.34
P. Lemkau, Grad. Assistant	636.30	30.09
J. Pelgarski, " "	542.00	24.08
E. Yang, " "	212.50	11.05
S. Gould " "	42.00	2.18
D. Huang, " "	225.00	11.70
<b>TOTALS</b>	<b>\$126,006.52</b>	<b>\$13,506.23</b>

TABLE V  
STUDENT FELLOWSHIPS

Name and area of work	Nationality	Tuition - 211(d)	Stipends - 211(d)
R. Seshadri	India	--	\$1,551.18
R. Gerber	United States	--	1,921.25
P. Wadsworth	" "	186.00	3,822.60
J. Horng	Republic of China	30.00	2,382.20
M. Caurie	Ghana	395.00	3,321.15
D. Stevenson	United States	--	2,169.46
T. Jacques	Belgium	760.00	3,257.52
L. Vidaeus	Sweden	760.00	3,490.20
S. Professorsky	Israel	760.00	4,033.08
P. Ross	United States	--	2,119.05
F. Sanchez	Peru	380.00	--
A. Sfeir	Chile	380.00	--
J. Arnold	United States	--	554.00
O. Kenerson	" "	--	1,218.78
TOTALS:		\$3,651.00	\$29,840.47

TABLE VI  
FOREIGN TRAVEL

Name and Title	Destination, Purpose and Results *	Duration	Amount
S. Holt, Adjunct Professor	Malta to Kingston & return to consult about ICMRD international planning	4 days	\$ 767.25
N. Marshall, Director, ICMRD	To Mexico City, Mexico and return to participate in on-site review and consult regarding research efforts of P. Wadsworth	3 days	418.97
J. Gates, Asst. Professor	To Paris, France and return to attend conference on European Fisheries Economics sponsored by the Organization for Economic Coop. Development and to present paper there	3 days	300.00
N. Marshall, Director, ICMRD	To Dar es Salaam, Tanzania and return to explore inter-institutional coop. possibilities in marine resource development	18 days	1,621.08
L. Landberg, Instructor	To Toronto, Canada and return to attend meeting Anthropological Assoc.	4 days	251.86
H. Lampe, Professor	To Vancouver, Canada and return to attend technical Conference on Fisheries Management Development	11 days	693.76
R. Shoop, Assoc. Professor	To Jamaica and return to explore coop. possibilities in green turtle aquaculture	10 days	920.94
L. Alexander, Director, Master of Marine Affairs & Professor	To Vancouver, Canada and return to attend technical Conference on Fisheries Management Development	11 Days	192.00
N. Marshall, Director, ICMRD	To Dar es Salaam, Tanzania and return to explore inter-institutional coop. possibilities in marine resource development	19 days	1,623.89
<b>TOTALS:</b>			<b>\$6,789.75</b>

See Annual Report text for details.

AID SUPPORTED ELEMENTS OF ICMRD - IIRT PROGRAM

1972 - 1973

Investigator's Name  
or Sub-Section

L. Alexander

Budget:

Personnel Costs	
Graduate Fellowships	<u>6,912.13</u>
Travel	
Domestic	<u>        </u>
Foreign	<u>192.00</u>
Other	
Equipment	<u>        </u>
Supplies	<u>        </u>
Publications	<u>        </u>
Communications	<u>        </u>
Library	<u>        </u>
Misc. (inc. Xerox, rental etc.)	<u>        </u>
TOTAL:	<u>7,104.13</u>

Effort:

Estimated \$\$

<u>Marine-Related Activities in the</u>	
<u>Caribbean-Gulf of Mexico Basin</u>	<u>6,393.72</u>
<u>        </u>	<u>        </u>
<u>        </u>	<u>        </u>
<u>Pre-Development Planning</u>	<u>710.41</u>
<u>        </u>	<u>        </u>

AID SUPPORTED ELEMENTS OF ICMRD - URI PROGRAM

1972 - 1973

Investigator's Name

or Sub-Section

C.O. Chichester

Budget:

Personnel Costs	<u>15,850.65</u>
Graduate Fellowships	<u>                    </u>
Travel	
Domestic	<u>    116.00</u>
Foreign	<u>                    </u>
Other	
Equipment	<u>                    </u>
Supplies	<u>    803.93</u>
Publications	<u>                    </u>
Communications	<u>    39.95</u>
Library	<u>                    </u>
Misc. (inc. Xerox, rental etc.)	<u>    758.58</u>

TOTAL:

17,569.11

Effort:

Estimated \$\$

Development Program Directed towards the Develop-  
ment of Infant Food

1,756.91

Carbonyl Accumulation during Browning

1,756.91

Planning for a Research Proposal on

5,270.73

Caratenoids

Center Development Planning

8,784.55

AID SUPPORTED ELEMENTS OF ICMRD - URI PROGRAM

1972 - 1973

Investigator's Name  
or Sub-Section S. Constantinides

Budget:

Personnel Costs	
Graduate Fellowships	<u>\$2,412.20</u>
Travel	
Domestic	<u>241.40</u>
Foreign	<u></u>
Other	
Equipment	<u></u>
Supplies	<u>434.60</u>
Publications	<u></u>
Communications	<u></u>
Library	<u></u>
Misc. (inc. Xerox, rental etc.)	<u></u>
<b>TOTAL:</b>	<u>\$3,088.20</u>

Effort.

	<u>Estimated \$\$</u>
<u>Marine food science programs in chile</u>	<u>\$ 154.41</u>
<u>Deterioration in fish muscle and molluscs</u>	
<u>  due to proteolytic enzymes</u>	<u>1,080.87</u>
<u>Utilization of underutilized species of</u>	
<u>  shrimp</u>	<u>617.64</u>
<u>Utilization of the crab</u>	<u>463.23</u>
<u>Utilization of the mussel</u>	<u>463.23</u>
<u>Non-conventional use of fish flesh and</u>	
<u>  waste</u>	<u>308.82</u>

AID SUPPORTED ELEMENTS OF ICMRD - URI PROGRAM

1972 - 1973

Investigator's Name  
or Sub-Section R. Cummings

Budget:

Personnel Costs	<u>775.60</u>
Graduate Fellowship	<u>4,630.20</u>
Travel	
Domestic	<u>413.10</u>
Foreign	<u>          </u>
Other	
Equipment	<u>          </u>
Supplies	<u>          </u>
Publications	<u>          </u>
Communications	<u>          </u>
Library	<u>          </u>
Misc. (inc. Xerox, rental etc.)	<u>          </u>

TOTAL:

5,818.90

Effort:

Estimated \$\$

Water Resource Management

4,364.20

Pre-Development Planning

1,454.70









AID SUPPORTED ELEMENTS OF ICMRD - URI PROGRAM

1972 - 1973

Investigator's Name  
or Sub-Section

L. Landberg

Budget:

Personnel Costs	<u>14,500.68</u>
Graduate Fellowship	<u>                    </u>
Travel	<u>                    </u>
Domestic	<u>                    </u>
Foreign	<u>251.86</u>
Other	<u>                    </u>
Equipment	<u>                    </u>
Supplies	<u>                    </u>
Publications	<u>                    </u>
Communications	<u>                    </u>
Library	<u>                    </u>
Misc. (inc. Xerox, rental etc.)	<u>35.62</u>

TOTAL:

14,788.16

Effort:

Estimated \$\$

A Bibliography for the Anthropological Study of

Fishing Industries and Maritime Communities

11,091.12

Socio-Economic Networks of Ngalawa Fishermen

of Tanzania, East Africa

3,697.04

AID SUPPORTED ELEMENTS OF ICMRD - URI PROGRAM

1972 - 1973

Investigator's Name  
or Sub-Section

N. Marshall

Budget:

Personnel Costs	<u>47.34</u>
Graduate Fellowships	<u>5,938.77</u>
Travel	
Domestic	
Foreign	
Other	
Equipment	
Supplies	
Publications	
Communications	
Library	
Misc. (inc. Xerox, rental etc.)	<u>56.82</u>

TOTAL:

6,042.93

Effort:

Estimated \$\$

Coral Reef and Reef Lagoon Studies

6,042.93

AID SUPPORTED ELEMENTS OF ICMRD - URI PROGRAM

1972 - 1973

Investigator's Name  
or Sub-Section . . . . . S. Marston

Budget:

Personnel Costs	_____
Graduate Fellowships	_____
Travel	_____
Domestic	310.10
Foreign	_____
Other	_____
Equipment	_____
Supplies	_____
Publications	_____
Communication	_____
Library	_____
Misc. (inc. Xerox, rental etc.)	_____

TOTAL:

310.10

Effort:

Estimated \$\$

<u>Study of U.S. Oil Interests in Possible</u>	_____
<u>  International Seabed Controls</u>	310.10
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

AID SUPPORTED ELEMENTS OF ICMRD - URI PROGRAM

1972 - 1973

Investigator's Name  
or Sub-Section

J. Milburn

Budget:

Personnel Costs

Graduate Fellowships

Travel

Domestic

395.19

Foreign

Other

Equipment

Supplies

Publications

Communications

Library

Misc. (inc. Xerox, rental etc.)

TOTAL:

395.19

Effort:

Estimated \$\$

Symposium on British Commonwealth Politics

395.19

AID SUPPORTED ELEMENTS OF ICMRD - URI PROGRAM

1972 - 1973

Investigator's Name

or Sub-Section

S. Saila

Budget:

Personnel Costs

Graduate Fellowships

2,169.46

Travel

Domestic

1,782.24

Foreign

Other

Equipment

Supplies

48.12

Publications

Communications

18.75

Library

Misc. (inc. Xerox, rental etc.)

248.93

TOTAL:

4,267.50

Effort:

Estimated \$\$

Fisheries Potential of the Inshore Tropical

Reef Environment

4,167.50

Mathematical Model of Salmonid Rearing

Facilities

100.00

AID SUPPORTED ELEMENTS OF ICMRD - URI PROGRAM

1972 - 1973

Investigator's Name  
or Sub-Section

M. Salomon

Budget:

Personnel Costs

Graduate Fellowships

4,096.15

Travel

  Domestic

  Foreign

Other

  Equipment

  Supplies

  Publications

  Communications

  Library

  Misc. (inc. Xerox, rental etc.)

TOTAL:

4,096.15

Effort:

Estimated \$\$

Improvement in the Technology of Traditional

Hot Fish-Smoking in West Africa

4,096.15

AID SUPPORTED ELEMENTS OF ICMRD - URI PROGRAM

1972 - 1973

Investigator's Name

or Sub-Section

R. Shoop

Budget:

Personnel Costs	<u>1,232.47</u>
Graduate Fellowships	<u>          </u>
Travel	<u>          </u>
Domestic	<u>          </u>
Foreign	<u>920.94</u>
Other	<u>          </u>
Equipment	<u>2,250.00</u>
Supplies	<u>516.55</u>
Publications	<u>          </u>
Communications	<u>          </u>
Library	<u>          </u>
Misc. (inc. Xerox, rental etc.)	<u>11.74</u>

TOTAL:

4,931.70

Effort:

Estimated \$\$

Mariculture of Sea Turtles

4,931.70



AID SUPPORTED ELEMENTS OF ICMRD - URI PROGRAM

1972 - 1973

Investigator's Name

or Sub-Section

L. Sprague

Budget:

Personnel Costs

Graduate Fellowships

554.00

Travel

Domestic

Foreign

Other

Equipment

Supplies

Publications

Communications

Library

Misc. (inc. Xerox, rental etc.)

TOTAL:

554.00

Effort:

Estimated \$\$

Closeout of prior year's effort

554.00

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_





AID SUPPORTED ELEMENTS OF ICMRD - URI PROGRAM

1972 - 1973

Investigator's Name

or Sub-Section

Director's Office

Budget:

Personnel Costs	<u>\$40,867.86</u>
Graduate Fellowships	<u>---</u>
Travel	
Domestic	<u>5,422.28</u>
Foreign	<u>4,357.70</u>
Other	
Equipment	<u>705.00</u>
Supplies	<u>106.26</u>
Publications	<u>933.29</u>
Communications	<u>614.29</u>
Library	<u>226.04</u>
Misc. (inc. Xerox, rental etc.)	<u>4,425.20</u>

TOTAL

\$57,657.92

Effort:

Estimated \$\$

<u>General management &amp; administration</u>	<u>\$20,180.28</u>
<u>Institutional programs</u>	<u>5,765.79</u>
<u>Planning workshops</u>	<u>14,414.40</u>
<u>Individual actions</u>	<u>5,765.79</u>
<u>Programs for the future</u>	<u>11,531.58</u>

AID SUPPORTED ELEMENTS OF ICMRD - URI PROGRAM

1972 - 1973

Investigator's Name  
or Sub-Section Curriculum Development

Budget:

Personnel Costs	<u>\$3,983.02</u>	
Graduate Fellowships	<u>1,218.78</u>	
Travel		
Domestic		
Foreign		
Other		
Equipment		
Supplies		
Publications		
Communications		
Library		
Misc. (inc. Xerox, rental etc.)		
TOTAL:		<u>\$5,201.80</u>

Effort:		<u>Estimated \$\$</u>
<u>Certificate Program</u>		<u>\$4,681.62</u>
<u>Others</u>		<u>520.18</u>

AID SUPPORTED ELEMENTS OF ICMRD - URI PROGRAM

1972 - 1973

Investigator's Name

or Sub-Section

Visiting Lecturers

Budget:

Personnel Costs	_____
Graduate Fellowships	_____
Travel	_____
Domestic	728.95
Foreign	767.25
Other	_____
Equipment	_____
Supplies	_____
Publications	_____
Communications	_____
Library	_____
Misc. (inc. Xerox, rental etc.)	966.48

TOTAL:

2,462.68

Effort:

Estimated \$\$

Lectu. ---

231.34

Contributing scientists

2,231.34

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_