AQUANEWS

Sustainable Aquaculture for a Secure Future

POND DYNAMICS/AQUACULTURE COLLABORATIVE RESEARCH SUPPORT PROGRAM NEWSLETTER

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Tenth Work Plan Splash

The PD/A CRSP is delighted to share news of a two-year grant extension awarded by the United States Agency for Intenational Development (USAID). In a suspense-filled countdown, the official extension notification arrived at Oregon State University on July 30, 2001, just one day before the original termination date of the CRSP grant.

The original term of the program's current grant was from August 1, 1996, through July 31, 2001. Because of a series of annual budget cuts that began in 1998, the program had been forced to selectively address grant objectives. Had the program come to completion as originally planned, numerous objectives set out in the grant proposal would have remained unaddressed. Over the course of more than a year of negotiations, CRSP Director Dr. Hillary Egna, supported by sister CRSPs, successfully persuaded USAID to extend the program's current grant term, thus permitting the research portfolio carried out under the current grant to fully meet planned objectives.

A new work plan—a collected set of research investigations—will accomplish that end. Development of the Tenth Work Plan began with the distribution of a request for proposals (RFP) to eligible US insitutions. The RFP invited proposals in research areas that were underrepresented in the Eighth and Ninth Work Plans, with the goal of filling in gaps in the body of research carried out under the current grant. As a result of the RFP process, approximately 45 new aquaculture research investigations

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On-the-Ground Uses of CRSP Pond Soil Research Results

by Claude E. Boyd, C. Wesley Wood, and Taworn Thunjai

The PD/A CRSP has supported our studies on pond bottom soils since the beginning of the current USAID grant in 1996. We have collected a large amount of information on physical and chemical characteristics of pond soils and are using these data to make a soil classification system for aquaculture ponds. Moreover, some of the findings of the research have practical significance towards understanding the dynamics of pond soil and for improving pond soil management. The purpose of this article is to provide some highlights of our findings that will be of interest to fish and shrimp farmers.

Cutting a pond sediment core into segments.

The main sources of sediment in ponds are suspended soil particles that enter via the water supply or originate from erosion of the wet sides of pond embankments. Suspended soil particles settle and accumulate in deeper areas of aquaculture ponds. For ponds in this study, sediment accumulated in deeper water areas at rates of 0.5 to 1 cm per year. Pond sediment is rather fluid in comparison to the original pond bottom soil beneath it. Sediment in ponds can cause several problems. Ponds become more shallow and decrease in volume as sediment accumulates. Soft sediment is not good habitat for benthic fish food organisms. The effectiveness of feeding and fertilization is negatively impacted when feed pellets and fertilizer granules are "lost" by sinking into soft sediment. Deep, soft sediment interferes with harvesting operations by occluding seines and hampering the movement of workers. Fish and shrimp also may become covered with

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Pond Soil Research

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soft sediment, and this can impair their market quality. During pond draining, soft sediment can be resuspended and exit ponds as suspended solids in effluents. This increases the water pollution potential of pond effluents.

Organic matter in ponds is derived mainly from uneaten feed, undecomposed manure, dead plankton, and aquatic animal feces. Sediment does not have as high an organic matter concentration as most fish and shrimp farmers commonly believe. Original bottom soil in most ponds in our study had less than 2% organic matter. Sediment usually contained 3 to 4% organic matter, and even in 50-year-old ponds, sediment contained only 5 to 6% organic matter. The highest concentrations of organic matter are found in the upper 5 cm layer of sediment. Much of the organic matter in this layer is of recent origin and susceptible to rapid decomposition by microorganisms. The organic matter in deeper sediment layers and in the original pond bottom soil is older than the organic matter in the surface layer, and it has already partially decomposed. Thus, it decomposes slower than fresh organic matter near the sediment surface. Anaerobic conditions that sometimes develop in surface layers of pond sediment usually are caused by fresh organic matter deposited during the current crop rather than older organic matter accumulations from previous crops. Nevertheless, when ponds are drained for harvest, procedures to lessen organic matter concentrations should be applied so that fresh organic matter concentrations in pond bottoms will be low as possible at the beginning of the next crop. This will provide a degree of protection against anaerobic zones in the bottom during the next culture period.

Pond sediment cores ready for laboratory analysis.

Nitrogen and phosphorus concentrations in pond sediment are higher than in original pond soil. The primary sources of these two nutrients are feed and fertilizer inputs. Phosphorus is tightly bound to soil particles and its solubility is low. There was no correlation between soil phosphorus concentration and the amount of phosphorus that could be extracted with water. However, soils with high clay contents tended to retain phosphorus more strongly than those of lesser clay contents. Incubation studies of pond soil samples revealed that ammonia mineralization usually did not occur during decomposition. The sediment does not appear to be an important source of nitrogen or phosphorus for the water of aquaculture ponds. Thus, aside from the possible need for greater phosphorus input in ponds with heavy clay soils, soil composition probably has a smaller influence on fertilizer requirements than often thought.

Sediment cores from an aquaculture pond.

A number of methods were used for measuring pH on a series of soil samples. For the same soil sample, each method usually provided a different pH reading. Differences were particularly great when pH values measured by inserting the pH electrode directly in wet soil were compared to those obtained for mixtures when the electrode was placed in a 1:1 mixture of dry soil and distilled water. Moreover, hand-held soil acidity testers, which often are used by fish and shrimp farmers, gave unreliable pH readings. Based on this research, the following method for measuring pH of pond soils is suggested: dry soil at 60°C in a forced-draft oven; pulverize soil to pass a 2-mm sieve; mix soil and distilled water in a 1:1 ratio (weight:volume); stir intermittently with glass rod for 30 min; insert dual electrodes or a combination electrode into the mixture; measure pH while stirring. There were three reasons for selecting this procedure: 1) it measures the pH of the soil under aerobic condition, and aerobic conditions usually exist at the soil-water interface; 2) precision of this method is high; and 3) most pond soil management recommendations in the literature are based on pH measured in 1:1 mixture of dry soil and distilled water.

Most farmers will not have the equipment to measure soil pH as suggested above. Nevertheless, it does not seem prudent to suggest some simpler method, because most recommendations assume that pH measurements are made in 1:1 dry soil to distilled water mixtures. Soil samples can be sent to laboratories for pH analysis by the procedure recommended above, or groups of small farmers might cooperate to purchase a standard, laboratory-style pH meter.

Practical Application

When ponds are drained for harvest, bottoms should be dried for at least two or three weeks before refilling. This will assure better contact between soil and the air, and aerobic microbial degradation of organic matter will be accelerated. Acidic soils should be treated with agricultural limestone to increase pH and enhance microbial activity. Further improvement in organic matter decomposition may be

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Pond Soil Research

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achieved by tilling ponds to 10-cm depth with a disk harrow to improve aeration.

A disk harrow is the best device for normal tilling of pond soils, for it is an energy efficient device and it pulverizes the surface soil. However, if there is a high concentration of organic matter or nutrients in the surface layer of the pond bottom, a mold-board plow (turning plow) could be used to bury the surface layer and expose deeper soil of lower organic matter and nutrient concentration.

During the culture period, the oxidation of bottom soils can be improved by scarifying the sediment surface. This may be accomplished by raking or by dragging a heavy chain over the bottom. Sodium nitrate is a soil oxidant, and it is widely claimed that low concentrations of nitrate in the water will prevent anaerobic conditions at the soil-water interface. Application of sodium nitrate to maintain 5 to 10 mg l^{-1} nitrate in the pond water did not increase the redox potential of sediment in aquaculture ponds at Auburn University.

Sediment thicker than 20 to 25 cm is detrimental to several pond management objectives. Thus, sediment should be removed from ponds before it becomes too deep. Excavated sediment should be placed back on insides of embankment from which it eroded. If sediment must be disposed of outside ponds, it should be used as landfill or spread in a thin layer and stabilized by compaction and grass cover to prevent erosion.

...Looking Forward

Two CRSP-funded studies in pond dynamics will be conducted under the Tenth Work Plan. The first, "Reaction of liming materials in pond bottom soils," involves collaboration Boyd and Wood at Auburn with four new principal investigators (PIs) from two new institutions—the University of the North, South Africa, and Embrapa Meio Ambiente, Brazil. This investigation will examine the influence of lime application methods on the exchange of substances between and within soil and water. The second investigation, "Effects of pond age on bottom soil quality," is designed to yield information and recommendations on liming and pond bottom drying practices.

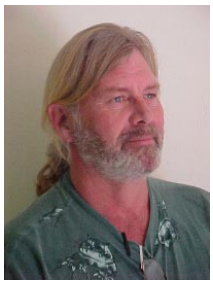
Koos Prinsloo, Director of the Aquaculture Research Unit at the University of the North in South Africa, is a new addition to the CRSP. He will be working side-by-side with old-timers Claude Boyd and Wes Wood, along with other newcomers Andrew Scholtz, Johan Theron, and Julio de Queiroz on the Tenth Work Plan project titled, "Reaction of liming materials in pond bottom soils." Prinsloo is a well-established and recognized researcher in the fields of freshwater ecology, aquaculture, and organic farming, having produced close to 120 publications and reports.

Koos Prinsloo

Johan Theron, researcher in the Aquaculture Research Unit at the University of the North, specializes in extension work. His recent publications include those on integrated agriculture-aquaculture systems, biofiltration, feed comparisons, and nutritional value of fish.

Johan Theron

Andrew Scholtz is also from the Aquaculture Research Unit at the University of the North. Scholtz brings 16 years of experience in the aquaculture field to the CRSP. His current position as Senior Technician will enable him to be an important contributor during the Tenth Work Plan.



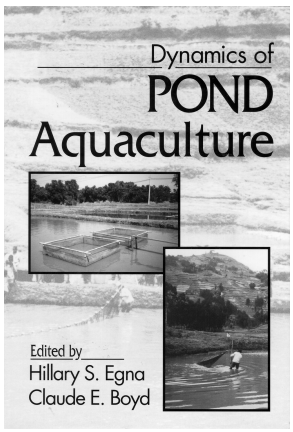
Andrew Scholtz

Julio Ferraz de Queiroz rejoins the CRSP community, this time as the Coordinator of Embrapa Meio Ambiente's National Program for Research and Development in Aquaculture, located in the state of São Paulo, Brazil. After receiving his Ph.D. on crustacean nutrition and reproduction from the State University of Ghent, Belgium, Queiroz worked on a CRSP project while a postdoctoral researcher at Auburn University with Claude Boyd. After his three years away from the CRSP, we welcome Queiroz back, this time as a Host Country PI.

Julio Ferraz de Queiroz

...For Further Reading

Claude Boyd and CRSP Director Hillary S. Egna are editors of *The Dynamics of Pond Aquaculture*, published by CRC Press in 1997. The 437-page book not only explains the physical, chemical, and biological processes that interact in pond culture systems, but also presents research findings and considers the people who depend on these systems. This book uses data from CRSP field research sites in Africa, Asia, and the Americas to present a complete picture of the pond aquaculture system and the environment in which it exists. Ordering information at <www.crcpress.com>.



Graduate Student Profile: Eddie Lopez

by Steve Sempier

Eddie Lopez has deep professional and academic roots in the PD/A CRSP. He has been actively involved in the CRSP for the past ten years and has played numerous roles. He initially worked on the Fish Pond Fertilization Trials Project in the Philippines as a host country Principal Investigator from 1991 to 1996 with Kevin Hopkins of the University of Hawaii and Jim Szyper of the Hawaii Institute of Marine Biology. Lopez also served as a member of the PD/A CRSP Technical Committee during his tenure as a principal investigator. One can quickly pick up, through his increasing amount of responsibilities, that Lopez is a motivated individual and has been a key participant in CRSP activities in the Philippines. As a result of Lopez's hard work with the PD/A CRSP, he has received funding that has supported his advancement through graduate school.

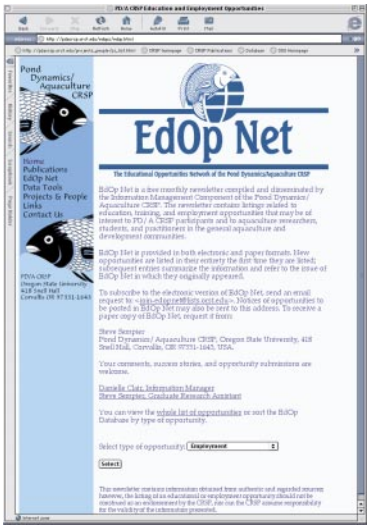
Eddie Lopez, CRSP graduate student at Central Luzon State University

Recently, Lopez has been building on his strong academic foundation while working with the PD/A CRSP. He obtained a B.S. in Agriculture with a major in inland fisheries at Central Luzon State University (CLSU), a Masters of Aquaculture at Auburn University, and an M.S. in aquaculture also at CLSU. Currently, Lopez is an Associate Professor and researcher at the Freshwater Aquaculture Center at Central Luzon State University and is pursuing his Ph.D. in Fisheries at the University of the Philippines in the Visayas (UPV).

After five years of hard work, Lopez is concluding his Ph.D. He has completed all of the required coursework, data collection, and data analysis and is now in the process of writing the manuscript in consultation with his dissertation adviser Crispino Saclauso, Professor at UPV. He plans to present his dissertation by December 2001. The Philippine Council for Aquatic Marine Resources Development (PCAMRD) has provided funding for Lopez's Ph.D. work, and additional financial dissertation support has come from the PD/A CRSP through the initiative of Chris Brown at Florida International University (FIU). FIU is the lead US university for the CRSP Philippines Project and holds a memorandum of understanding with CLSU.

Lopez's multifaceted dissertation is titled, "Interaction of growth, survival and social behavior of Genetically Manipulated Tilapia (GMT) (Nile tilapia–*Oreochromis niloticus*)." The project contains both descriptive and experimental components. The descriptive component includes analyzing motor and color patterns in GMT tilapia fingerlings and adults; observing feeding behavior of GMT tilapia with respect to food abundance and distribution; and evaluating fertilized egg size distribution. The experimental component comprises rearing GMT larvae to fingerlings at three stocking densities; analyzing social hierarchy and its effects on the growth and survival of dominant and subordinate conspecifics of GMT tilapia population; observing social hierarchy and compensatory growth in different size classes of GMT tilapia population; and exploring growth, survival, and social behavior of GMT fish as affected by space heterogeneity.

Lopez's motivation is demonstrated through his current, active involvement in research, teaching, and extension. The PD/A CRSP has been fortunate to have Lopez active in the CRSP for the past ten years and hopes that this relationship will continue as he earns his Ph.D. and continues to work in the aquaculture field.



EdOp Net a Window on Opportunities

EdOp Net has come a long way since the first issue in October 1996. With a mailing list of over 500 subscribers and over 1,200 visits per month to the website, EdOp Net has grown into a preferred resource for PD/A CRSP participants and others interested in current educational and employment opportunities in aquaculture. At the time of publishing there were approximately 100 opportunities posted on the website. If you know of any educational or employment opportunities in the aquaculture field, let us know.

EdOp Net is a great way to find new graduate assistants, postdocs, interns, or people with general experience in aquaculture, and it allows you to reach potential applicants from around the world. To subscribe electronically to EdOp Net or to post an opportunity, email Steve Sempier at <sempiers@ucs.orst.edu>. We invite you to peruse the various opportunities at our website, <pdacrsp.orst.edu/edops/edop.html>.

Philippines Fish Farmers Symposium

by Remedios Bolivar

As part of the celebration of the 25th founding anniversary of the College of Fisheries, the PD/A CRSP sponsored a fish farmers symposium on 27 June 2001 at the Freshwater Aquaculture Center (FAC) Conference Hall, Central Luzon State University, Nueva Ecija, Philippines. The primary objective was to disseminate information on how farmers can improve pond management practices. A farmers forum was held to provide an opportunity for farmers to share their experiences, problems, and other concerns in tilapia farming. The symposium was attended by about 140 fish farmers, students, and research staff from various agencies, including FAC researchers.

Certificates of attendance were awarded to the participants at the Fish Farmers Symposium. Shown in the photo are (L-R) Prof. Rodora Bartolome, Dr. Remedios Bolivar (CRSP Philippines Project PI), and Dr. Ruben Sevilleja (FAC Director).

The symposium highlighted pond management. Five lectures were presented by members of the faculty of the College of Fisheries and the FAC:

- Dr. Tereso A. Abella, Dean of the College of Fisheries, presented an overview of the Philippine freshwater tilapia aquaculture industry;
- Dr. Remedios B. Bolivar, the PD/A CRSP host country principal investigator, presented tilapia feeding strategies tested under the CRSP Philippines Project;
- Dr. Arsenia G. Cagauan, Chief of the Research Division, FAC, talked about water quality management in tilapia grow-out production;
- Prof. Apolinario V. Yambot discussed topics on fish health management; and
- Dr. Ruben Sevilleja, Director of FAC, gave a lecture on cost benefit of tilapia pond production.

The CRSP Philippines Project operates in collaboration with Florida International University, with Chris Brown serving as the US Principal Investigator.

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will be funded and carried out in the remaining grant term.

Research activities will be conducted with host country partners in Mexico, Honduras, Nicaragua, Brazil, Peru, Kenya, Malawi, South Africa, the Philippines, Vietnam, Thailand, Bangladesh, and Nepal.

The CRSP looks forward to the work ahead and welcomes all new—and returning—participating researchers and students to the CRSP network. *Aquanews* also looks forward to continuing to showcase the progress and accomplishments of projects sponsored by the CRSP in the next several years.

New Tenth Work Plan International Institutions

- Bangladesh Agricultural University, Bangladesh
- Department of Fisheries, Kasetsart University, Thailand
- Embrapa Meio Ambiente, Brazil
- Institute of Agriculture and Animal Science, Nepal
- Research Institution for Aquaculture No. 1, Vietnam
- University of Agriculture and Forestry, Vietnam
- University of Cantho, Vietnam
- University of the North, South Africa

New US Institution

- Michigan State University

Continuing International Institutions

- Asian Institute of Technology, Thailand
- Department of Fisheries, Ministry of Agriculture and Rural Development, Kenya
- Escuela Agrícola Panamericana, Zamorano, Honduras
- Freshwater Aquaculture Center, Central Luzon State University, the Philippines
- ICLARM-Malawi
- Instituto de Investigaciones de la Amazonia Peruana
- Moi University, Kenya
- Universidad Juárez Autónoma de Tabasco, Mexico
- Universidad Nacional de la Amazonia Peruana, Peru

Continuing US Institutions

- Auburn University
- Florida International University
- Oregon State University
- Southern Illinois University at Carbondale
- The Ohio State University
- The University of Michigan
- University of Arizona
- University of Arkansas at Pine Bluff
- University of Georgia

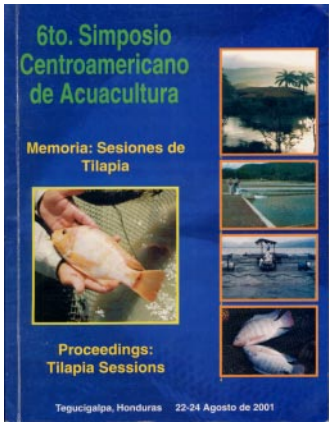
6 CASA Highlights CRSP

KRIS MCELWEE

Graduates of the aquaculture program at Escuela Agrícola Panamericana, including CRSP participant Hector Lagos (left), admire the school's booth at 6 CASA.

The Sixth Central American Symposium on Aquaculture—6 CASA— held 22 to 24 August 2001 in Tegucigalpa, Honduras, served as a showcase of the PD/A CRSP successes in Honduras. The meeting, with attendance of over 350, featured concurrent tilapia and shrimp sessions and was co-sponsored by the Asociación Nacional de Acuicultores de Honduras (ANDAH) and the Global Aquaculture Alliance. CRSP participants presented in and moderated sessions on marketing, genetics, and feeding. In addition, a special session entitled "Institutionalizing aquaculture development in Honduras: A multi-disciplinary approach" was hosted by CRSP researcher Dan Meyer of Escuela Agrícola Panamericana on 23 August. The session featured six presentations by CRSP Honduras Project participants as well as a round-table discussion and a hands-on demonstration of the WIDeST website.

Proceedings of the tilapia sessions were produced with support from the PD/A CRSP. The 148-page volume can be ordered from Dan Meyer (see address in article below). CRSP researchers gave the following presentations; the papers appear in the proceedings volume, and abstracts appear as Notices of Publication in this and upcoming issues of *Aquanews*:



- R. Phelps. Sex reversal: The directed control of gonadal development in tilapia
- D. Meyer. Nutrition and feeding of tilapia
- K. Fitzsimmons. Marketing tilapia
- N.O. Fúnez, I. Neira, and C. Engle. Supermarket outlets for tilapia in Honduras: An overview of survey results
- I. Neira and C. Engle. Markets for tilapia (*Oreochromis* sp.) in Nicaragua: A descriptive analysis of restaurants, supermarkets and stands in open markets.
- B. Verma. Overview of the PD/A CRSP project: Institutionalizing aquaculture development in Honduras.
- D. Meyer. Techniques for culturing tilapia on small farms
- E.W. Tollner. Levee pond design model
- T. Popma and D. Meyer. Training and technical assistance in warmwater fish culture
- B. Verma and R. Isaula. Information technology for aquaculture development in Honduras.

CRSP participants also took part in the following discussions and demonstrations:

- Discussion of tilapia genetics, reproduction, and sex-reversal procedures - R. Phelps, K. Fitzsimmons, D. Meyer, T. Popma
- Discussion of marketing of tilapia - K. Fitzsimmons, I. Neira, N.O. Fúnez, J. Molnar
- Production and marketing strategics used by small and medium-scale fish farmers in Honduras - J. Molnar, T. Popma
- Discussion of extension and development of aquaculture - B. Verma, J. Molnar, E.W. Tollner, T. Popma, D. Meyer
- Hands-on demonstration of the Web-based Information Delivery System for Tilapia (WIDeST), a resource on aquaculture for decision makers - R. Isaula and S. Meyer

Spanish-Language Tilapia Manual Available

The Honduras Project unveiled a new publication at 6 CASA in August. This Spanish-language manual, titled "Producción de tilapia en fincas integradas utilizando insumos de bajo costo," describes methods of tilapia production on Central American farms using low-cost inputs. The 37-page booklet was developed by Honduras Project members Dan Meyer and Suyapa Meyer, with support from Escuela Agrícola Panamericana Zamorano and the PD/A CRSP, and it includes entry-level information and illustrations of pond construction and culture handling, as well as a glossary of common terms in aquaculture.

This publication may be obtained by sending a request via letter or email to:
Dan Meyer
Escuela Agrícola Panamericana Zamorano
PO Box 93
Tegucigalpa FM, Honduras
Email: <dmeyer@zamorano.edu.hn>

Stakeholder Meeting Complements 6 CASA

In conjunction with 6 CASA, on the afternoon before the meeting began, the CRSP sponsored a stakeholder meeting attended by 13 Honduran fish farmers, extension workers, and educators to identify constraints to aquaculture in Central America. The meeting was facilitated by Carlos Nagel, with support in Tegucigalpa supplied by Suyapa Meyer. CRSP Technical Committee co-Chair Kevin Fitzsimmons offered an introduction to the program, translated into Spanish by Dan Meyer. The constraints analysis was conducted in Spanish. Some of the constraints identified as most important included the following:

- Lack of an integrated plan for aquaculture activity
- Low quality and lack of availability of fish fingerlings
- Lack of information for small farmers
- Lack of training opportunities
- Limited participation of women in fish culture
- Lack of marketing studies

Results from this meeting and others planned in Asia and Africa will be one source of input into a long-term, comprehensive research strategy as the CRSP begins now to develop a framework for a new grant proposal.

DAN MEYER

KRIS MCELWEE

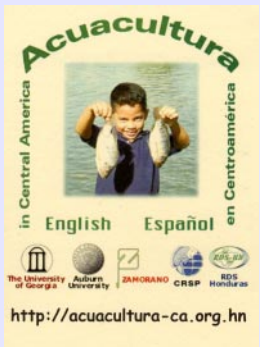
Participants in stakeholder meeting held in Tegucigalpa, Honduras, brainstormed to generate lists of constraints to aquaculture development (top). The group relaxed in front of the fruits of their labors (bottom).

Honduras Project Website Demo at 6 CASA

Acuacultura CA, a new website focused on aquaculture both in Honduras and in Central America generally debuted recently at <acuacultura-ca.org.hn>. One well-attended session at 6 CASA was a hands-on demonstration of the website, which was developed and is maintained through a collaboration of CRSP researchers at the University of Georgia, Auburn University, and Zamorano with colleagues from the Red de Desarrollo Sostenible-Honduras (RDS-HN) and other NGOs in Honduras. Its aim is to give extension workers and farmers easy-to-use information on fish culture through a website that is available in both Spanish and English. The site also allows farmers to connect with NGOs and researchers directly. Also available are over 100 documents, an Excel-based pond design model, a chat room, and a forum for users to ask questions of leading aquaculture experts. The success of the site has been reflected in its popularity. In its first five months there were 6,800 hits to the websites, and 300 users registered to access information. Registration is free.

Welcome to Acuacultura CA (from the website)

Acuacultura CA is the result of an important collaboration among several universities and the Sustainable Development Network Honduras. Our purpose in establishing this interactive website was to provide a versatile linkage point to assist NGOs and individuals to attain success in small-scale fish culture projects utilizing low-cost inputs.



The materials presented in the website are from diverse sources. They have been selected with the objective of providing information comprehensible to persons with some training in the agricultural and natural sciences, possibly beginning fish culturists.

In addition, the website offers the possibility to establish a fluid communication between persons with an interest in learning about fish culture and experts in the different fields of aquaculture. The universities collaborating on this work are: the University of Georgia and Auburn University, both of the USA, and Zamorano in Honduras. The principal source of financing for this website comes from the Pond Dynamics/Aquaculture Collaborative Research Support Program of USAID.

Notices of Publication

These Notices of Publication announce recently published work carried out under PD/A CRSP sponsorship. To receive a full copy of a report, please contact the author(s) directly unless it is otherwise noted.

CRSP Research Report 01-172

Management to minimize the environmental impacts of pond effluent: Harvest draining techniques and effluent quality

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An experiment was conducted to evaluate the amount of wastes discharged from fish ponds during harvest and to assess pond draining schemes and harvest techniques that may reduce waste loading in effluent water. Nile tilapia (*Oreochromis niloticus*) were cultured for 113–119 days in twelve 200 m^2 ponds with fertilization and supplementary pelleted feed. There were four treatments with three replicates each: (A) ponds were treated with teaseed cake at a rate of 10 ppm to partially anaesthetize tilapia 1.5 h prior to harvest by three seinings without draining ponds; (B) ponds were limed at a rate of 75 ppm calcium hydroxide 24 h prior to harvest and drained by sequential complete draining, and then tilapia were collected from a harvesting pit; (C) ponds were drained by sequential complete draining and tilapia were collected from a harvesting pit; and (D) ponds were drawn from 100 to 50 cm and tilapia were harvested by two seinings, followed by complete draining and collection of the remaining tilapia from a harvesting pit. Treatment D is the common practice in Thailand. The harvest efficiency was 97% in treatment A. Comparing the harvest efficiency for the first two seinings, there were no significant differences between treatments A and D. Liming in treatment B resulted in significantly higher concentrations of 5 day biochemical oxygen demand, total settable matter, total solids and total phosphorus (TP) in the water discharged from the last 25 cm depth than those at both 100–50 and 50–25 cm depths, while there were no significant differences in effluent quality parameters among different depths in both treatments C and D. Concentrations of all effluent quality parameters in the water discharged from the last 25 cm depth in treatment B were higher than those in treatments C and D. Seining in treatment D resulted in the highest concentrations of all effluent quality parameters except TP at middle depth. Compared with the common draining practice, adoption of the sequential complete draining schemes (treatments B and C) caused 33–86% reductions for different effluent quality parameters except total nitrogen and TP in the discharged wastes. The present experiment showed that the use of teaseed cake to anaesthetize tilapia could allow effective harvest by seining, without draining the pond. Alternatively, the discharge of potential pollutants from ponds into the environment could be reduced by sequential complete draining of ponds and collecting fish from harvesting pit (treatments B and C), and can be further reduced by modification of sequential partial draining of pond water level to 25 cm above pond bottom and seining fish without further draining. The present experiment demonstrated that appropriate management in pond draining and fish harvest could minimize the environmental impacts of pond effluents.

This abstract was based on the original paper, which was published in *Aquacultural Engineering*, 25(2001):125–135.

CRSP Research Report 01-173

Developments in integrated aquaculture in Southeast Asia

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Integrated aquaculture is inclusive of interactive utilization of resources and ecosystems in the artificial rearing of aquatic animals and plants. By the nature, purpose and scale of the operation, integrated fish culture can be categorized into five major modes. One is the traditional small-scale subsistence farming where fish are produced by recycling on-farm wastes in ponds or rice field, two is recycling of human excreta, three is the "industrialized" commercial operation by integrating medium and large-scale poultry or livestock farms with ponds for fish production, four is integration of aquaculture with natural ecosystems, e.g., shrimp culture with mangroves, cage and pen culture in lakes, cove culture in reservoirs. The fifth is environmental-oriented integration, where waste effluents from intensive aquaculture ponds are recycled to improve water quality and to grow filter feeder/herbivores or macrophytes as secondary crops. This paper presents

Notices of Publication (cont.)

concepts and practical examples for some of these systems.

This abstract was based on the original paper, which was published in L.M.B. Garcia (Editor), *Responsible Aquaculture Development in Southeast Asia, Proceedings of the Seminar-Workshop on Aquaculture Development in Southeast Asia, 12–14 October 1999*. Southeast Asian Fisheries Development Center (SEAFDEC), Iloilo, Philippines, pp. 77–88.

CRSP Research Report 01-174

Sex reversal: The directed control of gonadal development in tilapia

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Tilapia are becoming the most widely produced species of freshwater fish in the world. They can be produced in a variety of settings using a range of nutrient inputs. Males are the preferred sex to culture as they grow faster and divert less energy into reproduction. Males can be obtained using a variety of procedures but the most practical is through controlling gonadal development. Recently hatched tilapia fry have gonads that have not differentiated into ovaries or testes. It is possible to give such fish an exogenous source of hormone (androgen or estrogen) to control the development of the gonad. Fry less than 12 mm long can be harvested by seining along the edge of a spawning pond or from specialized spawning ponds where the pond is drained and harvested after 16-21 days. Proper size fish can also be obtained through a more intensive management approach where eggs are collected from the mouths of incubating females. Most commonly used approach to obtain male tilapia is to feed fry for 28 days or less a feed containing the androgen methyltestosterone. When fed properly the frequency of females in the population can be reduced to less than 5%. The short treatment duration very early in the fish's life history and rapid metabolism of metyltestosterone helps insure that tilapia are free of MT before fish reach the consumer. The production techniques associated with sex reversal are efficient and straight forward enough so that sex reversal has become the commercial procedure of choice to produce male tilapia fingerlings and has been a significant factor in the rapid growth of the tilapia industry.

This abstract was based on the original paper, which was published in D. Meyer (Editor), *6to Simposio Centroamericano de Acuacultura Proceedings: Tilapia Sessions, 22–24 August 2001*. Tegucigalpa, Honduras, pp. 35–60.

CRSP Research Report 01-175

Nutrition and feeding of tilapia

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According to the most recent estimates, world production of cultured tilapia *(Oreochromis sp.)* is in excess of 1 million metric tons. Tilapia are cultured in a great variety of aquatic environments and with many different management protocols.

The management of modern commercial tilapia production systems is an aquatic analog to North American feedlots used for beef production. The fish are held in cages and raceways at stocking densities that can exceed 100 fish/m^3. The fish are fed to satiation several times each day using specially formulated feeds, and then promptly sacrificed and filleted, for shipment to market.

Modern manufactured fish feeds are not well assimilated by tilapia. Typically only a small fraction (<30%) of the total content of N and P in the diet is incorporated into the fish's biomass (= growth). The remaining amounts of each macronutrient are never ingested (feed not consumed), excreted into the pond water, lost as part of fecal material, or used for maintenance.

There are several commercial farms in Central America that are successfully growing tilapia to export fresh fillets to North America. Additional farms are coming online in the region. In Honduras the demand for tilapia has increased in the past few years and several farms are focusing on local markets. No matter where they are sold, the purchase of feed for fattening these fish is the largest cost in the production budget for commercial tilapia farmers regionally.

Small-scale tilapia culture has not prospered locally. Fish culture is not a part of traditional agriculture in Central America. Local NGO run extension programs have had limited success in assisting rural farmers in growing tilapia. One important problem is the lack of knowledge in the proper management of costly inputs such as fish feed.

How farmers manage the feeding of their fish is often the key to success, or reason for the failure, of a particular farm. This paper discusses some of the biological aspects of tilapia in relation to its nutritional needs and practical feeding of fish in the culture environment.

This abstract was based on the original paper, which was published in D. Meyer (Editor), *6to Simposio Centroamericano de Acuacultura Proceedings: Tilapia Sessions, 22–24 August 2001*. Tegucigalpa, Honduras, pp. 61–70.

Upcoming Conferences and Expositions

Date	Topic/Title	Event Location	Contact Information
October 24–26, 2001	4th World Fish Inspection and Quality Control Congress	Vancouver, British Columbia, Canada	International Association of Fish Inspectors; 1568 Merivale Road, Box 225, Ottawa, ON, K2G 5Y7, Canada; Fax: 613-228-6654; Email: congress@iafi.net or conference@iafi.net (for conference information)
October 24–27, 2001	5th Latin American Conference and Exposition and 6th Ecuadorian Aquaculture Conference	Guayaquil, Ecuador	Phone: 1-760-432-4270; Fax; 1-760-432-4275; Email: worldaqua@aol.com; Website: <www.cenaim.espol.edu.ec/eventos/index.html>
October 31–November 1, 2001	Aquaculture China 2001 and China Fisheries and Seafood Expo	Shandong, China	Qingdao Shandong, PRC; Email: china@seafare.com; Website: <http://www.aquaculturechina.com>
November 4–6, 2001	Oldways Water Farming Initiative	Baltimore, Maryland, USA	Aimee Murdock or Deborah Good; Phone: 617-421-5500; Fax: 617-421-5511; Email: aimee@oldwayspt.org; Website: <www.oldwayspt.org>
November 6–9, 2001	ALIIA–International Exhibition of Fisheries, Aquaculture, and Relevant Equipment	Helexpo Exhibition and Congress Center, Athens, Greece	Anna Karra; 154 Egnatia Street, 546 36 Thessaloniki, Greece; Phone: 30-31-29-1-201; Fax: 30-31-29-1-551; Email: exhibitions@helenexpo.gr; Website: <www.helexpo.gr>
November 9–10, 2001	Second Annual Southern New England Aquaculture Conference	University of Rhode Island, Narragansett, Rhode Island, USA	Michael A. Rice; Phone: 401-874-2943; Email: rice@uri.edu
November 19–24, 2001	ASEAN-SEAFDEC Conference on Sustainable Fisheries in the New Millennium "Fish for the People"	Bangkok, Thailand	Conference Secretariat; PO Box 1046, Kasetsart Post Office, Bangkok 10903, Thailand; Phone: 66-2-940-6326-9; Fax: 66-2-940-6336; Email: conference@seafdec.org; Website: <www.seafdec.org/millennium/index.html>
November 25–30, 2001	6th Asian Fisheries Forum	National Sun Yat-Sen University, Kaohsiung, Taiwan	John Cooksey; Phone: 760-432-4270; Fax: 760-432-4275; Email: meetingmanager@aol.com
November 27–December 1, 2001	Marine Ornamentals 2001	Lake Buena Vista, Florida, USA	James C. Cato; Director, Florida Sea Grant College Program University of Florida, State University System of Florida, PO Box 110400, Gainesville, FL 32611-0400; Phone: 352-392-5870; Fax: 352-392-5113; Email: jcato@mail.ifas.ufl.edu; Website: <www.ifas.ufl.edu/~CONFERWEB/mo/index.html>
December 11–12, 2001	International Conference on Women in Fisheries	Mumbai, India	Indian Society of Fisheries Professionals; PO Box 11950, Azad Nagar, Andheri (west), Mumbai-400053, India Email: isfp@bom8.vsnl.net.in Website: <www.indianfisheries.org>
January 3–5, 2001	The Canadian Conference for Fisheries Research (CCFFR)	Vancouver, British Columbia, Canada	Scott Hinch, CCFFR Local Arrangements Chair; Email: shinch@interchange.ubc.ca; Website: <www.phys.ocean.dal.ca/ccffr/>
January 27–30, 2002	Aquaculture America 2002	Town and Country Hotel, San Diego, California, USA	George B. Brooks, Jr.; Phone: 520-562-6706; Fax: 520-562.6791; Email: gbbrooks@gilariver.com; Website: <www.was.org>
February 14–17, 2002	Fish International 2002	Bremen, Germany	Burgerweide; D-28209, Bremen, Germany; Phone: 49-421-3505-260: Fax: 49-421-3505-681; Email: bavendiek@messe-bremen.de; Website: <www.fishinternational.de/english/home>
February 25–27, 2002	International Forum on Tilapia Farming in the 21st Century	Los Baños, Laguna, Philippines	Rafael D. Guerrero III; Phone: 63-49-536-5579; Fax: 63-49-536-1582; Email: pcamrd@laguna.net; Website: <www.laguna.net/pcamrd>
April 23–27, 2002	World Aquaculture 2002	Beijing, China	Director of Conferences; Phone: 425-485-6682; Email: worldaqua@aol.com; Website: <www.was.org>

Workshops and Short Courses

Date	Title/Topic/Site	Contacts
November 5–9, 2001	Recirculating Aquaculture Systems: Principles of Design and Operation/Ft. Pierce, Florida, USA	Aquaculture Center for Training, Education, and Demonstration (ACTED), Harbor Branch Oceanographic Institution, 5600 US Hwy 1 North, Ft. Pierce, FL 34946; Phone: 800-333-4264 or 561-465-2400 ext. 416; Fax: 561-466-6590; Email: acted@hboi.edu; Website: <www.aquaculture-online.org>
November 12–15, 2001	Aquaponics Course/Bryson City, North Carolina, USA	Charlie Johnson, Aquaculture International; Phone: 828-479-6294; Email: cwjohnson@grahm.main.nc.us
November 14–16, 2001	Opportunities in Aquaculture/Ft. Pierce, Florida, USA	ACTED (see above)
November 15, 2001	Tilapia Farming/Ft. Pierce, Florida, USA	ACTED (see above)
November 26–29, 2001	Expert Consultation on Land and Water Use in Aquaculture/Rome, Italy	U. Barg; FIRI, FAO, Rome; Website: <www.fao.org/WAICENT/FAOINFO/FISHERY/meetings/meetings.asp#21AQ>
December 1, 2001	Aquatic Feeds Management Course for Finfish Farmers/ Waimanalo, Hawaii, USA	Program Manager at the Oceanic Institute; Phone: 808-259-3146; Email: gkarr@oceanicinstitute.org
December 8, 2001	Aquatic Feeds Management Course for Finfish Farmers/ Waimanalo, Hawaii, USA	Program Manager at the Oceanic Institute; Phone: 808-259-3146; Email: gkarr@oceanicinstitute.org
January 27–February 1, 2001	Practical Short Course on Feeds and Pet Food Extrusion (including aquaculture feeds)/College Station, Texas, USA	Mian N. Riaz; Food Protein R&D Center, 2476 TAMU, Texas A&M University, College Station, TX 77843-2476; Phone: 979-845-2774; Fax: 979-458-0019; Email: mnriaz@tamu.edu; Website: <www.tamu.edu/extrusion>
May 6–9, 2002	Management of Aquaculture Effluents/Hawaii, USA	Gary L. Jensen; National Program Leader–Aquaculture, US Department of Agriculture, Cooperative State Research, Education and Extension Service, Stop 2220, 1400 Independence Ave. SW, Washington, DC 20250-2220; Phone: 202-401-6802; Fax: 202-401-6156; Email: gjensen@reeusda.gov

What's the Catch? – University Day Draws Crowds to PD/A CRSP Booth

by Jeff Burright

As the new academic year drew near, over 500 Oregon State University faculty and staff visited the annual University Day event on September 17 to see, learn about, and collect free stuff from the 62 displays sponsored by many of the programs at the university. The event provided an opportunity for new and returning faculty and staff to become familiarized with the activities of the departments operating across campus. Organizations attracted interest to their booths using a variety of displays, posters, videos, and scads of promotional knick-knacks, ranging from bookmarks to mugs to OSU-logo fly-swatters.

At the PD/A CRSP booth, passers-by got reeled-in by—what else? A fishing game! With a whimsical grin and a hearty beckoning wave, Graduate Assistant Steve Sempier, the organizer of the CRSP booth, drew people in to learn about the program by inviting them to "go fish," casting a makeshift pole over a homemade pond façade erected at the table. Unlike the real thing, however, everyone who fished actually "caught" PD/A CRSP pens, pencils, or gummi-fish and information about the CRSP and its mission.

KRIS MCELWEE

Steve Sempier reels in a member of the Oregon State University community at the PD/A CRSP display at University Day.

The booth also featured informational posters and photographs, CRSP publications, and an on-site computer connected to the PD/A CRSP website. The booth was hosted throughout the morning by members of both the Information Management and Networking Component and the Program Management Office. As a result of University Day, many OSU personnel were introduced to the efforts of the CRSP, and everyone went home with a fish story.

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You can also access CRSP publications electronically at <pdacrsp.orst.edu/pubs/publications.html>.

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- ❑ My address has changed, and I have made corrections to the label. (Please mail label to address above.)
- ❑ I have discovered Aquanews online and no longer need to receive it on paper.
- ❑ I wish to discontinue receiving this publication.

AQUANEWS

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