FISHERIES STOCK ASSESSMENT

Title XII Collaborative Research Support Program

ANNUAL WORK PLAN

1987 - 1988

CRSP Program Management Office
College of Agriculture
Office of International Programs
The University of Maryland
College Park, MD 20742

The Fisheries Stock Assessment CRSP
-- A Search for New Methods

ANNUAL WORK PLAN, 1987 - 1988

Introduction

This document presents the Annual Work Plan for the period July 1, 1987 - June 30, 1988, 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 third 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 coooperation. 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 1987-88 on a quarter-by-quarter basis. This is followed by brief sections on program coordination, training, and expected international travel requirements.

WORK PLAN 1987 - 1988

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, and
2. Economic and Probabilistic Extensions of Standard Fisheries Models.

The principal host country institution collaborating on these two projects is UCR's Centro de 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 (UMCP-CBM) and by The University of Miami (UMiami); and additional collaboration on the Economic and Probabilistic Extensions of Standard Fisheries Models Project is being provided by The University of Delaware (UDelaware).

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

The 1987-1988 efforts will center on the publication of a book, consisting of an overview, an epilog, and chapters on (1) optimization techniques in fishery management, (2, simulation, (3) systems dynamics, and (4) merger of the previous three techniques with the CANOFISH system.

WORK PLAN 1987 - 1988

Project Name: MULTIPLE SPECIES FISHERIES RESEARCH

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. Jose Gracia (UCR)
Dr. Joseph Varilly (UCR)
Jorge Campos (UCR)
Eduardo Madrigal (Ministry of Agriculture)
J. C. Briceno (UCR)

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

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

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

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

United States Research Assistants: Cluney Stagg (UMCEES)
Gerard DiNardo (UMCEES)
Doug Levy (UMCP-CBM)
Hiren Trivedi (UMCP-CBM)
Jerald S. Ault (UMiami)
David Die (UMiami)
Victor Restrepo (UMiami)

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

Project Objective: To develop a better understanding of how multiple species fisheries influence the ecology and population dynamics of fish communities. Continued emphasis is placed on designing the components of CANOFISH, a decision support system with expert system features (DSS/ES), to study the

population dynamics and management of small-scale multiple species fisheries.

Specific Objectives for 1987 - 1988: Continuing work on the general project objectives, a new focus in the current year centers on preparing and publishing relevant chapters for a final report book detailing accomplishments at the midway point of the CRSP.

WORK PLAN BY QUARTER 1987 - 1988

July 1 - September 30, 1987

1. Continue refinement and enhancement of the DSS/ES (or CANOFISH) system to include:
   a) programming changes to improve appearance and presentation,
   b) programming changes to add robustness and greater error-recovery, and
   c) redesign of the ES knowledgebase to allow for easier addition of new components.
2. Complete manuscripts on the following:
   a) stochastic Markov Chain population model,
   b) continuum-distribution population dynamics,
   c) the application of the Analytical Hierarchy Process (AHP) to fisheries,
   d) inter- and intra-annual variability in the composition of catch in the Gulf of Nicoya corvina fishery, and
   e) physiologically structured models for fish stock dynamics (two papers).
3. Present manuscripts at annual American Fisheries Society (AFS) meetings on September 13, 1987, in Winston-Salem, North Carolina.
4. Continue development of fisheries database in Costa Rica along with specialized programs for routine reports.
5. Develop programs in Costa Rica for decision theory and stochastic dynamic programming.

October 1 - December 31, 1987

1. Continue refinement and enhancement of the DSS/ES (or CANOFISH) system to include:

a) programming changes to improve appearance and presentation,

b) programming changes to add robustness and greater error-recovery, and

c) redesign of the ES knowledgebase to allow for easier addition of new components.

2. Continue development of fisheries database in Costa Rica along with specialized programs for routine reports.

3. Develop programs in Costa Rica for decision theory and stochastic dynamic programming.

4. Begin preparation of manuscripts for book.

January 1 - March 31, 1988

1. Continue refinement and enhancement of the DSS/ES (or CANOFISH) system to include:

a) programming changes to improve appearance and presentation,

b) programming changes to add robustness and greater error-recovery, and

c) redesign of the ES knowledgebase to allow for easier addition of new components.

2. Continue development of fisheries database in Costa Rica along with specialized programs for routine reports.

3. Complete programs in Costa Rica for decision theory and stochastic dynamic programming.

4. Continue preparation of manuscripts for book.

April 1 - June 30, 1988

1. Finalize manuscripts and publish monograph.

WORK PLAN 1987 - 1988

Project Name: ECONOMIC AND PROBABILISTIC EXTENSIONS OF STANDARD FISHERY MODELS

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. Edison de Faria (UCR)
Jorge Campos (UCR)
Dr. Edwin Castro (UCR)
Dr. Ricardo Estrada (UCR)
Eduardo Madrigal (Ministry of Agriculture)

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

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

Other Participating U.S. Institutions: The University of Maryland-College Park-College of Business and Management (UMCP-CBM)
University of Delaware (UDelaware)

United States Associate Investigator: Dr. Lee Anderson (UDelaware)

United States Research Assistants: Cluney Stagg (UMCEES)
Chris Rogers (UDelaware)
Yang Gru (UDelaware)

Research Locations: UMCEES, UMCP-CBM, UDelaware, and UCR

Project Objective: To modify standard fisheries models to increase their utility to managers of small-scale fisheries.

Specific Objectives for 1987 - 1988: To incorporate components into CANOFISH.

To prepare and publish related manuscripts in final report book.

WORK PLAN BY QUARTER 1987 - 1988

July 1 - September 30, 1987

1. Continue refinement and enhancement of the DSS/ES (or CANOFISH) system to include:
    a) linkage of the 3-stage simulation model with CANOFISH and
    b) linkage of the "fishery-as-a-mine" model and other optimization procedures with CANOFISH.
2. Begin to incoporate Costa Rican fishery data into the 3-stage simulation model.
3. Begin to incorporate Costa Rican fishery data into the "fishery-as-a-mine" model.
4. Continue to examine the infrastructure of the fishery management sector in Costa Rica.
5. Present manuscripts at annual AFS meetings on September 13, 1987, in Winston-Salem, North Carolina.
6. Complete bibiliography of optimization models in fisheries.
7. Present a one-semester course at UCR on Optimization Techniques in Fisheries.

October 1 - December 31, 1987

1. Continue refinement and enhancement of the DSS/ES (or CANOFISH) system to include:
    a) continue linkage of the 3-stage simulation model into the 3-stage simulation model and
    b) continue linkage of the "fishery-as-a-mine" model and other optimization procedures into the CANOFISH.
2. Continue to incorporate Costa Rican fishery data into the 3-stage

simulation model.

3. Continue to incoporate Costa Rican fishery data into the "fishery-as-a-mine" model.

4. Continue to examine the infrastructure of the fishery management sector in Costa Rica.

5. Present a one-semester course at UCR on Optimization Techniques in Fisheries.

6. Begin preparation of manuscripts for book.

January 1 - March 31, 1988

1. Continue refinement and enhancement of the DSS/ES (or CANOFISH) system to include:

   a) complete linkage of the 3-stage simulation model into CANOFISH and

   b) complete linkage of the "fishery-as-a-mine" model and other optimization procedures into the CANOFISH.

2. Complete incorporation of Costa Rican fishery data into the 3-stage simulation model.

3. Complete incorporation of Costa Rican fishery data into the "fishery-as-a-mine" model.

4. Continue preparation of manuscripts for book.

April 1 - June 30, 1988

1. Finalize manuscripts and publish monograph.

Summary of Objectives and Work Plans for July 1, 1988 - June 30, 1989

Research in year 4 of the program will continue to focus on (1) further development of a full-scale implementable expert system for fishery

management, (2) development of new models and modification of existing techniques to optimization, systems dynamics and simulation in fisheries, and (3) full incorporation of the Gulf of Nicoya "model" fishery database into the DSS/ES and relevant models.

PROGRAM COORDINATION

Integration of the projects has been and will be maintained through regular exchange of manuscripts and travel by many of the researchers to meet with colleagues in the program. A second annual review meeting was held in Solomons, Maryland, in May, 1987, at which members from all institutions were present. A similar effort will be achieved in the coming year. This will include travel by several U.S. researchers to Costa Rica and to the the UMCEES/UCR session at the annual AFS meetings in September, 1987. Finally, full and complete coordination will be accomplished through the preparation and publication of the final report book.

SUMMARY OF EXPECTED TRAINING

Systematic training efforts will be continually involved in the interactions of the UMCEES and UCR researchers, particularly as the DSS/ES models are fitted to Costa Rica data. UCR will offer a course in Optimization Techniques in Fisheries.

PRELIMINARY TRAVEL PLANS 1987 - 1988

1. Jerry Ault to UCR in July-August, 1987 for two months to work with optimization group and on 3-stage simulation model.

2. Yang Gru to UCR in August, 1987 for three weeks to work on "fishery-as-a-mine" model with Costa Rican data.

3. Bruce Golden to UCR in August-September 1987 for 5 days to work with optimization group.

4. Cluney Stagg to UCR in August-September, 1987 for 10 days to work with Jerry Ault and Juan Chavarria on linkage of models to CANOFISH.

5. List of participants to present papers at the annual AFS meetings in September:

Brian Rothschild (Convenor)	UMCEES
Bruce Golden/Hiren Trivedi	UMCP-CBM
William Fox/Victor Restrepo	UMiami
Lee Anderson/Chris Rogers	UDelaware
Jorge Campos/Cluney Stagg/ Jose Chavarria/Eduardo Madrigal	UCR-CIMAR
Manuel Murillo	UCR-CIMAR
Cluney Stagg	UMCEES
Gerard DiNardo	UMCEES

6. Selected UMCEES researchers to visit UCR during 1988 to continue collaborative efforts and to facilitate program coordination.

WORK PLAN 1987 - 1988

University of Washington/University of Costa Rica Program

PROGRAM DESCRIPTION

The University of Washington (UW) in collaboration with The University of Costa Rica (UCR) 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 principle host country institution collaborating on these four projects is UCR's Centro de 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 (UDelaware).

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 to tropical, artisanal fisheries. The work involves the integration of various field, laboratory and theoretical studies.

A qualitative indication of the effects of the recent budget cuts for the UW/UCR CRSP components is as follows: The expected number of student research assistants was never attained. The expected acquisition of computer hardware and software has been curtailed, reducing the rate at which we could meet our originally stated goals. Travel to Costa Rica has been restricted to a bare minimum. In summary, the research has been slowed and some things put on hold for lack of people and other resources.

WORK PLAN 1987 - 1988

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: Ministry of Agriculture

Host Country Associate Investigations: Juan Chavarria (UCR-CIMAR)
Edwardo Madrigal (Ministry of Agriculture)

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

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

Other Participating U.S. Institutions: The University of Delaware (UDelaware)

United States Associate Investigators: Dr. Loveday Conquest (UW)
Dr. Lee Anderson (UDelaware)

United States Research Associate: Robert Burr (UW)

United States Research Assistants: Shi Quan Liao (UW)
Jose Orensanz (UW)
Christopher Rogers (UDelaware)

Research Locations: UCR, UDelaware, and UW

Project Objectives:

To develop statistical sampling methodology for the assessment of tropical fish stocks exploited via artisanal fisheries. Artisanal fish catches have been sampled at the ports of landing as well as on the "vessels at sea." These activities will continue, in conjunction with analyses of the acquired data. New sampling methodology will be tried in light of the analyses. Sampling in the field independent of the artisanal fishing activity has started and will continue. This latter sampling will be conducted both independently of, and in conjunction with hydroacoustic estimates of abundance. New developments in sampling methodology will continue to be

sought in order to improve stock assessment accuracy and efficiency. Sampling/assessment techniques will be integrated into a decision support system to assist tropical multispecies fisheries managers plan, execute and evaluate stock assessment sampling studies. An economics component (under Dr. Anderson) will continue to evaluate the utility of current stock and recruitment models for small-scale fisheries stock assessment and will develop new methodologies and economic extensions of these models to provide useful bioeconomic information.

WORK PLAN BY QUARTER 1987 - 1988

July 1 - September 30, 1987

1. Continue data transfer from UCR on fish catch tickets from the Ministry of Fisheries and interact with CIMAR to develop optimal data analysis approaches.
2. Continue data transfer and design additional experiments to increase data transfer from gill net surveys (scientific surveys).
3. Continue the transfer of data from fishing vessels on their catch when the fishery is open. Evaluate sampling design alternatives and continue analyses of data available.
4. Initiate Phase II of "A Decision Theoretic Framework for Sampling Designs and Analysis for Artisanal Fisheries Applications." Distribute Phase I.
5. Sampling for stock assessment:
    a. Identify a range of methodologies relevant to the specific sampling environment.
    b. Identify variables suitable for Bayesian estimation.
    c. Identify the economic (monetary) constraints involved in sampling and the relationship to variability of estimates.
6. Continue acquisition and preliminary analysis of spatial data on the distribution of fishing effort, by village location, fishing location, and vessel type.
8. Technical Reports and/or Working Papers:
    a. Complete Phase I of the sampling designs software (4. above) under the title "SAMPLE" (Burr, Vega, and Gallucci). Available via MAAF and CRSP.
    b. On the preliminary analysis of the landing data from the ongoing fishery (Campos, Orensanz, Conquest, and Burr).
    c. On alternative sampling designs for estimating catch from the

artisanal fleet (Campos, Liao, and Gallucci).

d. On the preliminary analysis of historical landing data from the records (Chavarria, Burr, and Conquest).

October 1 - December 31, 1987

1. Continue data transfer from UCR on:
   a. historical fish catch,
   b. the ongoing fishery, and
   c. the scientific survey data.
2. Continue development of software for the sampling of tropical multispecies fisheries.
3. Coordinate sampling design and spatial analyses with the hydroacoustics project.
4. Continue natural extensions of the work from preceding quarters.

January 1 - March 31, 1988

1. Continue the analyses of the data transferred from UCR to UW.
2. Field test alternative sampling methodologies.
3. Continue natural extensions of the work from preceding quarters.
4. Coordinate data collection with hydroacoustics project.

April 1 - June 30, 1988

Continue activities of previous quarter.

ECONOMICS COMPONENT

The economics component of the Sampling Catch Project is being carried out primarily by Dr. Lee Anderson (UDelaware) with the assistance of Christopher Rogers (UDelaware) and Yang Gru (UDelaware), and in collaboration

with the UCR-CIMAR research team. This component is being conducted under a subcontract with UDelaware 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 for the Economics Component by quarter for 1987-1988 is presented below.

July 1 - September 30, 1987

1. Continue expansion of the economic model to include related stocks.
2. Work with Costa Rican counterparts to continue the data flow necessary to test the model.

October 1 - December 31, 1987

1. Continue the activities of the previous quarter.
2. Adjust the model to fit other data bases.

January 1 - March 31, 1988

1. Begin technical report on expansion of model to other data bases.
2. Continue activities of previous quarter.

April 1 - June 30, 1988

1. Continue activities of previous quarter.

WORK PLAN 1987 - 1988

Project Name: AGE-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-CIMAR)

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: Han-Lin Lai (UW)
Jose Orensanz (UW)
Robert Burr (UW)

Research Locations: UCR and UW

Project Objectives:

To 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, once 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, and shifts in alternative gears).

WORK PLAN BY QUARTER 1987 - 1988

July 1 - September 30, 1987

1. Begin the application of catch-at-size analysis (CASA) to field data from artisanal fisheries. Expand the use of hydroacoustic data into the CASA model. Modify for microcomputer use.
2. Begin the application of MIX (a technique for separating overlapping distributions) to catch-at-size analyses where length of data are substituted for age data in tropical environments.
3. Continue development of the FERET (Fecundity and Recruitment Timing) component to describe and model the biomass inputs into the fishery.
4. Write and present the paper: "Small-Scale Fisheries in Latin America: perspectives on their management," by Gallucci and Murillo, at the 1987 annual American Fisheries Society meeting.
5. Complete and submit technical reports and publications of the following:
   a. "Effect of Variability on Estimates of Cohort Parameters Using Length-Cohort Analysis: with a guide to its use and misuse," by Lai and Gallucci.
   b. Complete documentation to be available via UW for the above analyses under the name "LCAN," by Lai and Gallucci.
   c. "Analysis of Benthic Time Series Data for Stock Assessment," by Gallucci, Lai, Orensanz.
   d. "Spatial and Temporal Dynamics of Recruitment in Soft Benthos: Perspectives on Management," by Orensanz and Gallucci.
   e. "A Comparative Study of Postlarval Life-History Schedules in Four Sympatric Cancer Species (Decapoda, Brachyura, and Cancridae): New Methods of Analysis," by Orensanz and Gallucci.
   f. Documentation of software for the above analyses under the name

"KRABS," by Burr, Orensanz, and Gallucci.

g. "Multispecies pseudo age-dependent analysis of species interaction for species with larval forms," by Gallucci, Granero-Porati, and Burr (tentative order of names).

h. "Analysis of characteristics of bottom trawl gear in conjunction with hydroacoustics in shallow, muddy bays," by Donnelly and Campos.

6. Review drafted manuscripts for working papers and technical reports from other CRSP project components. At this time:

a. "An Empirical Approach to Multispecies Stock Assessment," by Saul B. Saila and Karim Erzini.

b. "Geometric Programming Applied to Some Optimal Harvesting Problems," by Saul B. Saila and Karim Erzini.

c. "A Comparison of the Relationship between Optimal Harvesting Strategies & Reproductive Values in Four Marine Species with Different Life History Characteristics," by Saul B. Saila and Karim Erzini.

d. "The Significance of Physiologically Structured Models for Fish Stock Dynamics," by Jose M. Gracia-Bondia and Joseph C. Varilly.

October 1 - December 31, 1987

1. Begin technical report on catch-at-size analysis (CASA).
2. Apply CASA to Costa Rican data.
3. Continue the activities of the previous quarter.
4. Begin analysis of floating gillnet-hydroacoustic data.

January 1 - March 31, 1988

1. Begin analysis of fecundity data collected by UCR.
2. Begin the application of MIX to the catch-at-age analysis where length data are substituted for age data.

3. Complete technical report on CASA.

4. Continue other activities from above.

April 1 - June 30, 1988

1. Continue the evaluation of MIX to the catch-at-size analyses where length data are substituted for age data.

2. Continue the analyses of fecundity data.

3. Begin a technical report on the application of MIX to the catch-at-age analyses where length data are substituted for age data.

4. Continue activities of previous quarters as needed.

WORK PLAN 1987 - 1988

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-CIMAR)

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: UCR and UW

Project Objective:

1) To develop age determination methodology for tropical fish and invertebrates. 2) To 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) To develop an age determination laboratory at UCR that may later serve regional fishery agencies in Latin America. 4) To validate age determination techniques.

WORK PLAN BY QUARTER 1987 - 1988

July 1 - September 30, 1987

1. Purchase a WILD M-8 microscope for CIMAR.
2. Continue the development of ageing techniques for, and the ageing of, corvina and corvina-like species of fish.
3. Complete technical reports and manuscripts for publication:
   a. "Optimum Allocation for Estimating Age Composition Using Age-Length Key," by Lai.
   b. Users' Guides:
      1. "AGECOMP" = Age Composition and Optimum Allocation Using Age-Length Key
      2. "LMORT" = Estimation of Mortality from Length Frequency Data.
   c. "Analysis of Ageing Reliability from Different Bony Structures for Pacific Cod," by Lai, Gunderson, and Low.
   d. "A Time Series Analysis Approach to Studying Microstructure in Fish and Invertebrates," by Lai, Adlerstein, and Gallucci; and the associated software entitled "TSAMICRO" (tentative) to be available via UW.
   e. "Effects of Ageing Errors on Estimates of Growth, Mortality and Yield Per Recruit for Walleye Pollock," by Lai and Gunderson.
4. Continue field collections for age-length data.
5. Continue integration with FERET component to relate size, age, and recruitment timing and condition.

October 1 - December 31, 1987

1. Continue analysis of age data on two corvina species--Corvina phoxocephalus and Corvina albus.

2. Continue field collections for age-length data.

3. Continue validation, error propagation, and optimal sampling studies.

January 1 - March 31, 1988

1. Begin a technical report on age determination methodology (tentative title: "Age Determination Methodologies for Some Tropical Fishes") by Lai and Campos).

2. Begin technical report on the ageing of Corvina phoxocephalus and Corvina albus, by Lai and Campos.

3. Continue previous quarter's activities where appropriate.

April 1 - June 30, 1988

1. Complete the technical reports.

2. Continue field collections for age-length data.

3. Begin development of a Regional Center for ageing of fish at CIMAR by H. Lai visiting Costa Rica.

WORK PLAN 1987 - 1988

Project Name: SHALLOW WATER HYDROACOUSTICS

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-CIMAR)

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 Research Assistants: John Hedgepeth

Research Locations: UCR and UW

Project Objectives:

To 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 a 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 1987 - 1988

July 1 - September 30, 1987

1. John Hedgepeth will spend about 3 weeks in Costa Rica collecting data on wet season fish distribution.

2. Integrate local fishermen's knowledge with hydroacoustic surveys of the Gulf of Nicoya.

3. The following papers were presented at the 1987 International Symposium on Fisheries Acoustics. Revised manuscripts will be submitted as CRSP technical reports or working papers:

   a. "The Use of Stationary Hydroacoustic Transducers to Study Diel and Tidal Influences on Fish Behavior," by Thorne, Hedgepeth, and Campos.

   b. "Hydroacoustics and Ground Truth," by Thorne.

   c. "Diel and Tidal Influences on the Behavior of Fish in the Gulf of Nicoya, Costa Rica," by Thorne, Hedgepeth, and Campos.

4. Present the following manuscripts at the American Fisheries Society meeting in Winston-Salem, North Carolina:

   a. "Hydroacoustics as a tool for the study of fish behavior," by Richard Thorne.

   b. "Some impacts of technology on future fisheries management," by Richard Thorne.

October 1 - December 31, 1987

1. Begin analysis of data collected during the previous quarter.

2. Dr. Thorne will present the following paper at the Fourth International Conference on Artificial Habitats for Fisheries, in Miami, Florida: "Hydroacoustic observations of fish abundance and behavior around an artificial reef in Costa Rica," by Thorne, Campos, and Hedgepeth.

January 1 - March 31, 1988

1. Prepare a technical report on the computerized method of hydroacoustic data analysis entitled: "Using a digitizer with ecograms: spatial resolution and errors," by Hedgepeth.
2. Dr. Thorne and John Hedgepeth will travel to Costa Rica to collect data on dry season fish abundance and behavior for the second year.
3. Papers given at the American Fisheries Society and Artificial Habitats for Fisheries meetings will be prepared for publication.

April 1 - June 30, 1988

1. Begin data analysis on the data collected during the previous quarter.
2. Continue working on technical reports with a focus on the methodology to be used in shallow water embayments such as the Gulf of Nicoya.

PROGRAM COORDINATION

The four UW/UCR research projects are sufficiently complex to justify a general description of each. The objectives and methods employed in each project are complementary, however, so the data developed in one has multiple uses in other components.

The UW/UCR program is coordinated with the UMCEES program, which is also collaborating with UCR and UDelaware.

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

July 1, 1987 - June 30, 1988

1. Early data from field samples for all components will be made available for 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 continue to have priority to compensate for the liabilities of using the postal service.
3. Dr. Gallucci's research, teaching, and advisory roles in Peru and Argentina will contribute to the "regionalization" of our program's efforts.
4. Continue working on the handbook on the management of artisanal tropical fisheries that this CRSP will produce.
5. Systematics Project: Continue to 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.

SUMMARY OF EXPECTED TRAINING

In the following, professional interaction and development are included among the training activities.

1. Symposia:

   UCR/CIMAR scientists will participate in the following symposia and/or workshops.

   a. Annual American Fisheries Society meeting, September, 1987 (Murillo and Gallucci).

   b. Fourth International Conference on Artificial Habitats for Fisheries, October, 1987 (Campos, Hedgepeth, and Thorne).

   c. Ninth Biennial International Estuarine Research Congress, October, 1988 (Murillo).

   d. MAAF-UW Short Course "On the Management of Artisanal Fisheries, Seattle, Washington, September-October, 1988 (Chavarria and Donato).

   e. Workshop on Stochastic Processes, Center for Interdiscipinary Research, Universit at Bieleferld, Germany, November-December, 1987 (Murillo).

2. Interactions leading to enhanced skills:

   a. Construction of a facility for age determination.

   b. Development of techniques for doing spatial analysis and Bayesian sampling.

   c. Expansion of awareness of fisheries management concepts and methodology.

3. The short course "On the Management of Artisanal Fisheries," taught by Gallucci, Orensanz, and Parma of UW in September-October, 1987, will be attended by 2 persons from CIMAR, 2 from Peru, 2 from Chile, 6 from Argentina, 1 from Panama, 3 from Africa, and 3 from Italy.

PRELIMINARY TRAVEL PLANS 1987 - 1988

July 1 - September 30, 1987

1. R. Thorne (UW) to Winston-Salem, North Carolina to present a paper at the annual American Fisheries Society meeting, September 13-16, 1987.
2. J. Hedgepeth (UW) to CIMAR for wet season sampling, on the hydroacoustics project.
3. V. Gallucci (UW) and M. Murillo (UCR) to meet for project planning in September in Los Angeles.

October 1 - December 30, 1987

1. R. Thorne (UW) and J. Campos (UCR) to travel to Miami Florida to present a paper at Fourth International Conference on Artificial Habitats for Fisheries.
2. M. Murillo (UCR) to travel to Germany for Workshop on Stochastic Processes, November-December, 1987.

January 1 - March 31, 1988

1. V. Gallucci (UW) to CIMAR for sampling and program coordination.
2. R. Thorne (UW) and J. Hedgepeth (UW) to CIMAR for dry season sampling on hydroacoustics project.

April 1 - June 30, 1988

None.

The duration and specific timing of visits will depend upon events and funds. Visits by V. Gallucci would focus on general UW/UCR program coordination, UW-UMCEES coordination, UW subcontract to UD and, in detail, upon the four UW/UCR components.

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

WORK PLAN 1987 - 1988

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 Analyses and Modeling
2. Multispecies Field Studies

The principal host country institution collaborating on the Empirical Analyses and Modeling Project is The University of the Philippines in the 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 the USAID/ASEAN Coastal Resources Management Program (CRMP), 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 1987 - 1988

Project Name: EMPIRICAL ANALYSES AND MODELING

Host Country: Philippines

Host Country Lead Institution:
College of Fisheries, The University of the Philippines in the Visayas (UPVCF)

Other Participating Host Country Institutions:
International Center for Living Aquatic Resources Management (ICLARM)
Bureau of Fisheries and Aquatic Resources (BFAR)
Marine Science Institute, The University of the Philippines (UPMSI)

Host Country Principal Investigator: Dr.Sonia S. Formacion (UPVCF)

Host Country Associate Investigators:
Dr. Daniel Pauly, Senior Scientist (ICLARM)
Prof. Geronimo T. Silvestre, M.S., Scientist (UPVCF)
Prof. Ricardo R. Federizon, M.S. Department Head (UPVCF)
Mr. Victor C. Sambilay, Research Assistant (UPVCF)

Other Participating Country Institutions:
Research Institute for Marine Fisheries of the Agency for Agricultural Research and Development, Republic of Indonesia (Dr. Nurzali Naamin, Director)
Division of Marine Fisheries of the Department of Fisheries, Thailand (Boonlert Phasuk, Director)

United States Lead Institution: The University of Rhode Island

United States Principal Investigator: Dr. Saul B. Saila (URI)

Other Participating U. S. Institutions: None

United States Associate Investigators:
Dr. Conrad Recksiek, Scientist (URI)
Dr. John W. McManus, On-Site Scientist in the Philippines (URI)

United States Research Assistants:
Mr. Karim Erzini, M.S., Research Assistant II (URI)
Ms. Xiu Chen, Research Assistant III (URI)

Research Locations:
The University of the Philippines in the Visayas, College of Fisheries
The University of 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 of tropical fish stocks. A major emphasis is on the analysis and prediction of catch composition.

Specific Objectives for 1987 - 1988:

1. To continue research into new applications of stochastic modeling directed towards improving the management of tropical multispecies fisheries.
2. To complete comparative analyses of the community structures of the JETINDOFISH survey data from the southern Indonesian shelf, the Taiwanese trawl data from the northwest Australian shelf, the CSIRO research trawl data from the same region, the Ragay Gulf survey data of the UPVCF in the Philippines, and selected data sets from Thailand.
3. To continue to compile and analyze existing fishery data from various agencies in the Philippines to detect fishery trends useful in the management of these and other tropical fisheries.
4. To produce a user-friendly package of programs for community structure analysis of fishery and ecological data on microcomputers.
5. To initiate studies into the relationships between reproductive cycles and recruitment patterns derived from length-frequency analyses of selected soft-bottom commercial fish species.
6. To train Philippine researchers in modern approaches to fisheries and ecological analysis methods, including methods developed within the CRSP, in the context of semesteral courses offered at the University of the Philippines.

WORK PLAN BY QUARTER 1987 - 1988

July 1 - September 30, 1987

1. Investigate existing applications of stochastic modeling and related analytical approaches in other fields to determine which might be adaptable to fishery situations.
2. Complete community analyses of the Indonesian JETINDOFISH data on TWINSPAN and Decorana programs previously converted to use on microcomputers.
3. Assemble and analyze under-utilized existing data from the Philippine Bureau of Fisheries and Aquatic Resources (BFAR), the Bureau of Agricultural Economics, the Bureau of Agricultural Statistics, and the Philippine Fisheries Development Authority.
4. Continue work on the development of a flexible community analysis program based on the Ordered Similarity Matrix Analysis approach.
5. Analyze existing data on length-frequencies and maturity stages of 13 selected species for which a substantial data base exists in studies from the Ragay Gulf, Burias Pass, Ticao Pass, Samar Sea, and Carigara Bay of the Philippines.
6. Continue teaching a semester course at the University of the Philippines on applied community ecology and population biology approaches to fisheries and ecological management.

October 1 - December 31, 1987

1. Continue developing new modeling approaches for tropical fisheries management and producing appropriate microcomputer programs for dissemination to LDC fishery scientists.
2. Complete community analyses of Australian and Taiwanese trawl and survey data subsets. Compare results with those of Indonesia and the Philippines.

3. Continue length-frequency, catch-effort, and community structure studies of existing Philippine data sets.

4. Make user-friendly modifications to all existing community analysis programs being used for the international comparative analyses of trawl data for dissemination to CRSP collaborating agencies.

5. Evaluate results of recruitment vs. reproduction studies based on existing data to determine the need for obtaining more field samples of these or other species. Begin field sampling as appropriate.

6. Begin teaching a semester course in Community Ecology Concepts with an emphasis on approaches to community level fisheries management.

7. Implement a one-week training program in fish stock assessment October 16 - 23, 1987 at the UPVCF campus in Miagao, Iloilo.

January 1 - March 31, 1988

1. Continue developing new modeling approaches to tropical fisheries management. Publish and disseminate applications programs as available.

2. Obtain additional multispecies fishery data sets from Thailand, Indonesia, and elsewhere to confirm trends and patterns identified in previous analyses of Southeast Asian data which have value for management.

3. Obtain other data sets in Philippine agency files. Begin comparing overlapping data sets to determine error factors involved in estimation for management related trends.

4. Add supplemental computer programs to the community analysis package and begin preparing it for general distribution.

5. Continue field sampling of selected species for recruitment vs. reproduction studies.

6. Continue course on Community Ecology Concepts relevant to fisheries management. Compose a manuscript on this subject based on a literature review

and developments within the CRSP activities.

April 1 - June 30, 1988

1. Continue developing new stochastic modeling approaches, new programs, and preparing these for general distributions.

2. Assimilate all information obtained thus far from comparative analyses of Southeast Asian trawl data sets into a manuscript with management recommendations.

3. Assimilate all known information on the Philippine fisheries into a general review of the results obtained from the CRSP data analyses.

4. Finalize a community ecology data analysis package for general distribution, using the IBM microcomputer format. Prepare associated manuscripts and announcements.

5. Continue sampling for the recruitment vs. reproduction study. Evaluate preliminary results to produce guidelines for continuance into the second year of this sampling program.

6. Begin a new course in Applied Community Analysis and Population Biology at the University of the Philippines incorporating new methods as available from the CRSP. Incorporate training in the new community analysis package, and old and new versions of the URI-CRSP Fisheries Statistics Applications Systems (FSAS).

Summary of Expected Accomplishments by June 30, 1988

1. To have a tested set of user-friendly microcomputer programs facilitating a variety of stochastic modeling analyses, for distribution to LDC fishery researchers.

2. To have prepared a manuscript summarizing trends and patterns of management significance identified in community structure analyses of existing

trawl data sets from the Southeast Asian Region.

3. To have a series of papers and a review manuscript covering aspects of the fisheries of the Philippines brought to light in comparative analyses of all available data sets.

4. To have a user-friendly package of programs available to facilitate community-level analyses of fisheries and other ecosystems, for distribution to LDC fishery and environmental managers.

5. To have a preliminary analysis of data on recruitment vs. reproduction in selected soft-bottom fishes from both existing and field gathered data.

6. To have trained at least 30 Philippine researchers in fisheries and ecological analysis methods developed and adapted within the CRSP.

WORK PLAN 1987 - 1988

Project Name: MULTISPECIES FIELD STUDIES

Host Country: Philippines

Host Country Lead Institution:
Marine Science Institute, The 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),
Bureau of Fisheries and Aquatic Resources (BFAR), and
College of Fisheries, The University of the Philippines in the Visayas (UPVCF)

Host Country Associate Investigators:
Dr. Daniel Pauly Senior Scientist (ICLARM)
Mr. Wilfredo L. Campos, M.S., Research Associate (UPMSI)
Ms. Annabelle G.C. del Norte, M.S., Senior Research Assistant (UPMSI)
Mr. Naniel V. Aragones, Senior Research Assistant (UPMSI)
Mr. Philip A. Roa, Senior Scientific Program (UPMSI)
Mr. Ruben C. Garcia, Senior Scientific Engineer (UPMSI)
Mr. Cleto L. Nanola, Research Assistant (UPMSI)
Ms. Clarissa C. Arida, Research Assistant (UPMSI)
Ms. Mary Janeth P. Poot, Research Assistant (UPMSI)
Mr. Wilnorie P. Rasay, Research Assistant (UPMSI)
Mr. Rodolfo Reyes Jr., Research Assistant (UPMSI)
Mr. Miguel P. Miguel, Research Assistant (UPMSI)
Mr. Jesse Cabansag, Research Aide (UPMSI)
Also members of the U.S. AID/ASEAN Coastal Resources Management Program (CRMP) working collaboratively with the CRSP.

United States Lead Institution: The University of Rhode Island (URI)

United States Principal Investigator: Dr. Saul B. Saila

Other Participating U.S. Institutions: None

United States Associate Investigators:
Dr. John W. McManus, On-Site Scientist in the Philippines (URI)
Dr. Conrad W. Reckseik, Scientist (URI)
Mr. Kim Richardson, Voluntary Landsat Research (URI)

United States Research Assistants:
Mr. Alejandro Acosta (URI)
Mr. Ralph Turingan (URI/UPVCF)

Research Locations: The University of the Philippines
The University of Rhode Island

Project Objectives:

1. To produce at the end of the five-year CRSP one or more chapters in a book of methods for multispecies stock assessment, a summary of existing methods for assessing and managing shallow water (principally coral reef) multispecies fisheries, in conjunction with methods tested and developed by our own research team.

2. To assess the impact of fishing pressure relative to other factors influencing the abundances and distributions of fish species across a heterogeneous coral reef system and the variations in a community structure over a three-year period.

3. To obtain general information as to the relationship between the catch composition yielded by each of several important small-scale fishing gears and the composition of the fish community being exploited.

4. To assess the relationship between catch composition, standing stock, and fishery production in a variety of shallow water fish habitats.

5. To determine to what extent the catch composition and fishery production of a coastline can be predicted from habitat information obtained from satellite imagery, aerial photographs from low-cost aircraft, chart information, bathymetry, and environmental parameters obtained from site sampling.

6. To disseminate this information to countries involved in multispecies fisheries management, including the United States and developing countries.

7. To develop within the host country collaborating institution the capability to continue independently to investigate and to refine the assessment and management approaches which are developed within the CRSP.

Specific Objectives for 1987 - 1988:

1. To classify the major fish habitats in the Bolinao, Philippines study area using remote sensing and ground truth survey methods, to assess the areal extent of each habitat, and to determine the dominant biota associated with each.

2. To determine the commercially and nutritionally important fishes associated with each habitat, their relative abundances, and their variability over the year.

3. To identify the major small-scale fishery gear associated with each habitat, and to assess the catch per unit effort and catch compositions obtained by gear and habitat type.

4. To determine the levels of exploitation of representative fish species in each habitat to determine the degree of over- (or under-) fishing by length-frequency analysis.

5. To initiate regular sampling of the fishing activities and fish compositions by habitat to be continued until project completion for the evaluation of interannual variability and the extrapolation of results to remote-sensing based on broad area fishery potential yield estimates.

6. To develop and evaluate field and analytical methods which are useful for the management of shallow-water small-scale fisheries, including low cost methods for habitat mapping and fishing effort determination by aerial surveys.

7. To determine the relationships between length-frequency based recruitment estimates and reproductive stage in selected coral reef fish.

WORK PLAN BY QUARTER 1987 - 1988

July 1 - September 30, 1987

1. Continue refining habitat discrimination in Bolinao satellite image analysis, particularly with respect to the isolation of the effects of depth from those of bottom cover.
2. Continue developing the ultralight aircraft as a low-cost tool for marine habitat mapping, ground truthing, and the determination of small-scale fishing effort relative to available fish habitats.
3. Develop and test a low-cost television transmitter suitable for guiding a remote controlled aircraft along a preset aerial photography transect relative to position and scale markers placed along a route. Construct a remote control trainer aircraft for training in landing and take-off procedures.
4. Expand ongoing fishery monitoring to include a representative sampling of the fisheries of the Bolinao area. Both length-frequency and catch composition data will be obtained. Initiate in-situ sampling of fish in each major habitat type.
5. Initiate studies of the reproductive patterns of selected coral reef fishes relative to recruitment period predictions available from length-frequency data analyzed on the ELEFAN programs.

October 1 - December 31, 1987

1. Develop software to facilitate specifically the computer analyses which have been most effective in discriminating fish habitat types in satellite imagery. Develop software for the analysis of aerial photographs of shallow water habitats, particularly with respect to distinguishing, enhancing, and quantifying features likely to be important in determining fish distributions.
2. Conduct regular sampling of fishing effort using aerial surveys and sea-

level boat counts.

3. Build a remote controlled aircraft capable of carrying the TV camera, transmitter, and still camera.

4. Continue sampling of fish compositions in selected habitat types, and the associated fisheries.

5. Continue length-frequency and reproductive index studies of selected coral reef fish species.

January 1 - March 30, 1988

1. Continue image analysis research and extend into studies of the feasibility of computerized stereo analysis of underwater features for height and improved size measurements.

2. Continue fishing effort surveys.

3. Develop a protocol for use of the remote-controlled aircraft for aerial photography surveys.

4. Continue sampling of fish compositions in selected habitat types, and the associated fisheries.

5. Continue length-frequency and reproductive index studies of selected coral reef fish species.

April 1 - June 30, 1988

1. Begin developing a package of programs for image analysis of underwater marine habitats to supplement commercially available microcomputer image analysis systems.

2. Continue fishing effort surveys.

3. Continue refining the methodology for remote-controlled aerial surveys of fish habitats.

4. Continue sampling fish compositions and fishery productions by habitat

and gear. Prepare initial reports for presentation at the 6th International Coral Reef Congress scheduled for Australia in August 1988.

5. Continue length-frequency and reproductive index studies of selected coral reef species. Begin preliminary data analyses to determine whether or not procedural changes are desirable prior to continuation to achieve a two-year data set.

Summary of Expected Accomplishments by June 30, 1988

1. To have a preliminary version of a package of computer programs designed to facilitate image analysis of satellite and stereo aerial photographs to facilitate the classification of fish habitats in shallow waters.

2. To have modified an ultralight aircraft, to have developed a protocol for systematic surveys of fishing effort in shallow water areas, and to have used this system to obtain a general assessment of fishing effort by gear in each fish habitat in the Bolinao area.

3. To have a working model of a low-cost remote-controlled aircraft with a TV camera and transmitter, and a still camera system for the mapping of fish habitats in shallow waters.

4. To have completed a short-term assessment of the distribution of fish species in habitats of the Bolinao region, and of the harvestable production and catch composition by species and size for each major small-scale gear used in the habitats. This assessment will be summarized in manuscript form for presentation at the 6th International Coral Reef Congress in Australia in August 1988.

5. To have obtained the first of two years of data necessary for investigating the relationships between recruitment predictions based on length-frequency analysis and reproductive cycles in selected coral reef fish species.

PROGRAM COORDINATION

J. McManus, stationed in the Philippines, and ICLARM are both working on both projects and are thus able to provide some ongoing coordination of activities. A Coordinating Committee composed of J. McManus (URI), E. Gomez (UPMSI), and S. Formacion (UPVCF) provides regular review of research efforts and project and publications coordination. Research collaborators meet regularly with representatives of the Bureau of Fisheries and Aquatic Resources, the Philippines Council for Agriculture and Resources Research and Development (PCARRD), the USAID Rainfed Resources project, and the USAID/ASEAN Coastal Resources Management Program.

SUMMARY OF EXPECTED TRAINING

There is a continual training component in the URI/UP program, as J. McManus (URI) is stationed in the Philippines where he provides formal and informal training for CRSP research team members. J. McManus and D. Pauly (ICLARM) also teach regular courses at UP on CRSP-related scientific concerns. Details on the CRSP-based courses being taught at UP are summarized in the Work Plans by Quarter, above.

During October 17-23, 1987, at the time of the visit to the Philippines by S. Saila (URI), a major CRSP workshop will be conducted at UP. Participants will include fishery management and scientific personnel from all relevant Philippine institutions and will include representatives from Thailand and Indonesia as well. Following two days of presentations of selected papers on fish stock assessment in tropical waters, a four-day workshop will be conducted on the use of microcomputers, length frequency analysis, alternative stock assessment methods, multispecies assemblages, and sampling problems.

PRELIMINARY TRAVEL PLANS 1987 - 1988

Name	From/To	Dates	Purpose
S. B. Saila	R.I./Philippines	10/11/87-11/03/87	To evaluate Field Studies sub-project, to assist project personnel, to provide information exchange with colleagues at UP, and to conduct workshops or training sessions on new aspects of research conducted at URI on fishery stock assessment methodologies.
S. B. Saila	R.I./Winston-Salem,	09/13/87-09/17/87	To attend the American Fisheries Society meeting, to present a paper on the Gulf of Thailand fishery, and possibly to attend a CRSP Technical Committee meeting.
To Be Determined	To Be Determined	01/01/88-06/30/88	To participate in CRSP-wide coordination meetings

MANAGEMENT ENTITY

MEETING AND TRAVEL PLANS 1987 - 1988

Program Management Activities

Dr. John Rowntree, Program Director, Dr. Gerald Donovan, Board of Directors (Chair), and Dr. Vincent Gallucci, Technical Committee, will attend an AID/S&T CRSP Workshop in Virginia on July 12-13, 1987. Drs. Rowntree and Donovan plan to attend the 1987-1988 meetings of the CRSP Council and the Committee for International Fisheries Research and Assistance Institutions (CIFRAI) at the times and places yet to be announced.

The Program Director will attend the Technical Committee and Board of Directors meetings suggested below. In addition, the Program Director will visit the Philippines (tentatively, early December, 1987) and Costa Rica (tentatively, January-February, 1988) for site visits, timed to coincide with visits by the External Evaluation Panel.

The Program Director will participate in the site visits of the Triennial Reviews team either during the Spring, 1988, or later, if the Triennial Review is delayed until sometime in the fourth year of the CRSP program.

Technical Committee Meetings

The Program Director and the three U.S. (Drs. Gallucci, UW, Rothschild, UMCEES, and Saila, URI) and two host country (Drs. Murillo, UCR, and Gomez, UPMSI) Principal Investigators have tentatively planned to hold a Technical Committee meeting during the American Fisheries Society meetings, September 13-15, 1987, in Winston-Salem, North Carolina.

An additional meeting of the Technical Committee is tentatively planned for the Spring, 1988, to design a five-year Forward-Rolling Work Plan and proposal to extend the CRSP for three additional years beyond the current

five-year grant which ends on June, 30, 1990.

Board of Directors Meetings

The Board of Directors (Dr. Gerald Donovan, Chair, URI, Dr. Ian Morris, UMCEES, and Dr. Robert Stickney, UW) plan to hold a meeting in conjunction with the Spring, 1988, Technical Committee meeting, at a place yet to be determined.

External Evaluation Panel Activities

The External Evaluation Panel (EEP) members (Dr. Michael Sissenwine, NMFS, Woods Hole, and Dr. Albert Tyler, Biological Research Station, Nanaimo, B.C.) anticipate making site visits to each of the principal U.S. and host country institutions during 1987-1988. Dr. Tyler will tentatively visit UW in early October, 1987. Dr. Sissenwine will tentatively visit UP in early December, 1987. Dr. Tyler will tentatively visit UCR in the early part of 1988. Additional site visits to UMCEES and URI by an EEP member will be scheduled during 1987-1988. One of the EEP members is also expected to attend each of the planned the Technical Committee and Board of Directors meetings.

The EEP members will participate in the visits by the Triennial Review team during 1987-1988, or later, if the Triennial Review is delayed until sometime in year four of the CRSP.