

PN-AY-690

ANNUAL STOCK ASSESSMENT  
XII - Collaborative Research Program

ANNUAL  
WORK  
PLAN  
1986-87

**In cooperation with the United States Agency for International Development (Grant No. DAN-4146-G-SS-5071-00) the Fisheries Stock Assessment CRSP involves the following participating institutions:**

**The University of Maryland--Center for Environmental and Estuarine Studies**

**The University of Rhode Island**

**The University of Washington**

**The University of Costa Rica**

**The University of the Philippines-- Marine Science Institute (Diliman)**

**--College of Fisheries (Visayas)**

**In collaboration with The University of Delaware; The University of Maryland--College Park, College of Business and Management; The University of Miami; and The International Center for Aquatic Resources Management (ICLARM).**

**FISHERIES STOCK ASSESSMENT**

**Title XII Collaborative Research Support Program**

**ANNUAL WORK PLAN**

**1986 - 1987**

FSA CRSP  
Management Office  
1109 Symons Hall  
The University of Maryland  
College Park, MD 20742

**The Fisheries Stock Assessment CRSP  
— A Search for New Methods**

**ANNUAL WORK PLAN, 1986 - 1987**

**Introduction**

This document presents the Annual Work Plan for the period July 1, 1986 - June 30, 1987, for the Fisheries Stock Assessment Title XII Collaborative Research Support Program (CRSP). Funded by USAID under Grant No. DAN-4146-G-SS-5071-00, the Fisheries Stock Assessment CRSP is a 5-year collaborative research program extending from July 1, 1985 to June 30, 1990. Entering its second year, the CRSP is engaged in a global research program designed to develop new methodologies for stock assessment and management for small scale multiple species tropical fisheries.

**Participating Institutions:**

The Office of International Programs, College of Agriculture, University of Maryland-College Park serves as the Management Entity for the Fisheries Stock Assessment CRSP. The technical research efforts in eight separate projects, led by the University of Maryland-Center for Environmental and Estuarine Studies, the University of Rhode Island, and the University of Washington, are being conducted collaboratively with the University of Costa Rica and the University of the Philippines. Additional collaboration is being provided by the University of Maryland-College Park-College of Business and Management, the University of Delaware, the University of Miami, and the International Center for Living Aquatic Resources Management.

**Goals and Objectives:**

The Fisheries Stock Assessment CRSP is developing stock assessment methodologies for use by fisheries managers in developing countries. Specific objectives for the program include the following:

1. Production of a Stock Assessment Handbook for fishery managers in tropical countries -- a manual that will provide a "key" for optimal fishery stock assessment and management given the problem and available resources.
2. Testing of existing methodology for stock assessment as it applies to tropical fisheries.
3. Development of new methodologies for stock assessment in tropical developing countries.
4. Development and testing of multispecies fishery assessment methods.

**Program Description:**

The Fisheries Stock Assessment CRSP is composed of eight interrelated research projects, listed below in association with the names of the lead U.S. institutions and host countries where field research is being conducted.

The University of Maryland-Center for Environmental and Estuarine Studies/Costa Rica:

1. Multiple Species Fisheries Research
2. Economic and Probabilistic Extensions of Standard Fishery Models

The University of Washington/Costa Rica:

1. Sampling Catch and Abundance
2. Age and Size Dependent/Independent Modeling
3. Age and Size Relationships and Consequences of Errors
4. Shallow Water Hydroacoustics

The University of Rhode Island/Philippines:

1. Empirical Analyses and Modeling
2. Multispecies Field Studies

Research on the eight projects at participating institutions is being coordinated toward the achievement of overall project objectives. This coordination at each participating institution is being done by their respective principal investigators, who are providing an integrative role on their projects. Coordination among the projects at the various institutions is being facilitated by regular communication and cooperation. Overall technical guidance and coordination among the projects is being provided by the efforts of the Technical Committee which is composed of the Principal Investigators at the three lead U.S. institutions and the two lead host country institutions.

**Structure of this Report:**

The technical work plans have been prepared by the Principal Investigators in collaboration with each other and with their research team members. As nearly as possible, the work plans for each lead U.S. institution and for each project follow the same organization. Each lead U.S. institution's work plans by project are organized to present a summary of the researchers and institutions involved in each project, along with a statement of project objectives, followed by the technical work plans for 1986-87 on a quarter-by-quarter basis. This is followed by brief sections on program coordination, training, and expected international travel requirements.

**WORK PLAN 1986 - 1987****University of Maryland-CEES/University of Costa Rica Program****PROGRAM DESCRIPTION**

The University of Maryland-Center for Environmental and Estuarine Studies (UMCEES) in collaboration with the University of Costa Rica (UCR) is carrying out two CRSP research projects, noted as follows:

1. Multiple Species Fisheries Research,
2. Economic and Probabilistic Extensions of Standard Fisheries Models.

The principal host country institution collaborating on these two projects is UCR's Centro Investigacion en Ciencias del Mar y Limnologia (CIMAR).

Additional collaboration on the Multiple Species Fisheries Research Project is being provided by the University of Maryland-College of Business and Management and by the University of Miami; and additional collaboration on the Economic and Probabilistic Extensions of Standard Fisheries Models Project is being provided by the University of Delaware.

The two projects will, together, (1) design a decision support system, utilizing some expert system features, to study population dynamics and management of tropical and subtropical multispecies fisheries and (2) modify standard fisheries models to increase their utility to managers of small-scale fisheries.

## WORK PLAN 1986 - 1987

**Project Name:** MULTIPLE SPECIES FISHERIES RESEARCH

**Host Country:** Costa Rica

**Host Country Lead Institution:** University of Costa Rica (UCR-CIMAR)

**Host Country Principal Investigator:** Dr. Manuel M. Murillo (UCR-CIMAR)

**Other Participating Host Country Institutions:** None

**Host Country Associate Investigators:** Dr. Jose Gracia (UCR),  
Dr. Jaime Lobo (UCR),  
Jorge Campos (UCR),  
Eduardo Madrigal (Ministry of  
Agriculture), and  
J. C. Briceno (UCR)

**United States Lead Institution:** University of Maryland-Center for  
Environmental and Estuarine Studies  
(UMCEES)

**United States Principal Investigator:** Dr. Brian J. Rothschild (UMCEES)

**Other Participating U.S. Institutions:** University of Maryland-College Park-  
College of Business and Management  
(UMCP-CBM), and  
University of Miami (UMiami)

**United States Associate Investigators:** Dr. Bruce Golden (UMCP-CBM), and  
Dr. William Fox (UMiami)

**United States Research Assistants:** Cluney Stagg (UMCEES),  
Hiren Trivedi (UMCEES),  
Jerald S. Ault (UMiami),  
David Die (UMiami), and  
Victor Restrepo (UMiami)

**Research Locations:** UMCEES, UMCP-CBM, UMiami, and UCR

**Project Objective:** Develop a better understanding of how multiple species  
fisheries influence the ecology and population dynamics  
of fish communities. Emphasis is placed on designing the  
components of a decision support system (DSS)  
incorporating some expert system features (ES) to study



the population dynamics and management of tropical and subtropical multiple species fisheries.

**WORK PLAN BY QUARTER 1986 - 1987**

**July 1 - September 30, 1986**

1. Refine primitive DSS/ES prototype developed in Year 1.
2. Begin process of transfer of system to host country through visit of CIMAR personnel to University of Maryland.
3. Transfer stock assessment technology software library to host country.
4. Explore further differential equation and inverse methods of studying multiple species population dynamics, including a Miami meeting in August with UMCEES, UMCP-CBM, UMiami and UCR personnel.
5. Work on sequential hemaphroditic reproduction manuscript.
6. Finish stock assessment user's guide.
7. Finish spawning/recruitment pattern manuscript.
8. Work on institutional structure manuscript.
9. Finish protocol for recruitment pattern experiments.
10. Work on alteration of simulator to accept recruitment patterns.
11. Work on alteration of simulator to bookkeep individual birth dates.

**October 1 - December 31, 1986**

1. Refine further the DSS/ES prototype and complete transferral of existing system to host country with UMCEES personnel traveling to Costa Rica for that purpose.
2. Complete assessment of mathematical models applicable to fishery management and finish review paper.
3. Continue exploration of differential equation and inverse methods of

studying multiple species population dynamics.

4. Begin preliminary work on the development of a fish larval rearing facility in Costa Rica.
5. Work on sequential hemaphroditism manuscript.
6. Work on institutional structure manuscript.
7. Continue work on alterations to biological sector of simulator.
8. Visit Costa Rica to work on institutional and fishery sectors of simulator and install assessment program library.

**January 1 - March 31, 1987**

1. There will be a meeting in Costa Rica in January to consider progress and reevaluate directions.
2. More artificial intelligence features will be added to the prototype DSS/ES, the results of ongoing work will be added and the system will be set up specifically for the Gulf of Nicoya fishery.
3. There will be further development of larval rearing facility and training of personnel.
4. Continue exploration of differential equation and inverse methods of studying multiple species population dynamics.
5. Finish manuscripts on sequential hermaphroditism and institutional structure.
6. Complete alterations to biological sector of simulation.
7. Work on implementation of other model sectors of simulation.
8. Begin multi-dimensionalizing model for multiple species.

**April 1 - June 30, 1987**

1. More artificial intelligence features are being added to the prototype DSS/ES, the results of ongoing work are being added and the system is being set up specifically for the Gulf of Nicoya fishery.
2. Larval rearing facility will be completed.
3. Continue exploration of differential equation and inverse methods of studying multiple species population dynamics.
  - a. Begin experiments with spawning/recruitment patterns.
  - b. Complete multi-dimensionalizing model for multiple species.
  - c. Complete implementation of other sectors of simulation model.
  - d. Begin manuscript(s) on methodology developed to date.

**WORK PLAN 1986 - 1987**

- Project Name:** ECONOMIC AND PROBABILISTIC EXTENSIONS OF STANDARD FISHERY MODELS
- Host Country:** Costa Rica
- Host Country Lead Institution:** University of Costa Rica (UCR-CIMAR)
- Host Country Principal Investigator:** Dr. Manuel M. Murillo (UCR-CIMAR)
- Other Participating Host Country Institutions:** None
- Host Country Associate Investigators:** Arturo Villalobos (UCR),  
Dr. Edison de Faria (UCR),  
Jorge Campos (UCR),  
Dr. Edwin Castro (UCR),  
Dr. Ricardo Estrada (UCR), and  
Eduardo Madrigal (Ministry of  
Agriculture)
- United States Lead Institution:** University of Maryland-Center for  
Environmental and Estuarine Studies  
(UMCEES)
- United States Principal Investigator:** Dr. Brian J. Rothschild (UMCEES)
- Other Participating U.S. Institutions:** University of Maryland-College Park-  
College of Business and Management  
(UMCP-CBM), and  
University of Delaware (UDelaware)
- United States Associate Investigators:** Dr. Edward D. Houde (UMCEES),  
Dr. Lee Anderson (UDelaware),  
Dr. Arjang Assad (UMCP-CBM), and
- United States Research Assistants:** Cluney Stagg (UMCEES)
- Research Locations:** UMCEES, UMCP-CBM, UDelaware, and UCR
- Project Objective:** Modify standard fisheries models to increase their utility  
to managers of small-scale fisheries.

**WORK PLAN BY QUARTER 1986 - 1987****July 1 - September 30, 1986**

1. Refine primitive DSS/ES prototype developed in Year 1.
2. Begin process of transfer of system to host country through visit of CIMAR personnel to UMCEES.
3. Evaluate dynamic optimization models for applicability to Gulf of Nicoya fishery.
4. Continue data base development work in Costa Rica.

**October 1 - December 31, 1986**

1. Refine further the DSS/ES prototype and complete transferral of existing system to host country with UMCEES personnel traveling to Costa Rica for that purpose.
2. Continue overall assessment of mathematical models applicable to fishery management and finish review paper.
3. Continue data base development work in Costa Rica.

**January 1 - March 31, 1987**

1. There will be a meeting in Costa Rica in January to consider progress and reevaluate directions.
2. More artificial intelligence features will be added to the prototype DSS/ES, the results of ongoing work will be added and the system will be set up specifically for the Gulf of Nicoya fishery.

**April 1 - June 30, 1987**

1. Continue data base development work in Costa Rica.
2. More artificial intelligence features will be added to the prototype DSS/ES, the results of ongoing work will be added and the system will be set up specifically for the Gulf of Nicoya fishery.

**Summary of Objectives and Work Plans for July 1, 1987 - June 30, 1988**

The focus of research in the third year of both projects will continue to be on improving and enhancing the canonical fishery management decision support system/expert system (DSS/ES) and its components. The DSS/ES will have been developed as a prototype in the first two years of the CRSP. This will include both theoretical research on bioeconomic optimization, multispecies ecology and variability, and application of the DSS/ES to the Gulf of Nicoya "corvina" fishery.

Selected optimization models will be implemented from the following classes of techniques:

- 1) Classical Calculus of Variations and Optimal Control Theory.
- 2) Simple Nonlinear Programming Techniques.
- 3) Discrete Optimization Techniques.

The third year of the simulation studies will consist of experiments with the specific sciaenid fishery and will begin to incorporate relationships and processes developed in other CRSP projects. Generalized experiments, using newly developed processes are planned during the fourth and early part of the fifth year. The latter part of the fifth year will be devoted to preparation of the final report.

In addition to integrating the first two years results of multiple species ecology research into the DSS/ES, research will continue on:

- 1) The direct problem (the stochastic case).
  - a. Set up system of differential equations.
  - b. Life-history stages represented implicitly.
  - c. Physical factors (e.g. motion, irradiance, etc.) and how they relate to model coefficients.
  - d. Probabilistic collisions between food particles and prey and between predators and prey (probability of consumption, varying over time).
- 2) The inverse problem.
  - a. Determine the quantitative behavior of the system.

**PROGRAM COORDINATION**

The two UMCEES/UCR projects are being conducted in an integrated fashion. The second annual meeting of researchers from all the participating institutions is tentatively scheduled for January, 1987, in Costa Rica. Efforts are moving forward to develop a computer link among all the institutions involved. The University of Delaware economics component is being conducted collaboratively with both UMCEES and UW. Independent travel to and from Costa Rica for research and training purposes by participants from the various institutions involved will permit intermittent face-to-face communication to assure the coordination of the various activities.



**SUMMARY OF EXPECTED TRAINING**

Systematic training efforts will be continually involved in the interactions of the UMCEES and UCR researchers, as the DSS/ES models are transferred to Costa Rica. During visits to Costa Rica, the U.S. participants will conduct workshops on the use and operation of microcomputer systems and on the DSS/ES prototype and its various components.

**PRELIMINARY TRAVEL PLANS 1986 - 1987**

1. Drs. Rothschild and Golden and Professors Gracia and Lobo will meet in Miami in August, 1986, to assess progress and to prepare a status report.
2. Mr. Campos will travel to the University of Maryland in August, 1986, to initiate transfer of prototype DSS/ES to Costa Rica.
3. Professor Estrada will travel to the University of Maryland in the summer or fall of 1986 for interaction with Dr. Assad on optimization models.
4. Mr. Staff will travel to San Jose, Costa Rica in the fall of 1986 to complete the transfer of prototype DSS/ES to Costa Rica.
5. Dr. Fox will travel to Costa Rica in the fall of 1986 to coincide with the final establishment of the stock assessment software library.
6. Professor Chavarria will travel to Miami in the fall to work with Dr. Fox on implementation of the SIMULATOR model.
7. Dr. Manuel M. Murillo will travel to UMCEES for one week in the fall of 1986 to review progress on the projects and facilitate collaboration.
8. Members from each university of the UMCEES/UCR components of the CRSP will convene in Costa Rica in January, 1987.

**WORK PLAN 1986 - 1987****University of Washington/University of Costa Rica Program****PROGRAM DESCRIPTION**

The University of Washington in collaboration with the University of Costa Rica is carrying out four CRSP research projects, noted as follows:

1. Sampling Catch and Abundance
2. Age-Size Dependent/Independent Modeling
3. Age and Size Relationships and Consequences of Errors
4. Shallow Water Hydroacoustics.

The principal host country institution collaborating on these four projects is UCR's Centro Investigacion en Ciencias del Mar y Limnologia (CIMAR). Additional collaboration on the Sampling Catch and Abundance Project is being provided by the University of Delaware.

The four projects compose an integrated investigation of stock assessment and prediction that has as its objective the adaptation of concepts and methods of temperate fisheries management and the development of new methodologies, especially for tropical, artisanal fisheries. The work involves the integration of various field, laboratory, and theoretical studies.

**WORK PLAN 1986 - 1987**

- Project Name:** SAMPLING CATCH AND ABUNDANCE
- Host Country:** Costa Rica
- Host Country Lead Institution:** University of Costa Rica (UCR-CIMAR)
- Host Country Principal Investigator:** Dr. Manuel M. Murillo (UCR-CIMAR)
- Other Participating Host Country Institutions:** None
- Host Country Associate Investigators:** Juan Chavarria (UCR), and  
Edwardo Madrigal (Ministry of  
Agriculture)
- United States Lead Institution:** The University of Washington
- United States Principal Investigator:** Dr. Vincent F. Gallucci (UW)
- Other Participating U.S. Institutions:** The University of Delaware  
(UDelaware)
- United States Associate Investigators:** Dr. Loveday Conquest (UW) and  
Dr. Lee Anderson (UDelaware)
- United States Research Assistant:** Silvia Vega Gonzales (UW) and  
Christopher Rogers (UDelaware)
- Research Locations:** Universities of Costa Rica, Washington, and Delaware
- Project Objectives:** Develop statistical sampling methodology for the  
assessment of tropical stocks exploited via artisanal  
fisheries. Catch will be sampled at the villages, from  
vessels "at sea," and at fish markets. Sampling in the  
field will also be done independently of artisanal  
fishing activity, in conjunction with hydroacoustic  
estimates of abundance. The methodology being developed  
will allow for improvements in sampling designs using  
Bayesian and other decision theoretic techniques. The

statistical analyses and computations will be in the form of an expert system (ES) software package for transfer to Costa Rica. An economics component of the Sampling Catch Project will evaluate the utility of current stock and recruitment models for small-scale fisheries stock assessment and develop new methodologies and economic extensions of these models to provide useful bioeconomic information.

#### WORK PLAN BY QUARTER 1986 - 1987

##### July 1 - September 30, 1986

1. Begin analysis of spatial data received from J. Chavarria (CIMAR) on the distribution of fishing effort, by village location, fishing location, and vessel type. This will include the initial sample size estimation procedures.
2. Continue the review of data reporting formats of the Ministry of Fisheries currently used to monitor the fishery. Recommend particular modifications and concentrations of monitoring activity.
3. Complete Phase I of "An Expert System on Sampling Designs and Analysis for Artisanal Fisheries Applications," with programming and documentation.
4. J. Chavarria to visit UW to participate in analysis of spatial data, to bring data from Ministry of Fisheries, and to attend the XIII International Biometric Conference in late July, 1986.
5. Continue the preparation for and presentation of a formal paper at the XIII International Biometric Conference in Seattle on 28 - 29 July 1986: "Survey Design for Estimation of Parameters of Exploited Stocks," by S. G. Vega and V. F. Gallucci.

**October 1 - December 31, 1986**

1. Begin analysis of computer tapes supplied by Ministry of Fisheries.
2. Begin testing of modified reporting formats with simulated data scenarios.
3. Begin development of Bayesian Model, decision theory formulations.
4. Communication with J. Chavarria, assignments of responsibilities for reading and analysis of spatial data.
5. Coordinate sampling design and spatial analysis with hydroacoustic project.

**January 1 - March 31, 1987**

1. Continue above activities.

**April 1 - June 30, 1987**

1. Continue analyses of Ministry of Fisheries tapes. Begin introduction of decision principles into sampling designs.
2. Preparation and trip by S. Vega and possibly L. Conquest to University of Costa Rica (CIMAR) for review of our work to date and presentation of results for field evaluation with J. Chavarria.

**Summary of Expected Accomplishments by June 30, 1987**

1. Analyze data base of Ministry of Fisheries and evaluate data collection format.
2. Generate a map of spatial distribution of effort as an aid to new sampling designs.
3. Transfer field tested Expert System on Sampling Designs, Phase 1.
4. Start decision model for sampling designs.
5. Coordinate data collection with hydroacoustics project.

**ECONOMICS COMPONENT**

The economics component of the Sampling Catch Project is being carried out primarily by Dr. Lee Anderson (UDelaware) with assistance from Christopher Rogers (UDelaware) and in collaboration with C. Villalobos (UCR). This component is being conducted under a subcontract with the University of Delaware and is entitled "Economic and Probabilistic Extensions of Standard Fisheries Models." This work is also being done in cooperation with the UMCEES project with the same name. The work plan by quarter for 1986 - 1987 is presented separately below.

**July 1 - September 30, 1986**

1. Complete CRSP Technical Report and then a manuscript on basic economic analysis and submit for publication.
2. Continue to update the algorithm so that it contains the intricacies of the economic model.
3. Begin expansion of the economic model to include related stocks.
4. Work with Costa Rican counterparts to obtain data to test the model.

**October 1 - December 31, 1986**

1. Continue work on expanding the economic model.
2. Continue work on developing and improving the algorithm.

**January 1 - March 31, 1987**

1. Expand economic model to consider economics of enforcement and implementation.

2. Compare existing data in Costa Rica and data required for application of model. Determine if any differences are likely to be applicable to other developing countries and if so, try to adjust model to provide the best results possible given existing data.

**April 1 - June 30, 1987**

1. Continue work on the economic model improving the algorithm to match advancements in theory.
2. Prepare CRSP technical report and later a refereed paper containing expansions of economic model for journal submission.
3. Work with Costa Rican and University of Maryland and University of Washington counterparts to transfer the algorithm to their facilities.



**WORK PLAN 1986 - 1987**

**Project Name:** AGE AND SIZE DEPENDENT/INDEPENDENT MODELING

**Host Country:** Costa Rica

**Host Country Lead Institution:** The University of Costa Rica (UCR-CIMAR)

**Host Country Principal Investigator:** Dr. Manuel M. Murillo (UCR-CIMAR)

**Other Participating Host Country Institutions:** None

**Host Country Associate Investigators:** Dr. Joseph Varilly (UCR)

**United States Lead Institution:** The University of Washington (UW)

**United States Principal Investigator:** Dr. Vincent F. Gallucci (UW)

**Other Participating U.S. Institutions:** None

**United States Research Assistants:** Patrick Sullivan (UW) and  
Jose Orensanz (UW)

**Research Locations:** Universities of Costa Rica and Washington

**Project Objective:** Develop the framework, methodology, and validation techniques for understanding and predicting the abundance and growth of selected fish and invertebrate stocks. Existing models will be examined and improved ones developed. Data from field experiments will be used to estimate parameters for models which are a basis for predicting productivity. Field experiments seek to estimate: 1) age/size distributions of stocks per species, 2) age/size specific rates of mortality, 3) fecundity, and 4) growth. The theoretical framework and software written for this component will integrate these estimates with data from other projects, to allow fishery managers to follow the status of an exploited fish stock

and to predict the consequences of changes in a stock's environment (such as gill net mesh size, changes in effort, etc.).

**WORK PLAN BY QUARTER 1986 - 1987**

**July 1 - September 30, 1986**

1. Continue development of Catch-at-Size Analysis (CASA) Component.
  - a. Continue development of the pilot computer program, using the UW mainframe (CYBER) computer.
  - b. Acquire additional catch-at-size data from the Gulf of Nicoya.
  - c. Test and evaluate the estimation routines against simulated data and data from the Gulf of Nicoya.
  - d. Develop microcomputer program version for transfer to CIMAR. Begin bench mark tests of microcomputer to CYBER versions.
  - e. Begin development of methods to incorporate hydroacoustic data into CASA program.
2. Continue development and application of CAGEAN (Catch-at-Age Analysis) Component.
  - a. Acquire additional catch-at-size data from CIMAR and make preliminary conversion to catch-at-age.
  - b. Continue incorporation of data from hydroacoustic estimation.
  - c. Continue development of a simplified optimization technique for microcomputer use.
  - d. Adapt for microcomputer applications.
  - e. Continue dialog with Dr. Varilly on concepts and methods employed in CASA and CAGEAN.
3. FERET (Fecundity and Recruitment Timing) Component:

- a. Begin standardization of gonad grading and preservation.
  - b. Begin analysis of data from direct capture and from CASA results to estimate times and rates of recruitment.
  - c. Continue coordination with Curator of Fishes, the Los Angeles County Museum, also collecting fishes in Costa Rica.
4. Continue the preparation for presentation of the following formal papers at the XIII International Biometric Conference in Seattle on 28 and 29 July 1986:
- a. Lai, H. L., and V. F. Gallucci. "Effect of Variability on Estimates of Cohort Parameters Using Length-Frequency Data."
  - b. Sullivan, P. J. "Deterministic and Stochastic Descriptions of Spatial Heterogeneity in a Predator/Prey-Reaction/Diffusion System."

Both abstracts involve variability and how to deal with it when estimating age composition and modeling dynamics.

5. Revise manuscript after presentation at the American Association for the Advancement of Science (AAAS) Pacific Division meeting (Section on Oceanography and Limnology) on 10 June 1986,
- a. Gallucci, V. F., J. M. Orensanz, H. L. Lai. "Dynamics of Benthic Production and Recruitment in a Boreal Ecosystem."

**October 1 - December 31, 1986**

1. Continue development of the CASA project.
  - a. Begin development of a generalized computer program for CASA, suitable for use in a wide variety of environments.
  - b. Begin the use of Gulf of Nicoya data on a production-line basis.
  - c. Incorporate use of auxillary data, such as the results of hydroacoustic estimates, into general program.

- d. Initiate comparative study of age and size dependent estimation and modeling (CAGEAN and CASA).
2. Continue adaption of the CAGEAN project for artisanal application, in particular, to appraise effects of errors in aging.
3. Coordinate FERET component with a focus on species specific timing of spawning, age and size of spawners with data form both CIMAR and the Los Angeles County Museum.
4. P. Sullivan to visit CIMAR to participate in field studies and to collaborate with Dr. Varilly.

**January 1 - March 31, 1987**

1. Continue CASA project.
  - a. Complete approximations to estimation procedures.
  - b. Begin draft version of program documentation with examples.
  - c. Begin USAID/CRSP Technical Report on CASA.
  - d. Incorporate feedback from analyses and modify as needed.
  - e. Continue coordination with hydroacoustic component and sampling component to establish link between data availability and model development; initiate investigation, with sampling component, of the consequences of missing data on assessment results.
2. Continue FERET component to develop a time framework for spawning frequency, corresponding gonadal states, and checkmarks on hard bony structures.
3. Dr. Varilly and/or CIMAR research assistant to visit UW for collaboration, comparison and integration of results of research.

**April 1 - June 30, 1987**

1. Continue CASA Project.
  - a. Complete drafts of program documentation and of technical report as a collaborative effort; technical report is precursor to refereed publication.
  - b. Continue to incorporate feedback after application in UCR, and possibly after application elsewhere.
2. Continue FERET component, accumulating spring spawning/recruitment data.
3. Continue comparison of CAGEAN and CASA components.

**Summary of Expected Accomplishments by June 30, 1987**

1. Complete microcomputer software packages which will statistically estimate abundance and life history parameters. These packages will be based on age and size structured information and can incorporate hydroacoustic auxiliary information.
2. Manuscripts and documentation describing said estimation procedures prepared for collaborative publication as CRSP Technical Reports and in professional fisheries journals.
3. Interaction of Age and Size Dependent/Independent Modeling Project with Hydroacoustic and Sampling Catch and Abundance Projects and with CIMAR to facilitate development of efficient estimation procedures based on field studies.
4. A year-long record of recruitment timing, fish size and abundance history via FERET.

**WORK PLAN 1986 - 1987**

**Project Name:** AGE AND SIZE RELATIONSHIPS AND CONSEQUENCES OF ERRORS

**Host Country:** Costa Rica

**Host Country Lead Institution:** The University of Costa Rica (UCR-CIMAR)

**Host Country Principal Investigator:** Dr. Manuel M. Murillo (UCR-CIMAR)

**Other Participating Host Country Institutions:** None

**Host Country Associate Investigator:** Jorge Campos (UCR)

**United States Lead Institution:** The University of Washington (UW)

**United States Principal Investigator:** Dr. Vincent F. Gallucci (UW)

**Other Participating U.S. Institutions:** None

**United States Associate Investigators:** Dr. Han Lin Lai (UW)

**United States Research Assistants:** None

**Research Locations:** Universities of Costa Rica and Washington

**Project Objective:** 1) Develop age determination methodology for tropical fish and invertebrates. 2) Develop an age-size relationship for the corvina-like species in the Gulf of Nicoya to construct age-size keys and thus to draw inferences about recruitment, growth, and mortality. 3) Start to develop an age determination laboratory at UCR that may later serve regional fishery agencies in Latin America.

**WORK PLAN BY QUARTER**

**July 1 - September 30, 1986**

1. a. Begin planning of Age-Determination Regional Center at CIMAR.

- b. Continue the development of procedures to standardize reading by the training of Jorge Campos and a CIMAR staff person who will do aging on a production basis. Jorge Campos will visit UW for a period of about two weeks to study analysis methods. Upon return he will give the early training to an "age reader" at CIMAR.
2. a. Revise the manuscript: "Implications of Aging Variability on Estimates of Growth, Mortality and Yield per Recruit for Pollock" for the Canadian Journal of Fisheries and Aquatic Sciences (accepted), by Lai, H. L.
- b. Revise the manuscript: "Validation and Variation of Age Determination for Sablefish," by H. L. Lai, for the Canadian Journal of Fisheries and Aquatic Sciences, and as a CRSP Technical Report. This manuscript has the primary techniques and analyses to be employed on the tropical species.
- c. Prepare the Abstract: "Optimum Sampling Design for Estimating Age Composition Using Age-Length Keys," by H. L. Lai, to be presented at the XIII International Biometric Conference in Seattle, 28 and 29 July 1986, and as a CRSP Technical Report. This manuscript will describe the sampling plan for age composition studies considering both the cost and variability in aging.
- d. Prepare the manuscript: "A Time Series Analysis Approach to Studying Microstructure in Fish and Invertebrates," by H. Lai, S. Adlerstein, and V. Gallucci, as a CRSP Technical Report and later as a refereed paper. This methodology was developed by us and will greatly aid in the search for, and interpretation of, patterns in microlines. Software to be transmitted to CIMAR in this period.

**October 1 -- December 31, 1986**

1. H. Lai and J. Campos will begin a data file on aged and sized fish that will be available to all CRSP participants and continue to develop plans, now with Dr. Murillo, for the Age Determination Laboratory at UCR.
2. Continue microline analyses in conjunction with UCR investigators, and continue the collection of samples and the analyses of samples from the Gulf of Nicoya.
3. Begin introduction and correlation of FERET (Fecundity and Recruitment Timing) component data to aid in identification of spawning checks and to validate age estimates.

**January 1 - March 31, 1987**

1. Continue development of software for age-size data analysis. Costa Rican colleagues will continue collection of samples; Dr. Varilly (Age/Size Modeling Project) participates in the analyses.
2. Continue development of validating techniques.
3. Begin design of an optimal sampling program for an age-length key using the developed data base.
4. Begin investigation of propagation of errors in reading ages, in conjunction with other UW projects.

**April 1 - June 30, 1987**

1. H. Lai will prepare materials for presentation during a trip to Costa Rica in April/May, 1987, to: a) examine the Age Determination Laboratory, b) discuss and evaluate techniques, and c) give seminars on aging, on size-frequency analysis from the CASA component, and on applications of age data.



2. Prepare appropriate technical reports, exact contents to be determined based on the above.
3. Begin to draft manual on aging.
4. Begin procedures to make data files on aged fish available to all CRSP investigators.
5. Continue error propagation study.
6. Begin use of age data for modeling growth.

**Summary of Expected Accomplishments by June 30, 1987**

1. Establish a firm start on the UCR/UCR-CIMAR Aging Laboratory, which UCR wants to develop into a regional center.
2. Establish the procedures for aging and train the personnel.
3. Begin the data base on aged and sized animals.
4. Begin research activities in which age data is required.

**WORK PLAN 1986 - 1987**

**Project Name:** SHALLOW WATER HYDROACOUSTICS

**Host Country:** Costa Rica

**Host Country Lead Institution:** The University of Costa Rica (UCR-CIMAR)

**Host Country Principal Investigator:** Dr. Manuel M. Murillo (UCR-CIMAR)

**Other Participating Host Country Institutions:** None

**Host Country Associate Investigators:** Jorge Campos (UCR)

**United States Lead Institution:** The University of Washington (UW)

**United States Principal Investigator:** Dr. Richard E. Thorne (UW)

**Other Participating U.S. Institutions:** None

**United States Associate Investigators:** Dr. Gary L. Thomas (UW)

**United States Research Assistants:** None

**Research Locations:** Universities of Costa Rica and Washington

**Project Objectives:** Develop hydroacoustic fish assessment techniques for shallow-water, multispecies, environments such as the Gulf of Nicoya, Costa Rica. There are four aspects:

1. Determine the distribution, abundance and behavior of the corvina-like fishes, evaluating variables such as tidal, diel, location, seasonal, and annual. Measurements will be taken on abundance, vertical distribution, and velocity of fish, as well as salinity and water currents. Dual stationary transducers will be used, one mounted at a slant angle on the bottom, the other deployed at the surface and mounted at 90 degrees.
2. Determine the effectiveness of artificial reefs in attracting fish. The same deployment techniques as above

are used at three locations (on an artificial reef, adjacent to the reef, and a control).

3. Determine the efficiency of locally fished gill nets and other direct capture techniques.
4. Introduce the results of hydroacoustic estimation as auxiliary input for artisanal fisheries catch and stock assessment analysis.

#### **WORK PLAN BY QUARTER**

##### **July 1 - September 30, 1986**

All effort by R. Thorne. Preparation for rainy season field measurements in Gulf of Nicoya. Conduct field sampling in coordination with UCR (window is August through October). Begin writing CRSP Technical Report on shallow water hydroacoustic techniques with initial data from Gulf of Nicoya.

##### **October 1 - December 31, 1986**

Field sampling trip depending upon results of first trip. Analysis of results by R. Thorne, with additional effort from a UW graduate student. Completion of the CRSP Technical Report on shallow water hydroacoustic techniques. Further introduction of computational techniques to UCR counterparts, verification of analyses.

##### **January 1 - March 31, 1987**

Continued analysis. Preparation for the dry season field measurements in the Gulf of Nicoya, including extra measurements with advanced systems. This involves the use of more transducers, automatic multiplexing, varied transducer beamwidths, and acoustic target strength measurements. Probable

field trip, depending on coordination with UCR (window is February through April). Activity conducted by R. Thorne, a UW graduate student, and UCR counterparts.

**April 1 - June 30, 1987**

UCR counterparts conduct field sampling trip and do initial analyses of data. Possible participation of R. Thorne. Begin CRSP Technical Report on results of rainy and dry season measurements. Activity by R. Thorne, UW graduate student, and UCR staff.

**PROGRAM COORDINATION**

The four UW/UCR research projects, are sufficiently complex that some are composed of several components, each of which is defined in the general description of that project. Objectives and methods employed in each project are complementary, so data developed in one has multiple uses.

The UW program is coordinated with the program from the University of Maryland-CEES, which also has a subcontract to the University of Costa Rica and to the University of Delaware.

The work plan for the UW program has been presented project-by-project, but some aspects of the work plan are program-wide and will benefit all projects. These program coordination elements are briefly noted below, by quarter.

**July 1 - September 30, 1986**

1. Early data from field samples for all components collected over the past year will be made available on a trial basis for use by UW, UCR, and other CRSP investigators. The search for the most efficient format to facilitate transfer of data, during and after CRSP, will continue.
2. Efficient techniques (reliable and low cost) to transfer computer files between UCR and UW will be given a priority to compensate for the expensive and unreliable postal service. Software will be acquired and a subscription service selected. Methods to verify transmission will be sought.
3. Dr. Gallucci will visit Peru for advising at IMARPE (the Peruvian Institute for Marine Research) and the University of San Marcos on artisanal fisheries (not paid by CRSP). A trip to Argentina is planned by Gallucci to visit artisanal fisheries and their managers (not paid by CRSP), with planned

stops in Costa Rica to participate in sampling and to review progress. The data bases at IMARPE and Argentina regional fisheries offices will be examined for possible use in the CRSP analyses. This will contribute to regionalizing efforts.

**October 1 - December 31, 1986**

1. Begin planning for two short courses to be held in conjunction with CRSP.
  - a. A short course on Hydroacoustics, possibly in Costa Rica, in June 1987. R. Thorne plus UCR staff will serve as instructors. The course will be designed to attract participants from other countries in the region.
  - b. A short course on Artisanal Fisheries Management is presently planned for September 1987, in Seattle. V. Gallucci, J. Orensanz and others are instructors. This course is funded in part by the Tinker Foundation. The course is designed to attract UCR and other Latin American participants. This planning activity will continue throughout the year. Spanish language materials will be developed for both courses.
2. Begin the regular sharing and computer transmittal of data between concerned participants. Details of data collection and acquisition are in the appropriate components.
3. Begin parts of the handbook on the management of artisanal tropical fisheries that this CRSP will produce. Development of outlines, selection of examples, etc.
4. Systematics Project: Accumulate information base and recent keys on the corvina-like species of primary import in the artisanal fishery. The UCR/Los Angeles County Museum collection will supplement the collection at CIMAR.

UW/UCR

Program Coordination

January 1 - March 31, 1987

1. Continue above activities as noted.
2. Begin process of acquiring data from Peru and other possible fisheries in the region to evaluate feasibility of a regular exchange of data.

April 1 - June 30, 1987

Continue above activities as noted. Visit by V. Gallucci to participate in sampling, and to review progress in all four projects of the UW program.

**SUMMARY OF EXPECTED TRAINING**

1. Short courses:
  - a. on hydroacoustics estimation at CIMAR
  - b. on age determination at CIMAR
  - c. on fisheries management (all Latin American) at UW
2. Other individual and group interactions:
  - a. J. Campos and others on age determination
  - b. J. Chavarria on spatial analysis and Bayesian techniques
  - c. J. Varilly and students on fisheries management concepts and methodology
  - d. Other UCR interested parties by open seminars when UW personnel visit CIMAR



**PRELIMINARY TRAVEL PLANS 1986 -1987****July 1 - September 30, 1986**

- J. Campos (CIMAR) to UW for work on Age Determination Project and on Hydroacoustics Project
- J. Chavarria (CIMAR) to UW for work on Sampling Catch and to attend XIII Biometrics Conference
- V. Gallucci (UW) to CIMAR for dry season sampling and program coordination
- R. Thorne (UW) to CIMAR for dry season sampling, Hydroacoustics Project

**October 1 - December 30, 1986**

- P. Sullivan (UW) to CIMAR for work on Modeling Project
- R. Thorne (UW) to CIMAR (possibly)
- M. Murillo (CIMAR) to UW for project coordination

**January 1 - March 31, 1987**

- J. Varilly (CIMAR) to UW for work on Modeling Project
- V. Gallucci (UW) to CIMAR for rainy season sampling and program coordination
- R. Thorne (UW) to CIMAR for rainy season sampling on Hydroacoustics Project

**April 1 - June 30, 1987**

- S. Vega (UW) to CIMAR for Sampling Catch Project
- L. Conquest (UW) (possibly) same
- R. Thorne (UW) to CIMAR for Short Course on Hydroacoustics
- H. Lai (UW) to CIMAR to review Age Determination Laboratory and lecture on age and size frequency analyses

The duration and specific timing of visits will depend upon events and funds. Visits by V. Gallucci would focus on general UW program coordination, UW-UMCEES coordination, UW subcontract to UDelaware, and, in detail, upon three UW components: Sampling Catch, Age/Size Modeling, and Age Determination.

There will be some as yet unspecified domestic travel by UW team members to overall CRSP coordination meetings.

**WORK PLAN 1986 - 1987****University of Rhode Island/University of the Philippines Program****PROGRAM DESCRIPTION**

The University of Rhode Island in collaboration with the University of the Philippines is carrying out two CRSP research projects, noted as follows:

1. Empirical Analysis Modeling
2. Multispecies Field Studies

The principal host country institution collaborating on the Empirical Analysis and Modeling Project is the University of the Philippines (Visayas), College of Fisheries, and the principal host country institution collaborating on the Multispecies Field Studies Project is the University of the Philippines (Diliman), Marine Science Institute. Additional collaboration is being provided by the International Center for Living Aquatic Resources Management (ICLARM) which is based in the Philippines. The work is being coordinated with fisheries stock assessment activities undertaken by the Bureau of Fisheries and Aquatic Resources (BFAR), and institutions in Thailand and Indonesia are sharing in the exchange of fisheries data bases and research developments.

The two projects will integrate modeling and field studies to address tropical fisheries stock assessment issues. The projects, respectively, will (1) use existing fisheries data to develop mathematical models addressing the relationship among harvests, fishing effort, and species composition, and (2) develop and validate techniques for estimating fishery productivity and potential in reef and shore-line fisheries based on field studies.

**WORK PLAN 1986 - 1987**

- Project Name:** EMPIRICAL ANALYSIS AND MODELING
- Host Country:** Philippines
- Host Country Lead Institution:** College of Fisheries, University of the Philippines in Visayas (UPVCF)
- Other Participating Host Country Institutions:** International Center for Living and Aquatic Resources Management (ICLARM) and Bureau of Fisheries and Aquatic Resources (BFAR)
- Host Country Principal Investigator:** Prof. T.V.C. Jamir (UPVCF)
- Host Country Associate Investigators:** Dr. J. Carreon (UPVCF), Dr. S. Formacion (UPVCF), T. Sylvester (UPVCF), and Dr. Daniel Pauly (ICLARM)
- United States Lead Institution:** The University of Rhode Island (URI)
- United States Principal Investigator:** Dr. Saul B. Saila (URI)
- Other Participating U.S. Institutions:** None
- United States Associate Investigators:** Dr. C. Recksiek (URI) and Dr. John McManus (URI)
- United States Research Assistants:** Xiu Chen (URI) and Karim Erzini (URI)
- Research Locations:** Universities of the Philippines and Rhode Island
- Project Objective:** To use existing fisheries data to contribute to the development of mathematical models and computer programs which address the relationship among harvest, fishing effort, species composition and stability.

**WORK PLAN BY QUARTER 1986 - 1987****July 1 - September 30, 1986**

1. Prepare and present a formal paper entitled, "Multispecies Fisheries Models: Programmatic Approaches," to be presented at the annual meeting of the American Fisheries Society, Providence, Rhode Island, on September 16, 1986. This paper will summarize the progress made to date in this empirical analysis of multispecies fisheries data. This paper will be presented by S. B. Saila.
2. Prepare for international travel by S. B. Saila from U.S. to the Philippines as well as to Thailand and Indonesia. The purpose of this travel is to coordinate research activities among the research institutions involved, to assess the fishery data bases in Thailand and Indonesia, and to make arrangements for data analysis and use. The tentative dates for the travel are late September - early October, 1986.
3. Preparation for lecture and demonstration sessions at University of the Philippines by S. B. Saila.
4. Continuation of work by Saila, Recksiek and McManus with principal Philippines counterparts, Jamir and Gomez.
5. Continue work on fisheries related computer programs for transfer to the Philippines.
6. Present seminar at U.S. National Marine Fisheries Service, Northeast Fisheries Center on analysis of multispecies data (Saila).
7. Computer fisheries applications system program development (Saila, Recksiek, and Xiu Chen).

**October 1 - December 31, 1986**

1. Travel to Philippines by Sails. Present results of preliminary analyses to Jamir and to interested colleagues at University of the Philippines.
2. Bring computer fisheries applications program disks to the Philippines for initial orientation and explanation to University of the Philippines personnel.
3. Examine various Southeast Asian data bases for suitability and availability for analysis.
4. Continue development of multispecies model based on aggregated time series.
5. Incorporate suggestions from University of the Philippines and colleagues regarding the multispecies model as developed to date.
6. Consider and develop new programs based on initial visit to the Philippines and consultation with colleagues.
7. Examine suitability of models dealing with population fecundity as a response variable to exploitation or perturbations (Erzini and Sails).
8. Coordinate with ICLARM.

**January 1 - March 31, 1987**

1. Continue development of multispecies empirical model.
2. Initiate first phase of integrating the results of the Multispecies Field Studies Project with the empirical analysis and modeling project. It is expected that some indications of the following should be available:
  - a. The selectivity of some types of gear (traps and gill nets) to coral reef and reef associated fish assemblages.
  - b. The nature of the ingress and egress of fish into and out of traps,

and the modeling of trap capacity as a function of search time and other factors.

- c. Preliminary studies to develop an index of reef productivity, based on the second year studies.
3. Prepare publishable reports on some of the above.
4. Examine the results of Philippine work on reef ecosystems by McManus and colleagues to coordinate with the above.

**April 1 - June 30, 1987**

1. Continue multispecies model analysis and test with diverse data.
2. Prepare for joint publication the results of some of the initial analyses of Southeast Asian data sets.
3. Prepare for joint meeting of the CRSP members in the Philippines.
4. Continue development of fisheries analysis system in coordination with University of the Philippines (and ICLARM and BFAR) personnel.

**Summary of Expected Accomplishments by June 30, 1987**

1. To have available a working model of a system which utilizes aggregate time series data from a multispecies fishery. To provide documentation and test data for the program.
2. To have available and published a working set of about 40 computer programs being used, designed for use in tropical developing countries.
3. To have cooperative research projects in place at the Marine Science Institute and the College of Fisheries, University of the Philippines, which permit effective transfer of information and effective coordination.
4. To have suitable manuscripts on the empirical model and uses of its applications prepared for publication in a professional journal on fisheries.

**Summary of Objectives and Work Plans for July 1, 1987 - June 30, 1988**

The objectives and work plan for the period will be an extension and refinement of research which has been initiated during the previous year. It is believed that the empirical testing of programs and a multispecies model will result in modifications to some of the work during the 1987-88 period. Another visit to the Philippines by the Principal Investigator to coordinate activities and to assess the previous work is anticipated in the late summer of 1987. The visit will also allow active information transfer through lectures at the University of the Philippines.



**WORK PLAN 1986 - 1987**

- Project Name:** MULTISPECIES FIELD STUDIES
- Host Country:** Philippines
- Host Country Lead Institution:** Marine Science Institute, University  
of the Philippines (UPMSI)
- Host Country Principal Investigator:** Dr. Edgardo D. Gomez (UPMSI)
- Other Participating Host Country Institutions:** International Center for  
Living Aquatic Resources  
Management (ICLARM), and  
Bureau of Fisheries and  
Aquatic Resources (BFAR)
- Host Country Associate Investigators:** UPMSI Staff, and  
Dr. Dan Pauly (ICLARM)
- United States Lead Institution:** The University of Rhode Island (URI)
- United States Principal Investigator:** Dr. Saul B. Saila (URI)
- Other Participating U.S. Institutions:** None
- United States Associate Investigators:** Dr. John McManus (URI) and  
Dr. Conrad W. Recksiek (URI)
- United States Research Assistants:** Mr. Alejandro Acosta (URI)  
Mr. Ralph Turingan (URI)
- Research Locations:** Universities of the Philippines and Rhode Island
- Project Objective:** Develop and validate techniques for estimating  
fishery productivity and potential in reef and shoreline  
fisheries based on field studies. The major approaches in  
the field program will be 1) visual assessments to  
determine the composition and variability of the fish  
communities, and 2) sampling studies using fish traps and  
gill nets as assessment tools.

## WORK PLAN BY QUARTER 1986 - 1987

July 1 - September 30, 1986

1. Dr. McManus at Marine Science Institute Marine Laboratory, Bolinao, Pagasinan.

Phase I Taxonomy: Identification of common fish species through market surveys and field sampling; establishment of reference collection; specimen shipments to museums for identifications.

Sampling site selections, mapping, and fishing effort studies: Begin process of establishing monitoring sites for in situ studies, using SCUBA and visual assessment methodologies, of changes in community composition over time; prepare for initial surveys and reef cartography; initiate studies of quantifying fishing effort.

Dr. McManus will be assisted in taxonomy by Dr. Recksiek and Mr. Turingan; in the field he will be assisted by Dr. Recksiek and Messrs. Turingan and Acosta.

2. Dr. Recksiek at Marine Science Institute, Bolinao, Pangasinan.

Gill net and fish trap sampling: Initiate and carry out fish trap (pot) and gill net species selectivity studies: construct sampling gear, establish sites, carry out experimental designs to quantify gear performance.

Stock assessment technique development: Develop specialized techniques to tag reef and reef flat fishes with a view toward establishing home ranges, and growth, mortality and recruitment parameters.

Dr. Recksiek will initiate these studies and depart July 17, 1986 (having arrived with Messrs. Acosta and Turingan on May 21, 1986). Messrs. Turingan and Acosta will continue this work through September 30, 1986. Dr. McManus

will assist with field work and taxonomic problems.

**October 1 - December 31, 1986**

1. Dr. McManus at Marine Science Institute, Bolinao, Pangasinan.

Phase II Taxonomy: Comprehensive identification of local fish and associated organisms to stabilize resource related classifications and permit consolidation of published data and field observation by species.

Sampling sites, mapping, and fishing effort studies: Continue process of establishing monitoring sites and initiate long-term monitoring protocols; initiate surveys and cartography (including aerial survey methods if ultralight aircraft becomes available in the field); begin data collection in fishing effort studies.

2. Dr. Recksiek at URI.

Gill net and fish trap sampling: Document experience of prior quarter; design follow-up studies for winter quarter field work.

**January 1 - March 31, 1987**

1. Dr. McManus at Marine Science Institute, Bolinao, Pangasinan.

Phase II Taxonomy: Continued from previous quarter.

Sampling sites, mapping, and fishing effort studies: Continue and modify as appropriate long-term monitoring of sampling sites; continue cartographic work; establish fishing effort data collection protocols; consider assessing recruitment dynamics through field experiments.

2. Dr. Recksiek at Marine Science Institute, Bolinao, Pangasinan.

Stock assessment technique development: conduct follow-up studies on gill net and fish trap performance (based upon earlier work); attempt to

quantify relationships between gear selectivity and 'sampling zone' of scientific sampling year; continue efforts to establish stock recruitment dynamics through field experiments.

Drs. Recksiek and McManus will assist each other on the various field projects. A yet-to-be-named research assistant from URI may participate in these field studies.

#### April 1 - June 30, 1987

1. Drs. McManus and Recksiek at Marine Science Institute, Bolinao, Pangasinan.

Continue tasks outlined in previous winter quarter, modifying approaches as appropriate.

#### Summary of Expected Accomplishments by June 30, 1987

1. To have preliminary reports on fish trap and gill net studies drafted and evaluated. To determine the initial feasibility of fish trap and gill net sampling as indices of relative reef fish productivity.
2. To provide a preliminary evaluation of reef fish tag and recapture methodology for estimating growth and recruitment rates, as well as for population assessment.
3. To have prepared manuscripts for publication on methodologies under development, such as growth measurement, productivity assessment, and community stability.
4. To have developed some form of fishery effort and distribution of effort surveys for the Bolinao region.
5. To have resolved many of the current taxonomic problems, so that effective identification is possible for the vertebrate and invertebrate communities in

the Bolinao area. This is a requirement for effective community level studies.

**Summary of Objectives and Work Plans for July 1, 1987 - June 30, 1988**

It is anticipated that the objectives and work plans for this period will be an extension of work initiated primarily at the Bolinao Field Laboratory and projects initiated at the College of Fisheries and Marine Sciences Center.

More specifically, it is believed that development of a first-order index of reef and reef-flat relative productivity should be completed.

Coordination of field studies with ICLARM and perceived needs by the University of the Philippines and perhaps the Bureau of Fisheries and Aquatic Resources should result in the later phases of field research being closely related to important fisheries management problems in the Philippines.

**PROGRAM COORDINATION**

J. McManus, stationed in the Philippines, and ICLARM are both working on both projects and are thus able to provide some coordination of activities. A Coordinating Committee composed of J. McManus, E. Gomez (UPMSI) and J. Carreon (UPVCF) provides regular review of research efforts and project and publications coordination. Plans have been instituted to meet regularly with representatives of the Bureau of Fisheries and Aquatic Resources, the Philippines Council for Agriculture and Resources Research and Development (PCARRD), and the USAID Rainfed Resources Project.

**SUMMARY OF EXPECTED TRAINING**

There is a virtually continuous training component in the field studies segment of the URI subcontract. The reason for this statement is that Dr. John McManus is continuously posted at the Bolinao Field Station where interaction on a daily basis with Philippine counterparts and junior colleagues results in a form of on-the-job training for them. In addition to this informal training, both the field studies segment and the empirical modeling segment have formal training components. Dr. McManus is formally committed to spending approximately 10 percent of his time as a training officer at the Marine Sciences Center of the University of the Philippines as well as at the College of Fisheries, Quezon City. Dr. Conrad Recksiek, who is now in the Philippines, is also providing some formal training during the 2nd and 3rd quarters of 1986 at Bolinao and at the College of Fisheries.

A very vital preliminary phase of our collaborative training program has been the dissemination of diskettes containing fisheries stock assessment related programs to both institutions at the University of the Philippines and to ICLARM. Dr. McManus and Dr. Recksiek are both involved in training University of the Philippines personnel in the effective use of these programs and in obtaining comments from ICLARM.

In addition to the above, Dr. Saila has made arrangements to accept one member of the faculty of the University of the Philippines for overseas graduate training at the University of Rhode Island. Finally, Dr. Saila is expected to assist in further training during his projected trip to the Philippines in September-October of 1986.

## PRELIMINARY TRAVEL PLANS 1986 - 1987

<u>Name</u>	<u>From/To</u>	<u>Dates</u>	<u>Purpose</u>
A. Acosta	Philippines/R. I.	9/30/86	Return to U.S. from Philippines
R. Turingen	Philippines/R. I.	9/30/86	Return to U.S. from Philippines
S. Saila	R.I./Philippines	9/29/86- 10/31/86	Collaborate Research Efforts
S. Saila	Philippines/Thailand and Indonesia	10/20/86- 10/30/86	Provide Training Program Initiate Collaborative Data Sharing
J. McManus	Philippines/Thailand and Indonesia	10/20/86- 10/30/86	Provide Training Program Initiate Collaborative Data Sharing
C. Recksiek	R.I./Philippines	Winter- Spring/87	Conduct Collaborative Research and Training
UPMSI Staff Member	Philippines/R.I.	Fall/1986	URI Graduate Training
UPMSI Staff Member	Philippines/R.I.	Dates Undetermined	Project Coordination
UPVCF Staff Member	Philippines/R.I.	Dates Undetermined	Project Coordination



**MANAGEMENT ENTITY****MEETING AND TRAVEL PLANS****Planned CRSP Meetings:**

1. Technical Committee Meeting, July 17-18, 1986, Kingston, R.I. This meeting will review the CRSP Work Plans and objectives, consider alternative reprogramming and rebudgeting options for conducting the CRSP research program on a reduced, \$800,000 per year budget (rather than the initially approved \$1,000,000 per year budget), and recommend several reprogramming options for consideration by the Board of Directors.
2. Board of Directors Meeting, August 4, 1986, Chicago, Ill. This meeting will consider CRSP reprogramming and rebudgeting alternatives suggested by the Technical Committee, and will set the future directions for the CRSP.
3. Technical Committee Meeting, Spring-Summer, 1987 (tentative). This tentative meeting will review the technical work of the CRSP and coordinate the preparation of the Annual Work Plan for year-3 of the program, 1987-88, and the Annual Report for 1986-87. Early discussions suggested this meeting might be held in the Philippines, but budget considerations may require holding it in the U.S.

**Tentative Travel Plans:**

<u>Name</u>	<u>From/To</u>	<u>Dates</u>	<u>Purpose</u>
J. Rowntree (Program Dir.)	MD/R.I.	7/16/86- 7/19/86	Attend Technical Committee Meeting
V. Gallucci	WA/R.I.	"	"
K. Tenore	MD/R.I.	"	"
C. Stagg	MD/R.I.	"	"

Management Entity		Meeting and Travel Plans	
<u>Name</u>	<u>From/To</u>	<u>Dates</u>	<u>Purpose</u>
M. Murillo	Costa Rica/MD and R.I.	7/12/86- 7/20/86	Attend Technical Committee Meeting
E. Gomez	Philippines/R.I.	7/13/86- 7/20/86	"
<hr/>			
J. Rowntree	MD/Chicago	8/4/86	Attend Board Meeting
G. Donovan	R.I./Chicago	"	"
I. Morris	MD/Chicago	"	"
R. Stickney	WA/Chicago	"	"
P. Larkin	British Columbia/ Chicago	"	"
<hr/>			
J. Rowntree	Location of Meeting Undetermined	Spring/Summer, 1987 (Tentative)	Attend Technical Committee Meeting
V. Gallucci	"	"	"
B. Rothschild	"	"	"
S. Saila	"	"	"
M. Murillo	"	"	"
E. Gomez	"	"	"
External Evaluation Panel Member	"	"	"
<hr/>			
J. Rowntree	MD/Philippines	Fall, 1986	Field visit, contact host country counterparts, USAID Mission, etc.
External Evaluation Panel Member	?/Philippines	"	"
J. Rowntree	MD/Costa Rica	Spring, 1986	"
External Evaluation Panel Member	?/Costa Rica	"	"
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Management Entity

Meeting and Travel Plans

External Evaluation Panel Members and Program Director tentatively to visit participating U.S. institutions.

Program Director (J. Rowntree) and Board Chair (G. Donovan) tentatively to attend CRSP Directors' Meeting and Consortium for International Fisheries Research and Assistance Institutions (CIFRAI) meetings.