

AQUANEWS

THE NEWSLETTER OF THE POND DYNAMICS / AQUACULTURE COLLABORATIVE RESEARCH SUPPORT PROGRAM

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FROM THE DIRECTOR'S DESK

Howard Horton, Program Management Office--

After some delays and adjustments, the Pond Dynamics/Aquaculture CRSP appears to be settling down to a productive year. The biggest news this fall was the arrival of our approved grant for the continuation of the CRSP from September 1, 1987 to August 31, 1990.

The U.S. Agency for International Development has approved \$2.85 million for this period subject to the availability of funds, program evaluations, and program priorities. We received an initial obligation of \$610,000 for the period of September 1, 1987 through April 30, 1988. We recently issued subcontracts to Auburn University, the University of California at Davis, and the Consortium for International Fisheries and Aquaculture Development. We appreciate the cooperation of all of the subcontractors in finalizing their expenditures and accounts as of August 31, 1987.

We are pleased with the resolution of the growing pains in Thailand. The coalescence of three projects into one led to some confusion regarding the organization of the project. As a consequence, Dr. Jim Diana and I went to Thailand in early August to meet with Host Country principals. We were well received and enjoyed a spirit of cooperation that made our task much easier. The result will be Memoranda of Understanding with the Thailand Department of Fisheries and the Asian Institute of Technology that should facilitate the research proposed by the University of Michigan, Michigan State University, and the University of Hawaii. Mr. David Delgado of the USAID Mission in Bangkok was particularly helpful and enthusiastic in his support. The responsibility for coordinating our research efforts in Thailand rests with Dr. Diana of the University of Michigan, who did a masterful job of negotiating the respective Memoranda.

We are looking forward to a successful year as we start our new grant and hope to see you at the Annual Meeting in Kona, Hawaii.



Fish Culture Seminar in East Africa

CRSP Team in Rwanda--

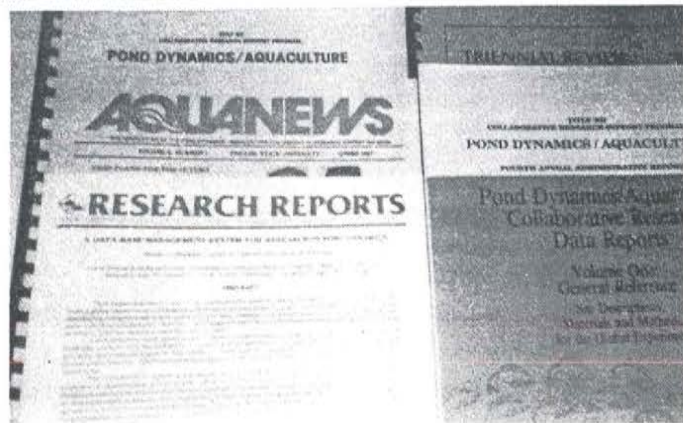
Felicien Rwangano and Eugene Rurangwa, Rwandan research associates with the Rwanda/Oregon State University CRSP project, participated in a seminar on fish culture in high altitude East Africa, which was held in Bujumbura, Burundi on February 22 to 23, 1987.

The seminar was organized by the Ministry of Agriculture, Waters and Forests of Burundi in collaboration with the Peace Corps in Burundi. Twenty-three participants from Burundi, Zaire, and Rwanda were joined by a representative from the Peace Corps Office in Washington and an FAO representative from the regional office in Addis Ababa. Rwanda was also represented by Karen Veverica and John Moehl, technical assistants with the USAID/Auburn University Rwanda Fish Culture Project and Nathanael Hishamunda, Acting Director of the National Fish Culture Project.

Participants gave presentations describing their respective projects, stations, or areas and discussed a number of topics including pond management, fingerling production, marketing, and research. They also visited the fingerling production facility at Bujumbura.

The participants noted the progress that had
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NEW CRSP PUBLICATIONS

Two new publications were launched this fall. *Pond Dynamics / Aquaculture Collaborative Research Data Reports* and *CRSP Research Reports* present technical papers and results of CRSP research in Pond Dynamics and Aquaculture.

CRSP Research Reports contain scientific papers written by CRSP researchers on a variety of subjects related to aquaculture. Kevin Hopkins, Jim Lannan, and Jim Bowman, of Oregon State University, submitted the first paper:

- A data base management system for research in pond dynamics.

CRSP Research Reports will publish only the abstracts of CRSP-supported research that were previously published in refereed scientific journals. Each abstract will appear as a Notice of Publication. Notices of Publication have been distributed for the following papers:

- Idiopathic muscle necrosis in the freshwater prawn, *Macrobrachium rosenbergii* de Man, cultured in Thailand;
- Breeding and Rearing of Sand Goby (*Oxyeleotris marmoratus*, Blk.) Fry

Each volume of *Collaborative Research Data Reports* contains the results and data from the Global Experiment, which is the major research activity in the Pond Dynamics/Aquaculture CRSP. The Global Experiment was designed to quantitatively describe the physical, chemical, and biological principles of pond culture systems. Data collected over three experimental cycles, each including wet and dry seasons, were entered into a central data base, which is maintained by the Program Management Office. *Data Reports* present this data base along with interpretations of site-specific results.

The first volume of *Data Reports* acts as a reference for the series; it contains descriptions of sites and experiments, materials and methods, and data management. Subsequent volumes will focus on each of the seven projects separately by experimental cycle (year). Volumes 2 and 3 present results from Cycle I of the projects in Thailand and Indonesia, respectively.

Both publications will be printed as occasional reports and are free of charge upon request.

Burundi Fish Culture Seminar (continued from page 1)

been made since the previous year when they had met in Butare, Rwanda for a similar seminar. At that time, one of the most important topics of discussion had been the production of fingerlings at high altitudes. All three countries were having difficulty producing enough fingerlings to meet the needs of the stations and rural farmers. This year, fingerling production had improved significantly as classical techniques were adapted to high altitude conditions.

The participants agreed that regional collaboration would benefit fish culture in all three countries. Plans were made to hold a third conference in 1988 in Bukavu, Zaire and to invite representatives from Kenya, Tanzania, and Uganda. The Rwasave station (site of the CRSP) and the Kigembe station (site of the USAID/Auburn-Rwanda Fish Culture Project) were selected as regional centers for research and training, respectively. Rwasave would serve as a center for storage, analysis, and distribution of research results. It would also act as a center for coordinating research activities in the region.

CRSP MODEL DEVELOPMENT

Raul Piedrahita, Univ. of California at Davis--

A major focus of the Pond Dynamics/Aquaculture CRSP is on the analysis and synthesis of data collected during the global experiment. Over three experimental cycles in seven locations throughout the world, the CRSP has amassed a large amount of data, which has been compiled in a data base.

The data base will be used to develop computer models that describe conditions in the experimental ponds. The goal of the models is to extend the knowledge of the dynamic behavior of aquaculture ponds by quantifying relationships between water quality, weather, management actions and fish production. The information gleaned from the models will be used to suggest guidelines for effective management strategies for water quality and fish yield worldwide.

Computer models can be described as collections of mathematical expressions that are used to simulate conditions found in a prototypical system. In our case, the prototype is the aquaculture pond. Mathematical expressions are developed from conceptual representations of the relationships between variables in the system and from analysis of data.

Rationale for Model Development

The use of computer models for analysis of complex systems has become widespread in the last decade. Availability of powerful, inexpensive computer systems that can be used for data analysis and

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modeling, as well as for data acquisition, has made possible the development of computer models that simulate complex systems. Models have been recognized as effective tools for the quantification of processes taking place in these systems.

The Pond Dynamics/Aquaculture CRSP recognized at the outset that aquaculture ponds are extremely complex ecosystems. The choice of sites, the experimental protocols, the monitoring of variables and the frequency of measurements were all determined with an understanding of the complexity of the system. Results obtained to date have confirmed this initial perception, and have made computerized analysis of the data a necessity.

The CRSP aims to increase the usefulness of models of aquaculture ponds by addressing the limitations inherent in previous computer models, such as difficulty of use, non-compatibility between computers, and oversimplification of system dynamics. The CRSP is developing two models. One is designed to be "user friendly," whereas the other is designed to be compatible with different computer systems. Developers of previous models have not had the benefit of a data base such as the one created by the CRSP. This data base is unique in that the collection of the data was standardized. Availability of these data will allow the calibration and validation of models on a scale not before possible. Validated models will be useful tools for management, education, and research.

Modeling Process

Development of a computer model follows a well-defined series of steps. These are described as they relate to our specific efforts.

1. Intended use of the model. The CRSP is developing models for use in research, teaching, and ultimately for the management of ponds. As the models are calibrated and validated, they become more accurate predictors. As input/output routines are improved, the models become more "user friendly." These qualities increase the utility of the models for teaching and management. Ultimately, the models will be used to develop management guidelines for specific situations. The models also will be made available to the public and the scientific community.

2. Conceptual Model. A conceptual model is composed of variables or components, and the processes that connect them to one another and to external conditions. In a conceptual model, variables and processes are not quantified; however, their importance is acknowledged by inclusion in the model. In the CRSP, conceptual models were not formally proposed at the outset of the Program. The selection of variables to be measured, the frequency of monitoring, the parameters to be

manipulated, the sites, the number of replicates, and other factors were based on the knowledge of the participating researchers.

Conceptual models have been developed and are being used to formulate mathematical relationships that describe conditions in aquaculture ponds.

3. Model Formulation. The selection of mathematical expressions that describe the variables and processes identified in the conceptual model constitutes "model formulation." One model is designed to simulate several components in the ponds, including phytoplankton, fish, organic matter, and nutrients. A second model is designed to simulate only dissolved oxygen concentration. In both models, equations are based on mass balances. The equations are general and are adapted to the temporal and spatial characteristics of the various sites by changing the values assigned to each parameter.

4. Computer Implementation. The two models under development have been implemented on personal computers (Apple Macintosh). The model designed to simulate only dissolved oxygen has been programmed using a dynamic modeling language, called Stella™, whereas the second model has been programmed in FORTRAN. Ease of use, flexibility of output presentation, and usefulness as a demonstration and educational tool are much greater for the model programmed in Stella™ than that in FORTRAN. Language limitations on Stella™, however, limit the complexity of the model and the type of input that can be used. The FORTRAN model is more complex and includes a larger number of variables. Both models are programmed for execution at hourly intervals, and are designed primarily for the short-term (24-48 hours) simulation of variables.

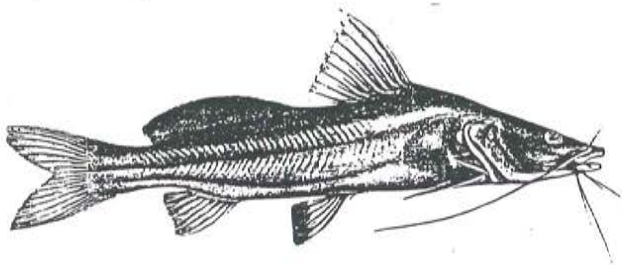
5. Calibration. The process of calibration of a computer model consists of running the model for a given set of data and adjusting parameter values to obtain simulations that match measured values. Calibration of a model is a formal way of determining if the model accurately represents the system. Both models are calibrated using the available data. Data templates have been examined and sets of data that include the parameters needed for the execution of the model have been identified. Uniform wind and cloud cover have been assumed due to the lack of hourly values for wind and solar radiation.

Model Use and Limitations

The extreme complexity of the ecology of aquaculture ponds, the dependence of pond processes on highly variable parameters of climate, water, and

Data Synthesis (continued from page 3)

nutrient supplies, and limitations inherent in the data make it difficult to calibrate the model. As calibration proceeds and the models are adjusted, confidence in their predictive qualities will increase. The calibrated models will be validated against data different from those used in the calibration process. The calibrated and validated models will be used to study the effects of environmental conditions, water quality, soil characteristics, and management actions on water quality and fish production. Results will be presented in tabular and graphical form for distribution and testing at research sites. These results will provide guidelines that can be used to design new aquaculture facilities and to propose management strategies to obtain optimum yields.



PROJECT HIGHLIGHT: HONDURAS

Ronald Phelps, Auburn University—

In Honduras, the Pond Dynamics/Aquaculture CRSP Project greatly contributed to the renewal of interest in aquaculture. The CRSP built on existing infrastructure and has assisted the Hondurans in developing an effective aquaculture program.

The "El Carao" aquaculture station in Comayagua, Honduras has been the site of operation for the CRSP from 1984 to 1987. An earlier project funded by the USAID Mission began developing this site for aquaculture in 1977. The CRSP assisted in making the station fully operational. At the start of the CRSP Project, Honduran biologists produced 260,000 hybrid tilapia fingerlings per year at "El Carao." With the CRSP's assistance, production increased nearly three-fold (to 740,000 fingerlings in 1987). The station now also produces Chinese carp fingerlings. These improvements were achieved even though pond area for production was decreased to provide more area for research.

A major accomplishment of the CRSP is the establishment of an excellent water quality laboratory capable of meeting the station's needs as well as those of RENARE, Honduras' Department of Natural Resources. (RENARE is the counterpart institution for Auburn University in this Pond Dynamics/Aquacul-

ture CRSP Project.) The CRSP also has supported the training of laboratory staff. The quality of the facility has led RENARE to consider transferring some of its activities from the capital to "El Carao."

Research conducted by the CRSP has resulted in many direct and indirect benefits. One of the most important is the rekindling of interest in aquaculture research by station staff and RENARE administrators. The first experimental cycle of the CRSP provided an opportunity to train Hondurans in research methods. The CRSP also has assisted staff in the evaluation of research priorities; they now take a larger view of the Station and its outreach. Important considerations used in these evaluations are: who will benefit from the research, what resources are available to the target group that is interested in fishfarming, and how can the research results be extended to the field?

Experimental Cycles II and III not only strengthened the station staff's ability to carry out research but also yielded results that were directly beneficial to Honduras. Cycle II identified the benefits and costs of three nutrient sources used in aquaculture. Cycle III built on the results of Cycle II by using the most cost-effective nutrient source to determine the optimum rate of fertilizer application. During both of these studies, station staff organized "field days" and other demonstrations to show government policy-makers that aquaculture is a productive enterprise, worthy of their continued support.

The CRSP has served as a catalyst for linking various groups involved in aquaculture in Honduras. A Honduran national advisory committee has been formed, which represents government agencies, private and state universities, the Peace Corps, and the Pond Dynamics/Aquaculture CRSP. Through the committee's efforts, the first national aquaculture seminar has been held and a second is in the planning stage. The ability of the CRSP to work with other programs has led USAID/Honduras to fund this outreach for an additional year after the end of the official CRSP project.

CRSP Financial Management Workshop

Personnel from the Program Management Office received special training in mid-November in the care and management of USAID funds. A Financial Management Workshop was organized by USAID to educate and inform CRSP managers of current financial issues and the role of the CRSP in extension.

USAID Financial Management staff stressed the need for accurate and timely financial reports from the Universities that are primary grantees for each CRSP. USAID estimates the budgets of each CRSP using an

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CRSP NEWS

Thailand. C. Kwei Lin and Vinij Tansakul attended a conference on the Future of Fisheries in Thailand, which was organized by the Southeast Asia Fisheries Development Center and the Thai Department of Fisheries.

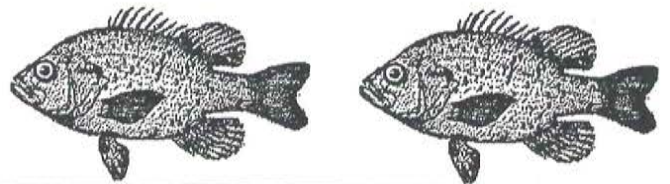
Panama and Honduras. Drs. Arlo Fast and Ron Phelps travelled to Panama in May to begin planning for the implementation of the Fourth Work Plan in Aguadulce. Dr. Phelps visited the CRSP site in Honduras in May and again in November to discuss the future of the CRSP project in Honduras. He met with John Warren, USAID, Mr. Bart Green, former CRSP Research Associate, and with staff from the Honduras Department of Natural Resources (RENARE).

The CRSP *Program Management Office* has not moved; however, the name of the Office in which we are located has been changed from "Office of International Agriculture" to "Office of International Research and Development." Please address your correspondence accordingly.

1988 CRSP Annual Meeting

This year's CRSP Annual Meeting will be held in Hawaii immediately following the World Aquaculture Society (WAS) Meeting. CRSP participants will have the opportunity to partake in the WAS meeting, which is uniquely geared toward the CRSP's interests. Two special sessions are offered on marketing strategies in aquaculture and on aquaculture in developing countries. Over 11 CRSP-supported research papers and posters will be presented at the WAS Meeting.

The theme of the CRSP Annual Meeting is the collective interpretation of data from the three years of the global experiment. The external evaluation committee will be present, marking the beginning of a triennial review year. The Meeting will take place from January 10 to 14, 1988 in Kona, Hawaii. The 19th Annual Meeting of the World Aquaculture Society will be held in Honolulu from January 5 to 9, 1988.



Financial Workshop (continued from page 4)

historical (9-12 months) rate of monthly expenditure. Inaccurate estimates of encumbrances coupled with the effects of time lags in receiving financial reports have, in the past, resulted in inflated pipelines.

Pipelines, defined as the unspent balance in the grant at the end of a reporting period, are used to make decisions on the allocation of new funds (or obligations) to each CRSP. Large balances, or inflated pipelines, could result in lower allocations and a reduced appropriation of annual funds from Congress. Mr. Sandy Owens of USAID/Financial Management, requested that the Universities (or Grantees) submit quarterly financial reports that are prepared on an accrual rather than cash basis.

Mr. Jay Bergman, USAID Office of Procurement, discussed funding options for the CRSP's. Mission "buy-ins" present the CRSP's with an opportunity to obtain funding for technical assistance activities. However, these activities, usually short-term in scope, need to be consistent with the overall goals of the particular CRSP. During the panel discussion on the role of the CRSP's in extension, USAID staff noted that the CRSP's would be wise to begin pursuing funding opportunities from other public agencies and the private sector in order to conduct extension activities.

CRSP MILESTONES

The reorganization of the CRSP has led to many changes in personnel over the past six months.

Rwanda. Dr. Boyd Hanson was replaced by Ms. Karen Veverica, formerly Technical Assistance Team Leader of the Rwanda Fish Culture Project. She presently is taking courses at Oregon State University towards a doctorate degree in Fisheries. Dr. Hanson, who performed exceptionally as CRSP Research Associate in Rwanda, has accepted a position as Biometrician with the University of Arkansas, Fayetteville, on the USAID Farming Systems Research Project in Rwanda. Felicien Rwangano, Host Country Research Associate, will begin a Master's degree program in Fisheries at OSU, under Dr. Richard Tubb, U.S. Co-Principal Investigator on the Rwanda Project.

▼
Panama. Dr. David Teichert-Coddington, U.S. Research Associate of the Gualaca CRSP Project, is now at the Aguadulce CRSP Project with Dr. David Hughes.

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Honduras. After four years of successful operations, the project in Honduras will no longer be part of the CRSP. However, with financial support from the (please turn to page 6)

USAID Mission, the project will continue with a slightly different focus. The project will retain Mr. Bart Green, U.S. Research Associate from Auburn University. Mr. Green plans to continue CRSP-related research but only as it applies to a broader aquaculture program prescribed by the Mission.

University of Hawaii. Dr. Robert Brick has replaced Dr. Philip Helfrich as the Co-Principal Inves-

tigator from the University of Hawaii. Dr. Helfrich will retain his position on the Board of Directors. Dr. Brick has considerable domestic and international experience in aquaculture and has worked extensively with freshwater and marine shrimp. He presently is Aquaculture Coordinator at the University of Hawaii and is serving as Session Leader during the 1988 World Aquaculture Society Meeting in Hawaii. The CRSP welcomes Dr. Brick aboard.

MEETINGS AND TRAINING PROGRAMS

27-28 January 1988. Texas Fish Farming Conference and Annual Convention of the Fish Farmers of Texas. This year's workshop will focus on design and construction of aquaculture facilities. A trade show will be held in conjunction with the conference. For information, please contact: Dr. Joe Lock, Extension Fisheries Specialist, Drawer 38, Overton, Texas 75684, USA. Tel.: (214) 834-6191.

24 March-14 July 1988. Aquaculture Training Program. This program is intended for fisheries and aquaculture professionals from foreign countries. Major emphasis is placed on practical training in various techniques essential for the successful rearing and culture of fresh water fish and shrimp. For information, please write to: Aquaculture Training Program, Dept. of Fisheries and Allied Aquacultures, Auburn University, Alabama 36849-4201, USA.

20-23 June 1988. Aquaculture Engineering Technologies for the Future. This conference will address state-of-the-art developments in the design, construction, and operation of modern aquaculture systems ranging from low-cost subsistence production to commercial high-value aquaculture. For information on submitting a paper or poster, please write to: The Conference Section, The Institute of Chemical Engineers, 165-171 Railway Terrace, Rugby CV21 3HQ, United Kingdom.

5-11 September 1988. China Fishery '88, Shanghai, an International Exhibition on Fish Farming, Fishery Technology, and Equipment. For information, please contact: SHK International Services Ltd., 22/F, 151 Gloucester, Hong Kong.

24-28 October 1988. Fisheries Bioengineering Symposium. Sponsored by the Bioengineering Section of the American Fisheries Society. The symposium will focus on five major topics: habitat improvement; upstream/downstream fish movement; improved hatchery operation; alternative hatchery production systems; and technology transfer and evaluation. For information on submitting papers, please contact: Dr. John Colt, Fisheries Bioengineering Symposium, Fish Factory, P.O. Box 5000, Davis, California 95617, USA.

18-21 April 1989. The Second Asian Fisheries Forum, Tokyo, Japan. The theme, "Fisheries Science and Communities: Partners in Development," reflects a growing awareness that closer links between fisheries and social scientists are necessary if fisheries management issues are to be properly managed. Other sessions will be held on Aquaculture Systems, Diseases, Fisheries Education, Nutrition, Physiology, Genetics and Reproduction, and Marketing. For information, please contact: The Secretariat, The Second Asian Fisheries Forum, Dept. of Fisheries, Faculty of Agriculture, University of Tokyo, Yayoi 1-1-1, Bunkyo-ku, Tokyo 113, Japan.

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