



PD/A CRSP Research in the Social Sciences

Research efforts within the PD/A CRSP are directed toward the development of technologies that are relevant to small-scale fish farmers with the intention of increasing their income and food security. To achieve this aim it is imperative that PD/A CRSP researchers have a thorough understanding of the economic, social, and political realities of farmers for whom they develop technologies. The social and economic component of the PD/A CRSP was designed to address this necessity and is dedicated to collecting data and obtaining information that will facilitate the development of sustainable aquaculture technologies and systems. For example, CRSP researchers affiliated with Auburn University are engaged in a study to develop socioeconomic profiles of fish farmers from CRSP host. In a separate study, researchers from Auburn University and the University of Delaware have implemented research to determine the factors constraining the success of fish culture systems established through USAID-funded development projects in Panamá and Guatemala in the 1980s. At the University of Arkansas at Pine Bluff, CRSP researchers have been engaged in risk analyses of shrimp production and estimations of returns to investment of PD/A CRSP research to develop a picture of the economic realities surrounding tilapia and shrimp production in Honduras and as well other PD/A CRSP host countries.

Socioeconomic Aspects of Aquacultural Development: Who Is Growing Fish, Under What Circumstances, and Why?

PD/A CRSP Project Leader Joseph Molnar from Auburn University has conducted a series of studies of countries where the CRSP has operated or currently operates. Practicing fish farmers from the surrounding regions of CRSP sites in Rwanda, Honduras, the Philippines, Thailand, Kenya, and Peru were surveyed to determine the approaches fish farmers are using, the problems they are experiencing, and their expectations and aspirations for the aquaculture enterprise. The socioeconomic studies also profiled the number and kinds of ponds that farmers are using to grow fish, what they feed their fish, how they sell the fish, and the significance of fish farming to their household and farming systems.

In Rwanda, research indicated that pond inputs were often scarce, and the water was very cold for tilapia. Nonetheless, farmers were avidly constructing fish ponds and doing what they could to have fish as part of their farm activities. Women were particularly interested in fish culture because it provided a source of cash for their own and their children's needs. Group ponds also were a source of solidarity and social support for women, and they also gave young men access to land and an activity independent of their families in a situation where land was in short supply.

Honduran farmers struggled with a government that changed personnel at the main research station every six months or so and thus was not well-organized to

provide extension assistance or operate efficiently. They also faced a poorly-developed system for marketing their fish. In areas where large fish farms provided a reliable source of fingerlings, many small- and medium-scale farms provided food security and income for the families operating the farms and for their

... continued on p. 10



A tilapia fish pond in Nyeri district, Central Province, Kenya, in the highlands surrounding Mt. Kenya.

Graduate Student Profile: Diego Valderrama

by Matt Niles

Diego Valderrama, a 26-year-old native of Cali, Colombia, began working towards an M.S. degree under a graduate research assistantship granted by the PD/A CRSP in January 1998. Majoring in Aquaculture Economics at the University of Arkansas at Pine Bluff, Diego came directly from Colombia to join the Aquaculture/Fisheries Center at UAPB after contacting Dr. Carole Engle, Coordinator of the Aquaculture/Fisheries Center at UAPB, and learning of the CRSP project in Honduras.

Diego holds a B.S. in Marine Biology from the Universidad de Bogota Jorge Tadeo Lozano, Colombia, which he completed in 1994, and his research experience there actually had more to do with coral reefs than with aquaculture. His work as a marine biologist included a project to evaluate changes in the composition of marine zooplankton populations resulting from increased freshwater input.

Diego enjoyed his work with coral reefs, but looked forward to shifting his focus towards aquaculture research. The fact that there were no graduate programs in Colombia focusing on aquaculture research further motivated Diego to travel abroad.

Admittedly, however, Aquaculture Economics never crossed Diego's mind as a potential course of study. "I defined my major as a consequence of my enrollment in the CRSP, and I am actually very glad to have [been] involved in the Honduras project," he explains.

"I definitely had a strong interest in aquaculture as an activity that could help developing countries of Latin America to take advantage of their natural resources to generate some of the much-needed foreign exchange."

Diego's thesis project involves an extensive economic analysis of shrimp farming in Honduras, and includes an analysis of the economic impact of the CRSP's research there. This analysis was based largely on surveys of Honduran shrimp farmers distributed by Carole Engle at a workshop

sponsored by the CRSP and ANDAH in October 1997.

The completed forms were collected by Diego in March 1998, when he traveled to Honduras to conduct the difficult task of contacting the farmers and collecting the completed survey forms. Personal interviews with busy farm managers and accountants were often required to complete the questionnaires, which were obtained from 21 farms.



ELLEN MCNUITY

Diego Valderrama

The first part of Diego's thesis project was a risk analysis of shrimp farming in Honduras, the objective of which was to quantify the potential for profit or loss of shrimp farms.

In the risk analysis, the 21 farms that participated in the survey were grouped into four scenarios that reflected different management strategies and scales of operation. Enterprise budgets were developed for every scenario, and the potential for profit was determined for each.

Diego will present the results of this first part of his thesis at the V Central American Symposium on Aquaculture, to be held in San Pedro Sula, Honduras, in August 1999. Diego also plans to publish his results in an American peer-reviewed journal.

Diego is currently working on the second part of his thesis, which

involves the development of an optimization model for shrimp farming in Honduras, using the same survey data. The objective of the optimization model is to formulate a complete annual plan of activities (such as stocking dates, stocking densities, feeding rates, and duration of grow-out cycles) for shrimp farmers in Honduras, intended to maximize farm profits at a reduced risk level. These plans will take into consideration the various constraints (availability of land, capital, supply of seed, etc.) faced by shrimp farmers, and will be developed for the different farm scenarios used in the first part of Diego's project.

Diego looks forward to the opportunity to apply some of the experience and skills he acquired as a result of working with the CRSP in his own country of Colombia.

"To my knowledge, little research has been conducted on the economics of shrimp farming in Colombia," Diego explains, adding, "The industry was heavily affected by the introduction of the Taura Syndrome Virus (TSV) in 1993. As a consequence, many of the farms were taken out of business. However, the industry made a comeback last year and prospects for the future of existing shrimp farms are optimistic. Then, there is a present need for optimization tools that enable farm managers to identify the best strategies to be implemented in the post-Taura years. I feel that my work experience with the CRSP has provided me with the abilities to respond to these particular needs of the shrimp farming industry in Colombia."

Asked of his plans after he completes his thesis, Diego doesn't rule out the prospect of a Ph.D. in Aquaculture Economics, and he described several potential projects he is likely to become involved with at the University of Arkansas at Pine Bluff, including a variety of catfish-rearing projects in Arkansas and a new tilapia marketing project in Central America that will be initiated this year. 🐟

Three New Fish in the Pond

by Deb Burke

Within the last year, three new team members have joined the CRSP's research effort in Southeast Asia: Dr. Remedios Bolivar (Central Luzon State University, Philippines); Dr. Chris Brown (University of Hawaii, USA); and Dr. Amrit Bart, (Asian Institute of Technology, Thailand). Below, Bolivar, Brown, and Bart discuss how they became involved with the CRSP. They also share their views on aquaculture in Southeast Asia and the role of the PD/A CRSP in supporting the development of sustainable aquaculture.

Remedios Bolivar

In the Winter 1999 issue of *Aquanews* we introduced you to Dr. Remedios Bolivar, who began her work as the Host Country Principal Investigator with the PD/A CRSP Philippines prime site in September 1998. Bolivar's interest in aquaculture grew from her awareness of the abundant water



Remedios Bolivar

resources in the Philippines, much of which is suitable for aquaculture. Bolivar observed that in the Philippines there is "great potential and opportunities

for aquaculture to contribute to the livelihood enhancement of the people, especially of the rural constituents" and feels that her work with the PD/A CRSP will benefit tilapia farming in the Philippines.

Bolivar's interests in aquaculture focus on tilapia breeding and genetics, particularly in selective breeding. In the Philippines, according to Bolivar, "there is a high demand for genetically improved tilapia stocks but there are only a few fish breeding programs." Additionally, she stated that "there is a need to increase the availa-

bility of quality fingerlings to further increase aquaculture production."

"Tilapia farming in Southeast Asia is still basically semi-intensive," commented Bolivar, and she thinks it is important that gaps in scientific and technical knowledge be addressed through research to intensify fish production. Bolivar feels that these gaps exist in the following areas: nutrition and feeding management, environmental requirements, growth and behavior, seed production, and genetics. Equally important to obtaining scientific and technical knowledge, asserts Bolivar, is "the adequate transfer of information and technical guidance to target clientele groups."

Regarding the future of the tilapia aquaculture industry in the Philippines and Southeast Asia, Bolivar believes that existing aquacultural practices should be assessed. To address this need, the Freshwater Aquaculture Center, CLSU, in collaboration with the Hawaii Institute of Marine Biology at the University of Hawaii, Manoa, is identifying practical pond management options for tilapia production, focusing particularly on fertilization, feeding, and stocking practices. "The output from this project," Bolivar states, "will help optimize intensification of tilapia farming in the country and other tilapia producing countries in Southeast Asia."

On-farm research is an aspect of Bolivar's work with the PD/A CRSP which she finds satisfying, as is evidenced in the following comment: "I am happy to have been involved on a project with the PD/A CRSP. The work has given me the opportunity to reach out to the tilapia farmers directly through our on-farm research activities." Additionally, she feels the challenge of her work with the PD/A CRSP will be to get the technical and scientific information out to the target fish farmers. "A lot of research projects have been done without the component of technology transfer and dissemination to the intended beneficiaries. A strong effort should be made for target clientele to utilize and benefit from meaningful research projects in aquaculture production."

Chris Brown

Chris Brown came on board with the PD/A CRSP as Project Leader for the new Philippines prime site in May 1998. In addition to his work with the CRSP, Brown

is a full professor and aquaculture coordinator at the University of Hawaii. Prior to his professorship at UH he worked as a researcher in the Department of Zoology at the University of California, Berkeley. His educational background includes a BS in biology from Union College followed by a PhD in biology from the University of Delaware. Over the years Brown has been involved in various scientific activities. He has been an invited speaker for a number of scientific meetings of the World Aquaculture Society (1997, 1995), the National Science Foundation-sponsored Symposium on Vertebrate Development (1996), an International Conference on Hormone Applications in Aquaculture (1994), and the Twelfth International Conference on Comparative Endocrinology (1993), to name only a few. Brown also traveled to the Centro de Investigación Científica y de Educación Superior de Ensenada, Mexico, as a visiting scientist, and to the Göteborg University, Sweden, where he studied the molecular mechanisms of embryogenesis as a Senior Fulbright Scholar.



Chris Brown

Brown developed an interest in ornamental fish as an adolescent and this interest evolved into a more serious research focus in fish physiology during the 1970s. At various points throughout Brown's career he has worked with ecologists, endocrinologists, and aquaculturists, and his experiences in each of these disciplines have almost always been related to fish. Brown's primary research interests include developmental biology, gene

... continued on p. 6

New Administrative and Technical Reports Available

Hot off the presses, the PD/A CRSP Sixteenth Annual Administrative Report is a 100-page publication containing an introduction to the program, reports from the three research support components, a summary of research conducted under the Eighth Work Plan, and abstracts of all the technical reports submitted within the reporting period. Additionally, a history of the PD/A CRSP, list of participants, financial summary, program and researcher linkages, and list of publications are included.

For the first time, in response to fiscal constraints, the Sixteenth Annual Technical Report is not being distributed as a bound volume. Instead, individual reports can be ordered. A table of contents listing the reports is available, and abstracts are printed in the Administrative Report.

Full-text versions of both the Administrative and Technical Reports will soon be available on-line at the PD/A CRSP website <www.orst.edu/dept/crsp/pubs/publications.html>. Additionally, hard copies of the Administrative Report and individual technical reports, as well as the Technical Report's table of contents can be ordered by email from crspsmail@orst.edu or from:

Publications
Pond Dynamics/Aquaculture CRSP
Oregon State University
400 Snell Hall
Corvallis OR 97331 USA



Fertilization Guide Available from PD/A CRSP

Pond Fertilization: Ecological Approach and Practical Application
by Christopher F. Knud-Hansen

This 137-page report provides an approach to pond fertilization that takes into account the efficiencies, ecological impacts, and economics of various fertilizers as well as the dynamic chemical and biological processes that take place in pond ecosystems. The book incorporates years of PD/A CRSP pond dynamics and fertilization research in a form designed to be understood by regional extension workers, educated farmers, aquaculture students, and scientists.

Copies can be requested from:

Publications
Pond Dynamics/Aquaculture CRSP
Oregon State University
400 Snell Hall
Corvallis, OR 97331-1641

E-mail: crsp.mail@orst.edu

Reengineering Partnerships in USAID

by Matt Niles

Director Hillary Egna and new PD/A CRSP Assistant Director Cormac Craven and were among several CRSP participants who attended a recent USAID workshop on March 4th and 5th in Newport, Oregon. "Reengineering Partnerships in USAIDs Environmental and Natural Resource Management Programs in Africa" was the title of the two-day

workshop, which averaged about 25 participants over the course of the event, the majority of whom were Oregon State University affiliates involved with USAID work in Africa.

The presentation in Newport was only one stop along a nationwide education effort by USAID promoting new ways of improving the work of USAID in Africa, informing USAIDs partners about the changes USAID is making in its operations, and encouraging potential USAID partners to actively participate in creating new and

more committed relationships with USAID.

Hoping its reengineering process will be more than a new set of streamlining procedures, USAID is encouraging the development of a new mindset that will make USAIDs efforts more effective. USAID hopes to achieve this by promoting a more "outcome/results" approach to environmental and natural resource management projects, rather than

... continued on p. 5

Meet Cormac Craven, New PD/A CRSP Assistant Director

by Matt Niles

The Program Management Office welcomes Cormac Craven, who recently accepted the newly-created position of Assistant Director of the PD/A CRSP. The Assistant Director position was created following the departure of Brigitte Goetze. Conceived as a position on-track to Goetze's former position of Deputy Director, the PD/A CRSP Assistant Director serves as a liaison between the Program Management Office and CRSP participants, in addition to a variety of additional duties.

Hailing from Kilcormac, Ireland, Craven is a recent graduate of the Marine Resource Management program at Oregon State University. While in the MRM program, Craven's work included a project in which he examined methods to improve the safety and quality of albacore tuna caught by Oregon's fishing fleet. He looked at simple, affordable methods of fish chilling that could be used by fishermen to improve the quality of their catch. His project included the distribution of informational brochures and reports that proved to be very popular among the fisherman. Craven also helped to develop computer models to simulate the chilling of albacore to determine optimal refrigeration rates and capacity of onboard refrigeration



PD/A CRSP Assistant Director Cormac Craven

equipment, which is sometimes exceeded by fishermen, resulting in reduced catch quality and potential rejection of the catch by tuna buyers.

Craven's interest in aquaculture-related work dates back to an aquaculture class he attended early in his undergraduate career. In 1991, Craven completed his undergraduate degree from Galway Regional College on the west coast of Ireland, a mere 60 miles from his home town, where he majored in Applied Aquatic Sciences. A year of his undergraduate work was devoted to aquaculture courses, which focused primarily on salmonid culture. Craven gained additional aquaculture experience as a student

working at a salmon hatchery in Ireland, which proved to be his first exposure to closed, freshwater aquaculture systems.

After completing his studies at Galway College, Craven spent two years working at an aquaculture facility in western Ireland. Here he managed the Atlantic salmon production facilities, which were composed of floating net pens. Craven was involved in all aspects of the farm's operation, from everyday production duties like feeding and stocking to interacting with local residents, suppliers, and hungry seals.

Craven should fit right in here at the CRSP, as he is no stranger to aquaculture production optimization; his farm boasted some of the highest production levels of any salmon farm in Ireland.

While most of his time is occupied by administrative duties, Craven feels that his aquaculture background will be an asset in communicating with CRSP researchers and dealing with the more technical aspects of the day-to-day operation of Program Management Office.

When he's not working away in his corner office, Craven enjoys mountain biking and hiking in the hills surrounding Corvallis and takes full advantage of the wide variety of excellent beer produced in Oregon's Willamette Valley. Again, welcome, Cormac, to the PD/A CRSP. 🐟

Reengineering Partnerships

... from p. 4

focusing on the function or process of a project.

The workshop included presentations and role-playing activities, in which participants broke into teams to represent issues. Each team critiqued actual plans submitted to USAID and compared the plans' methods to those outlined in USAID's newly reengineered guidelines to analyze the effectiveness of each plan.

Through the efforts of these on-going workshops across the country, USAID hopes to accomplish its goal of "crafting better partnerships among NGOs, PVOs, local governments, contractors, and other donors within the environmental/natural resource management sector." In doing so, it is hoped that the end result of this collaboration will be a significant increase in the positive impact USAID can make in its environmental and development efforts throughout the world. 🐟

Congratulations, Deb!

All of us here at the Program Management Office would like to congratulate our own Deb Burke for the successful defense of her thesis, entitled "An analysis of the social relations at an aquaculture development site in Kenya." While things got a little tense at times in that hot little room, Deb didn't let the disappointed looks from the audience and her advisors get to her, and she eventually persevered.

All kidding aside, Deb gave an excellent presentation of her work in Kenya, which, as alert readers may recall, was featured in the inaugural "Graduate Student Profile" column in the Spring 1998 issue of *Aquanews*. Again, congratulations, Deb, on your brand new degree, and good luck in all of your future endeavors. 🐟

New Fish in the Pond

... from p. 3

expression, and nutrition. More recently Brown has developed an interest in the practical aspects of cost-effective aquaculture.

Brown became familiar with the PD/A CRSP through the work of his colleagues from the University of Hawaii, who have a long history of involvement with the program (often in the Philippines), including retired CRSP Board member Phil Helfrich, previous CRSP researchers Arlo Fast and Kevin Hopkins, and Jim Szyper, who currently works with the program. Consequently, Brown has followed CRSP work in the Philippines for almost ten years. When Brown learned of the establishment of a Philippines prime site he said he found the prospects of participating in the development of the site especially appealing.

Brown discussed his perspective on aquaculture and the role of the PD/A CRSP in the Philippines. He believes that aquaculture is a necessity in the Philippines. He notes that he is very impressed with both the scale and progressiveness of aquaculture activities. Additionally, he says, "It is my impression that many of the brightest and most highly motivated people go into aquaculture in the Philippines; certainly that can be said of my host country institution, the Freshwater Aquaculture Center, which is viewed as one of the best, if not the best, institutions within the Central Luzon State University." Brown added, however, that sometimes "certain assumptions are upended." Once he went to a place with a big sign out front that said the "Internet Cafe." Brown realized that "neither the java nor the javascript was the sort we [in the US] are accustomed to; they had computers, you bet, but no phones or internet access and the coffee was Nescafe prepared over a propane stove."

The CRSPs strongest role in aquaculture in the Philippines, according to Brown, will be providing assistance in identifying, developing, and integrating appropriate technologies and bringing together the most

practical or effective technical elements related to aquaculture. Brown elaborates, "In our project, for example, we are not only conducting on-farm tests of practical feeding paradigms, but we are also using fish provided by the GIFT Foundation. My vision is one in which the edges of the various projects melt away into a way of life." Of the work of the PD/A CRSP, Brown states that he hoped "to see the Central Luzon State University fulfill its potential as a regional center for technology development and dissemination."

In regards to his participation thus far in the program, Brown said his work with the PD/A CRSP and Central Luzon State University administrative entities have been relatively easy and straightforward. The challenges Brown foresees with working with the PD/A CRSP include the departure of former Deputy Director Brigitte Goetze who Brown said had been enormously helpful to him, and the budget reductions that the PD/A CRSP received last spring.

Amrit Bart

Amrit Bart joined the PD/A CRSP in November as the new Host Country Principal Investigator in Thailand. Bart received his MA in agriculture economics, MS in Fish Reproduction/Aquaculture and his PhD in Aquatic Biology/Aquaculture from Auburn University. After completing a three-year fellowship at the Center of Marine Biotechnology, University of Maryland, Bart joined the faculty of the Asian Institute of Technology (AIT) in March 1998. Bart's other academic and research experiences include a three-year assignment in Indonesia as an Aquaculture Education/Research Specialist and a year of teaching, research, and outreach at AIT. Bart was an invited speaker at the World Aquaculture Society Meeting in Thailand in 1996 where he discussed the effects of sperm concentration and egg number on fertilization efficiency with channel catfish, *Ictalurus punctatus*, eggs and blue catfish (*I. furcatus*) sperm. At the Society for Theriogenology Annual Meeting in 1994, Bart spoke

about the effect of blue catfish sperm concentration and cryopreservation of sperm on fertilization efficiency with channel catfish eggs.

Bart notes that he became familiar with the activities of the CRSP through his studies at Auburn University. He comments in his interview that he is "impressed at the tenacity of the CRSP to continue producing quality research despite vast [35%] budget cuts." After Bart joined the faculty of AIT last March he was asked if he would be interested in participating as a Host Country Principal Investigator with the PD/A CRSP, a position he said he eagerly accepted.

Bart said he first developed an interest in aquaculture during his senior year in college. He attended a course called "Choices in Environmen-



Amrit Bart

talism," which challenged him to think of economically feasible ways to grow food that used sustainable and environmentally friendly technologies. The challenge posed in this course intrigued Bart and he decided to explore the possibilities of aquaculture.

Bart's primary interests in aquaculture are fish reproduction, genetics, environmental stress response, and understanding aquaculture systems as a whole. Recent interests he has pursued include genetic conservation and gene banking using cryogenic technology.

Bart discussed the constraints to aquaculture he had observed in

... continued on p. 8

PD/A CRSP Update

by Deb Burke

One of the goals of the Information Management and Networking Component (IMNC) of the PD/A CRSP is to keep *Aquanews* readers informed about what's been going on within the program and how the program is connected to the greater aquaculture community. This article covers recent program connections and linkages, information about the CRSP Listserve and the Sixteenth Annual Administrative and Technical Reports, and co-authorship by a CRSP researcher of a water quality management text for pond aquaculture.

Recent Connections and Linkages

PD/A CRSP on-site researcher in Kenya, Karen Veverica, met with individuals from the University of

Nairobi and the International Centre for Research in Agroforestry (ICRAF) regarding the farming of *Clarias* and laboratory collaboration, respectively. Additionally, Veverica met with the Wetland Programme Officer, Project Officer, and Field Officer from the World Conservation Union (IUCN) in Nairobi. Veverica has also been involved with discussions and a meeting pertaining to the drafting of a constitution for a Fish Farmers Association of Kenya Society and continues to meet with trout farmers interested in starting up tilapia ponds.

In the Philippines the PD/A CRSP maintains its association with the Genetically Improved Farmed Tilapia (GIFT) Foundation and the Bureau of Fisheries and Aquatic Resources (BFAR). The CRSP will be using fish from the GIFT Foundation in its research activities and in turn will provide promotional assistance through the distribution of GIFT fish

for use in PD/A CRSP on-farm trials. Chris Brown, Philippines Project Leader, also contacted BFAR for the purpose of introductions.

During his trip in March to Peru to meet with rural fish farmers, Joseph Molnar, CRSP researcher from Auburn University, in collaboration with Peru CRSP researchers Gonzalo Llosa Talavera and Fernando Alcántara, established initial relations with CARE/Peru and the Peruvian Catholic Relief Organization.

PD/A CRSP researcher Kevin Fitzsimmons from the University of Arizona made electronic introductions with several tilapia farms in Peru, Venezuela, Suriname, and Mexico.

The PD/A CRSP recently established a Memorandum of Understanding (MOU) with the Universidad Juárez Autónoma de Tabasco in Mexico. The MOU was signed in

... continued on p. 8

CRSP Conference Activity

by Matt Niles

A number of PD/A CRSP researchers participated recently in two major conferences, the Fifth Asian Fisheries Forum, held 10–14 November 1998, and Aquaculture America '99, held 27–31 January 1999.

CRSP researchers from the University of Michigan, USA, and the Asian Institute of Technology, Thailand, were involved in the following presentations and poster sessions at the Fifth Asian Fisheries Forum:

- Kaewprakaisaengkul, C., C.K. Lin, and Yang Yi. Construction and application of hapa washer
- Lin, C.K. and Yang Yi. Comparative economic analyses for different grow-out strategies of Nile tilapia in earthen ponds;
- Lin, C.K. M.K. Shrestha, J.S. Diana, and D.P. Thakur. Management to minimize the environmental impacts of pond draining: Harvest draining technique and effluent quality
- Lin, C.K., Yang Yi, and J.S. Diana. Effects of management strategy on nutrient budgets in Nile tilapia (*Oreochromis niloticus*) ponds
- Pant J., P. Promthong, C.K. Lin, and H. Demaine. Fertilization of ponds with inorganic fertilizers: Low cost technologies for small-scale farmers
- Yang Yi. An integrated cage culture system in earthen ponds: A bioenergetics growth model for Nile tilapia

Boyd, CRSP researcher from Auburn University, also spoke at the Fifth Asian Fisheries Forum on environmental management in aquaculture.

"Aquaculture on the Rise" was the theme for Aquaculture America '99, held in Tampa, Florida, 27–31 January 1999. Claude Boyd presented the keynote address on aquaculture sustainability and environmental issues, and presentations of CRSP researchers ranged from CRSP-related topics such as "Sex Manipulation in *Oreochromis niloticus*," by William Shelton and Ronald Phelps, to non-CRSP-related subjects like Christopher Kohler's talk on the production of sunshine bass. Additional presentations included the following:

- Christopher Kohler organized and moderated a session on "Meeting the hatchery challenges of the new millennium"
- Raul Piedrahita presented talks on aquaculture recirculating systems issues and water quality parameters in fish ponds
- David Teichert-Coddington and Claude Boyd presented a paper entitled "Treatment of harvest discharge from intensive shrimp ponds by settling"
- David Teichert-Coddington and Ronald Phelps presented a paper on methyltestosterone concentration and feed storage temperature
- Rebecca Lochmann presented a paper entitled "Nutritional aspects of health and related components of baitfish performance"
- Kevin Fitzsimmons presented a talk entitled "Aquaculture competitions—High schools and Future Farmer of America career development opportunities"

PD/A CRSP Ninth Work Plan—Roadmap to the 21st Century

The PD/A CRSP Ninth Work Plan is now available in hard copy format by request (see ordering information on page 4). This 92-page document describes two-year investigations to be conducted by CRSP researchers beginning between 1 August 1998 and 1 May 1999 under the program's current 1996-2001 USAID grant. The document will also soon be available for downloading from the program website (address on front cover).

Preparation of the Ninth Work Plan involved an unprecedented level of review of work plan proposals. Proposals were solicited based on priorities and constraints identified in the CRSP grant and in other program documents as described in the Ninth Work Plan Restricted Request for Proposals. Well into the review and selection process, the PD/A CRSP learned of a substantial reduction in its USAID budget allocation. As a result, significant changes had to be made in the proposed work plan to ensure adequate coverage of the critical areas within the newly imposed financial constraints. A number of work plans were eliminated and research support activities

curtailed. Additionally, substantial budgetary reductions were absorbed by the Program Management Office (PMO).

The investigations contained in the Ninth Work Plan will be implemented at CRSP prime sites in Peru, Kenya, the Philippines, and Thailand and in the US. (A restricted request for proposals has been issued to identify a lead institution for work in Honduras. The new Honduras project will likely be in place by mid-year. While the work plan for Honduras is, therefore, not included in the current publication, it is "technically" Ninth Work Plan research and will appear in a subsequent Addendum to the Ninth Work Plan.)


Ninth Work Plan investigations address a broad range of research themes (pond dynamics, reproduction control, aquaculture systems modeling, effluents and pollution, marketing and economic analysis, decision support systems, feeds and fertilizers, new aquaculture systems/new species, appropriate technology, and adoption/diffusion) as well as research support efforts in education development and database management. 

New Fish in the Pond

... from p. 6

Southeast Asia and the potential role of the CRSP. He states that a "number of technical issues in quality of fish seed, disease, and nutrition continue to be important in Southeast Asia." He also commented that many of "the more intensive inland aquaculture ponds receive water from rivers and reservoirs that contain agricultural, household, and industrial pollutants. Little is known about their long-term impact on fish reproduction, growth, deformities, and effects on consumers." Bart feels that "CRSP involvement in studies of long-term impact on reproduction, larvae, food fish, and broodfish in a culture system contaminated by unhealthy effluents" would "significantly help in formulating effluent discharge policies by the regional governments."

Regarding his future with the PD/A CRSP, Bart comments that he is looking forward to working with CRSP researchers who he stated have an "excellent reputation."

The PD/A CRSP would like to extend its welcome to Drs. Brown, Bolivar, and Bart. 

PD/A CRSP Update

... from p. 7


March 1999, and Gabriel Marquez Couturier will be the new Host Country Principal Investigator.

Marion McNamara, coordinator of Education Development Component of the PD/A CRSP, has been providing assistance to conference organizers of the Fifth Central American Symposium on Aquaculture (originally scheduled to take place 3 to 5 March 1999). Due to Hurricane Mitch the conference was rescheduled to take place 18 to 20 August 1999. McNamara announced the new Call for Papers submission date, which is now 1 June 1999 and reflects the new date of the conference (see back page). Additionally, McNamara continues to correspond with authors of invited and contributed papers and will be compiling and laying out the conference proceedings. To receive more information about the conference, contact Marion McNamara—phone 541-737-6419 or email mcnamarm@ucs.orst.edu.

CRSP Listserve and Annual Reports

The Information Management and Networking Component (IMNC) of the PD/A CRSP recently set up the new CRSP Listserve to replace the previous listserv, AQUACUL, for CRSP participants. In addition, the IMNC distributed the Sixteenth Annual Administrative Report; the Sixteenth Annual Technical Report is available upon request (see page 4 for details on ordering PD/A CRSP Annual Reports).

CRSP Researcher Co-Authors Book on Pond Aquaculture Water Quality

Recently the book *Pond Aquaculture Water Quality Management*, was released by Kluwer Academic Publishers. The book is written by Claude Boyd, a PD/A CRSP researcher, and Craig Tucker. This book provides a complete, up-to-date account of water quality and its management in aquaculture ponds. 

Tilapia Recipes—A New *Aquanews* Feature

Matt Niles, CRSP stalwart and king of the barbecue, has combed his top-secret culinary sources to find tasty tilapia treats. His efforts debut in this issue of *Aquanews*. Clip and save them all!

Baked Tilapia with Tomatoes and Olives

Ingredients:

| | |
|--|---------------------------------------|
| 6 tilapia fillets | |
| 1/4 cup extra-virgin olive oil | 1/2 cup coarsely chopped green olives |
| 4 sprigs of fresh thyme | 1/4 tsp. dried hot red pepper flakes |
| 3 tomatoes, peeled, seeded and chopped | 2 garlic cloves, minced |
| | 1/2 cup finely chopped red onion |
| | 1 T. fresh lime juice |

Instructions:

Preheat the oven to 400 degrees. Oil lightly a shallow baking dish large enough to hold the fillets in one layer. In a bowl stir together the oil, the thyme, the tomatoes, the olives, the red pepper flakes, the garlic, the onion, and the lime juice. In the prepared baking dish arrange the fillets, skin sides down, season them with salt, and spoon the tomato mixture over them. Bake the fish, uncovered, in the middle of the oven 15 to 20 minutes, or until it just flakes.

Obtained from <tilapia.unh.edu/WWWPages/TGP/Recipe4.html>

Spicy Grilled Tilapia with Aioli

Ingredients:

2 lb. tilapia fillets
 1 tsp. garlic powder
 1 tsp. onion powder
 1 tsp. cumin
 2 T. chili powder

Instructions:

Spray grill rack with non-stick coating. Rinse tilapia with cold water and pat dry with paper towels. Combine spices and sprinkle on both sides of fillets. Place on heated grill 4 to 5 inches from hot fire. (Can also broil in oven). Cook 4-5 minutes per 1/2 inch measured at thickest point. Turn once halfway through cooking time. Serve with Aioli.

Instructions to make Aioli:

1 1/2 cup mayonnaise
 6 garlic cloves, pressed
 1 1/2 T. lemon juice
 1 1/2 T. Dijon mustard
 3/4 tsp. dried tarragon

Combine all ingredients in a bowl. Refrigerate.

Obtained from <tilapia.unh.edu/WWWPages/recipe2.html>

Broiled Tilapia with Sweet Potato Crust

Ingredients:

2 six-oz. tilapia fillets
Filling:
 3 sweet potatoes, cooked and peeled
 3 tsp. fresh lemon juice
 4 tsp. fresh orange juice
 1 T. butter
 1 tsp. salt
 1/2 tsp. minced ginger

Crust:
 3 graham crackers
 1 cup roasted pecans
 2 T. melted butter
Sauce:
 5 T. heavy cream
 1 T. vanilla
 2 T. fish stock or water
 pinch of seafood or Creole seasoning

Instructions:

Grind sweet potatoes, juices, butter, salt and ginger together and set aside. Grind the graham crackers, pecans and butter together. Cover the fish with the sweet potato mixture. Then sprinkle the pecan mixture over the top. Broil the fillets until golden brown, approximately 4 minutes. In a small skillet, add the cream, vanilla, stock and seasoning. Bring to a boil and cook for a minute, until the alcohol in the vanilla is gone and the sauce coats the back of a spoon. Pool the sauce on a plate. Place the broiled fish fillet on top and serve.

Serves: Two

Obtained from <tilapia.unh.edu/WWWPages/recipe5.html >

Social Science Research

... from p. 1

surrounding communities.

Filipino farmers receive some of the highest prices for tilapia of all the PD/A CRSP host countries. The CRSP study also found that a steady supply



Poultry house located over a tilapia pond in Thailand. Integrated production systems are quite common in areas surrounding both the Thailand and Philippine research sites.

of fingerlings and practical advice flowing to fish farmers from research and extension agencies surrounding the Freshwater Aquaculture Center at Central Luzon State University was contributing to the growing popularity of fish farming in Luzon.

One Thai farmer excused himself from an interview and farm visit because he had a golf game and the fish pond was really his wife's activity. This anecdote illustrates the growing middle class in the Central Thailand provinces surrounding Bangkok where the Asian Institute of Technology, a host country institution, is located. In the less prosperous mountain areas or in Northeast Thailand, poverty and poor soils make fish culture an important option for generating income and food security for many families.

Kenyan farmers struggle with weak support services for aquaculture and a strong desire for bigger fish. This expectation is hard to meet in small ponds in the upland areas surrounding Mt. Kenya. Nonetheless, some farmers manage to continue growing tilapia because the small quantities they are producing are relatively easy to market and the

demand is often high. Sagana Fish Farm, a research site, is an important source of fingerlings and expertise in a region where fish and fish culture are a comparatively new part of the diet and the farming system, respectively.

Of the PD/A CRSP regions surveyed, the Peruvian Amazon has perhaps the most promising outlook for fish culture. The natural hydrologic cycle of the Amazon provides for a set of needs of small-scale fish farmers and creates opportunities for farmers. The river fishery's well-developed marketing system is a singular asset for fish farmers who can harvest and sell their fish during the high-water period when river fish are scarce and the price of fish is high. Ponds are widely dispersed among the many small communities in drainage basins

surrounding Iquitos. Researchers at the Instituto de Investigaciones de la Amazonia Peruana, a host country institution, focus on reproductive



LEONARD LOVSHIN

Guatemalan farmer and Peace Corps volunteer observing 100-m² family fish pond with chicken coop in 1988.

processes in the large predator fish at the top of the food chain. Producers stock a variety of fruit-eating and bottom-feeding fish in polyculture systems using largely wild-caught fingerlings from the Amazon and its tributaries.

An important theme that emerged from these socioeconomic profiles is the importance of nongovernmental organizations such as CARE and others who support local aquaculture activities with technical and financial

assistance. The impacts of CRSP research are magnified through the many enduring relationships that these organizations have with people throughout the rural sector.

The Influence of Fish Culture Technology, Extension Methodology, and Socioeconomics on the Success of Fish Culture on Limited-Resource Farms in Guatemala and Panamá: An Ex-Post Evaluation

CRSP researchers Leonard Lovshin and Upton Hatch from Auburn University and Norman Schwartz from the University of Delaware undertook a study that evaluated the current status of fish pond projects initiated by USAID and Auburn University in the 1980s on farms with few available resources in Guatemala and Panamá. The fish pond projects utilized culture systems that were similar to the culture systems that CRSP researchers study. The study examined the impact of aquaculture technology, extension services, local socioeconomic conditions, and policy environments on the projects. The evaluation team (an aquaculturist, an agricultural economist, and a social anthropologist) had the rare opportunity to evaluate the sustainability of two different types of fish farming projects. Typically, ex-post evaluations of aquaculture projects occur shortly after external support has

ended, rather than after 14 and 9 years as was the case in Panamá and Guatemala, respectively.

Results of the study revealed that the fish pond projects did not have the intended impact on household nutrition and income for a combination of technical, domestic, economic, social, and broad political reasons. In both Guatemala and Panamá technical difficulties, including problematic (i.e., unreliable, insufficient) water supplies to the

... continued on p. 11

Social Science Research

... from p. 10

ponds and a lack of sufficient nutrient inputs to increase fish yields at harvest, hindered the success of the fish culture projects. Additionally, technical assistance to farmers was inconsistent due to civil unrest and changing policy environments in Guatemala and changing government strategies in Panamá. In Guatemala factors such as theft and participant priorities that changed along with changing domestic priorities influenced the outcome of fish pond projects. In Panamá projects were affected by a lack of business and



LEONARD LOVSHIN

Panamanian community fish pond project integrated with pigs, chickens, and gardens as viewed in 1984.

managerial skills, overdependence on local elites and/or the government for assistance, and macrosocial and political changes.

In both Guatemala and Panamá, many project participants who maintained their ponds did so to irrigate gardens and water animals; they also used the ponds as flooded

rice paddies. Thus, although the projects did not meet intended goals related to fish culture, participants found ways to profit from the existence of the ponds. Overall, the study found that in Guatemala and Panamá fish culture was unable to maintain the nutritional and economic benefits to impoverished rural inhabitants that were documented at project termination.

Risk Analyses and Returns to Investment of Shrimp Production in Honduras

CRSP researcher Carole Engle, from the University of Arkansas at Pine Bluff, conducted surveys of Honduran shrimp farmers to obtain information regarding production practices, costs, yields, prices, and farmers' responses to research results generated by the PD/A CRSP. These results have been valuable for a number of activities: the development of a training manual, risk analysis, and estimates

of the return to investment of CRSP shrimp production research in Honduras. Descriptive information from the surveys was compiled to prepare a bilingual (English and Spanish) training manual on financial and investment analyses related to shrimp farming for the Asociación Nacional de Acuicultores de Honduras (ANDAH). Additionally, the survey data were used to complete a risk analysis, using a Monte Carlo simulation procedure, that forecasts the likelihood of achieving profit, break-even yield, and break-even prices for a small, medium, and intensively managed shrimp farms. Overlay and trend charts were developed to compare

distribution outcomes among different farm scenarios and to draw overall conclusions from the risk analysis. Graduate student Diego Valderrama is currently using the data collected from the risk analysis research as the basis for his Master's thesis, "Economic Analysis of Shrimp Farming in Honduras." (See related article on page 2.) Valderrama's thesis will include a stochastic mathematical programming model that will examine shrimp farm economics from a whole-farm perspective and include constraints related to cash flow and other financial, labor, and household constraints.

Engle and Siddhartha Dasgupta, another CRSP researcher from the University of Arkansas at Pine Bluff, also completed a study to estimate the economic returns to investment of shrimp farming research in Honduras. The study indicated that total factor productivity indices of shrimp farming were increasing, indicating technical progress as a result of research. Engle and Dasgupta also found that returns to CRSP investment alone generated an internal rate of return of 45% when the private sector is included in the estimation. Overall, the study indicated that, in Honduras, the CRSP funds have been leveraged effectively with private sector capital.

Future studies Engle will be initiating include a market study to evaluate the potential to enhance the domestic market for tilapia in Honduras and Nicaragua. Additionally, Engle is planning to perform an estimation of returns to investment from CRSP research in Thailand.

CRSP socioeconomic research contributes to our knowledge of local social and economic systems, which can help inform the development of appropriate aquaculture strategies and technologies. Social science investigations also can provide an understanding of the role that aquaculture plays in development—who benefits from aquaculture development, who is left out, and the circumstances where it does a great deal of good. 🐟

Contributions for this article were provided by Joe Molnar, Leonard Lovshin, and Carole Engle.



DIEGO VALDERRAMA

Sampling procedures on shrimp farms in Choluteca, Honduras, are observed during development of PD/A CRSP economic survey.

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 99-129

AQUACULTURE EXTENSION IN RWANDA*

Karen L. Veverica
Department of Fisheries and Allied Aquaculture
Auburn University, Alabama, USA

Nathanael Hishamunda and Pélégie Nyirahabimana
Department of Agricultural Economics and Rural Sociology
Auburn University, Alabama, USA

This report discusses the first phase of the National Fish Culture Project in Rwanda that extended from 1983 through 1988. The project focused solely on fish culture and endeavored to improve fish production in existing ponds through a dynamic extension service. Physical, social, and economic constraints to fish culture in Rwanda are presented in addition to background on the project's extension strategy and a description of the extension agent training. Fifty-five extension agents were trained, and upon completion of the project, approximately 3,000 ponds had been covered through the project's extension efforts. Over the four-year duration of the project, average pond productivity increased from 3.4 to 14.5 kg are⁻¹ yr⁻¹. A 41% internal rate of return was calculated for fish culture as a farm enterprise. The increased cost to maintain the extension program in comparison with the increase in fish production resulted in a 27% internal rate of return to the government of Rwanda. Finally, recommendations for future fish culture projects are discussed in addition to a five-phase aquaculture development plan.

*To order this publication, contact:
Publications/Information Management
PD/A CRSP
400 Snell Hall
Oregon State University
Corvallis OR 97331-1641, USA

CRSP Research Report 99-130

DRY MATTER, ASH, AND ELEMENTAL COMPOSITION OF POND-CULTURED TILAPIA *OREOCHROMIS AUREUS* AND *O. NILOTICUS*

Claude E. Boyd and Bartholomew W. Green
Department of Fisheries and Allied Aquacultures
Alabama Agricultural Experiment Station
Auburn University, Alabama 36849 USA

This study was conducted to determine the dry matter and elemental composition of two species of tilapia, *Oreochromis aureus* and *O. niloticus*. Thirty-two *O. aureus* (total length, 85–223 mm; live weight, 10.2–210 g) and 34 *O. niloticus* (total length, 61–282 mm; live weight, 13.7–282 g) were dried, cooled, and weighed to the nearest 0.01 g to calculate the percentage dry weight. From these samples, carbon and nitrogen analyses were made and ash content was determined. To calculate the concentrations of phosphorus, calcium, magnesium, sodium, potassium, iron, manganese, zinc, and copper, five ml of a 2 N acid solution were added to the ash. The mixture was dried and the remaining residue was diluted to volume with the 2 N acid solution in a 100 ml volumetric flask and filtered through acid-washed filter paper. Element concentrations of the two species of tilapia were calculated. Though fish samples represented a wide range in total length and total weight, regression analyses of concentrations of dry matter, ash, and individual elements (Y) on total length (X) did not reveal an influence of fish size on composition. Minor elements such as iron showed greater variation whereas major elements, ash, and dry matter showed less variation. Tilapia are comprised of approximately 25% dry matter—which consists of approximately 20% inorganic matter (ash), 80% organic matter, and 44% carbon—and 75% water. The average nitrogen concentration for both species combined was 8.7% and the protein content of the whole fish was approximately 56.6%. A correlation matrix was developed from simple linear regressions conducted between all combinations of individual elements in each species. Significant correlations among the elements were found, indicating that fish probably have a fairly consistent proportion of the different elements contained in their bodies. Two examples are provided illustrating how the data compiled in this study were used to compute efficiencies of nutrient utilization and potential nutrient loading in aquaculture ponds.

This abstract was excerpted from the original paper, which was published in *Journal of the World Aquaculture Society*, 29(1):125–128.

Notices of Publication

CRSP Research Report 99-131

THE EFFECTS OF FERTILIZATION AND WATER MANAGEMENT ON GROWTH AND PRODUCTION OF NILE TILAPIA IN DEEP PONDS DURING THE DRY SEASON

James S. Diana
School of Natural Resources and Environment
University of Michigan
Ann Arbor, Michigan 48109-1115 USA

C. Kwei Lin
Asian Institute of Technology
P.O. 2754
Bangkok, Thailand 10501

Fertilization guidelines developed for shallow ponds (1 m) with controlled depths were tested in deeper (2.5 m) ponds to determine effectiveness of these guidelines for culture of Nile tilapia *Oreochromis niloticus*. Twelve ponds of 2.5-m depth were used in four treatments: (A) weekly fertilization with water addition; (B) weekly fertilization without water addition; (C) one early fertilization without water addition; and (D) fertilization frequency dependent on nutrient concentrations, without water addition. Sex-reversed Nile tilapia were stocked at 2 fish/m² with an initial weight of 15 g, and harvested after 234 d. Depth of water declined from 2.4 m to 1.6 m over the experiment in ponds without water addition. Fish growth rate was significantly higher in treatments A and B (0.86 g/d), than in other treatments, as was yield (3,830 kg/ha). Treatment C was lowest in growth (0.086 g/d) and yield (168 kg/ha), with treatment D intermediate. Fish growth rates and yields were strongly correlated to manure input ($R^2 = 0.89$ and 0.94 , respectively), and residuals were not correlated to any physical or chemical variables. Growth and yield in these deep ponds were somewhat lower than those in previous experiments for shallow ponds with regular water inputs. However, stagnant ponds did not accumulate nutrients and metabolites at rates higher than ponds with controlled water depths.

This abstract was excerpted from the original paper, which was published in *Journal of the World Aquaculture Society*, 29(4):405-413.

CRSP Research Report 99-132

RELATIONSHIP BETWEEN SECCHI DISK VISIBILITY AND CHLOROPHYLL A IN AQUACULTURE PONDS

Daniel M. Jamu, Zhimin Lu, Raul H. Piedrahita
Department of Biological and Agricultural Engineering
University of California
One Shields Avenue
Davis, CA 95616-5294 USA

The potential of using Bannister's linear equation ($k_t = k_w + k_c c$) (where k_t is the overall light extinction coefficient, k_w represents the non-phytoplankton light extinction, k_c is the specific light extinction coefficient due to chlorophyll *a* (chl_a), c is the chl_a concentration, and $k_c c$ represents the light extinction due to chl_a) to partition sources of turbidity in Secchi disk visibility (SDV) measurements in aquaculture ponds was evaluated. Eight data sets from five sites around the world were used in the study. Chlorophyll *a* data were regressed against the overall light extinction coefficient determined from SDV measurements. The relationship between chl_a and overall light extinction coefficient was linear for seven of the eight data sets. The contribution of non-phytoplankton turbidity to SDV measurements was estimated by the intercept of the linear regression line (equivalent to k_w). The values obtained (range = 3.61–8.91 m⁻¹) were variable and unpredictable between replicate ponds at all sites, but did not vary significantly over time ($P < 0.05$). Because chl_a concentration serves as an indicator of phytoplankton concentration, the contribution of phytoplankton turbidity to SDV measurements was estimated by the slope of the linear regression line (equivalent to k_c) multiplied by the chl_a concentration. The slope of the regression line (0.014 ± 0.006 m⁻¹ (mg m⁻³)⁻¹) was similar to values reported for natural freshwater systems. The partitioned light extinction coefficients and chl_a concentrations were also used to determine the threshold chl_a concentration above which SDV measurements are determined primarily by chl_a. The threshold chl_a concentrations (177–980 mg m⁻³) above which phytoplankton biomass becomes the primary determinant of SDV were higher than observed chl_a concentrations. The results indicate that Bannister's linear equation can generally be used to partition and quantify the sources of turbidity in aquaculture ponds. The results also suggest that the contribution of non-phytoplankton turbidity to SDV measurements in fertilized and fed aquaculture ponds can be more important than phytoplankton turbidity.

This abstract was excerpted from the original paper, which was published in *Aquaculture*, 170(1999):205–214.

Upcoming Conferences and Expositions

| Date | Topic/Title | Event Location | Contact Information |
|--------------------------|---|--------------------------------|---|
| April 26- May 2, 1999 | World Aquaculture '99 | Sydney, Australia | WAS Conference Manager, World Aquaculture Society, 21710 7th Place West, Bothell, WA 98021; Phone: 425-485-6682; Fax: 425-483-6319; Email: worldaqua@aol.com |
| June 17-19, 1999 | Atlantic Aquaculture | New Brunswick, Canada | Master Promotions, PO Box 565, St. Johns, New Brunswick, Canada E2L 3Z8; Fax: +1-506-658-0750; Email: show@nbnet.nb.ca |
| June 23-26, 1999 | The 5th International Interdisciplinary Conference on the Environment | Baltimore, Maryland, USA | Demetri Kantarelis or Kevin L. Hickey, IEA/Kantarelis-Hickey Assumption College, 500 Salisbury Street Worcester, MA 01615; Phone: 508-767-7557 (Kantarelis), 508-767-7296 (Hickey); Fax: 508-767-7382; Email: dkantar@assumption.edu, khickey@assumption.edu; Internet: <champion.iupui.edu/~mreiter/iea.htm> |
| August 7- 10, 1999 | Aquaculture Europe '99 | Trondheim, Norway | Stiftelsen Nor-Fishing, Nidarohallene, N-7030 Trondheim, Norway; Phone: 47-73-92-93-40; Fax: 47-73-51-61-35 |
| August 11- 14, 1999 | AquaNor '99 | Trondheim, Norway | Stiftelsen Nor-Fishing, Nidarohallene, N-7030 Trondheim, Norway; Phone: 47-73-92-93-40; Fax: 47-73-51-61-35 |
| September 13-16, 1999 | ICES Symposium on the Environmental Effects of Mariculture | New Brunswick, Canada | Dr. D. J. Wildish, Dept. of Fisheries and Oceans, Biological Station, St Andrews, N.B., Canada E0G 2X0; Email:wildishd@mar.dfo-mpo.gc.ca |
| November 17-20, 1999 | Aquaculture Venezuela '99 | Puerto La Cruz, Venezuela | WAS Conference Manager, World Aquaculture Society, 21710 7th Place West, Bothell, WA 98021; Phone: 425-485-6682; Fax: 425-483-6319; Email: worldaqua@aol.com |
| February 1-4, 2000 | Aquaculture America 2000 | New Orleans, Louisiana, USA | WAS Conference Manager, World Aquaculture Society, 21710 7th Place West, Bothell, WA 98021; Phone: 425-485-6682; Fax: 425-483-6319; Email: worldaqua@aol.com |
| May 2-6, 2000 | World Aquaculture 2000 | Nice, France | WAS Conference Manager, World Aquaculture Society, 21710 7th Place West, Bothell, WA 98021; Phone: 25-485-6682; Fax: 425-483-6319; Email: worldaqua@aol.com |
| July 20-23, 2000 | Third International Conference on Recirculating Aquaculture | Roanoke, Virginia, USA | Dr. George Libey, Recirculating Aquaculture Conference 2000, Virginia Tech, Blacksburg, VA 24061; Phone: 540-231-6805; Fax: 540-231-9293; Email: CFAST@vt.edu |
| January 21-25, 2001 | Aquaculture 2001 | Orlando, Florida, USA | WAS Conference Manager, World Aquaculture Society, 21710 7th Place West, Bothell, WA 98021; Phone: 425-485-6682; Fax: 425-483-6319; Email: worldaqua@aol.com |

Workshops and Short Courses

| Date | Title/Topic/Site | Contacts |
|---|--|---|
| Year-round | Work Experience in Hatcheries Techniques/ Asian Institute of Technology, Thailand | Training and Consultancy Unit, Aquaculture and Aquatic Resources Management Program, School of Environment, Resources and Development, Asian Institute of Technology, PO Box 4, Klong Luang, Pathumthani 12120, Thailand; Phone: 66-2-524-5445; Fax: 66- 2-524-5484; Email: tcuaasp@ait.ac.th |
| Year-round | Training and Research in Fisheries and Stock Management/Wageningen Agricultural University, the Netherlands | G. van Eck, Dept of Fish Culture & Fisheries, PO Box 338, 6700 AH Wageningen, The Netherlands; Phone: 31-8370-8330; Fax: 31-8370-83937; Email: gerrie.van.eck@alg.venv.wau.nl |
| Year-round | Tropical Aquaculture Advanced Training in a Third World Country/Escuela Agricola Panamericana (EAP), Honduras, and Asian Institute for Technology, Thailand | Zentralstelle fuer Ernährung und Landwirtschaft (ZEL) Feldafing/ Zschortau, Deutsche Stiftung fuer Internationale Entwicklung (DSE), D-82336 Feldafing, Germany; Phone: ++49-8157-38-0; Fax: ++49-81-57-38-227 |
| April 28-30, June 10-12, August 25-27, October 28-30, and December 1-3, 1999 | Opportunities in Aquaculture Workshop/ Aquaculture Center for Training, Education, and Demonstration (ACTED), Harbor Branch Oceanographic Institution, Fort Pierce, Florida | ACTED; Phone: 800-333-4264 or 561-465-2400 ext. 416; Fax: 561-466-6590; Email: acted@hboi.edu; Internet: <www.hboi.edu/aquaculture/acted.html> |
| May 8, September 10, and November 6, 1999 | Backyard Aquaculture Workshop/Aquaculture Center for Training, Education, and Demonstration (ACTED), Harbor Branch Oceanographic Institution, Fort Pierce, Florida | ACTED; Phone: 800-333-4264 or 561-465-2400 ext. 416; Fax: 561-466-6590; Email: acted@hboi.edu; Internet: <www.hboi.edu/aquaculture/acted.html> |

Workshops and Short Courses (cont.)

| Date | Title/Topic/Site | Contacts |
|---------------------------------------|--|--|
| May 9-June 11, 1999 | HDNR Smithsonian Conservation Short Course: "Biodiversity Monitoring and Assessment for Adaptive Management"/Washington, D.C. | Christopher Ros c/o SI/MAB Program, Smithsonian Institution, S. Dillon Ripley Center, 1100 Jefferson Drive SW, Suite 3123, Washington, D.C. 20560-0705; Phone: 202-357-4793; Fax: 202-786-2557; Email: cjr@ic.si.edu; Internet: <www.si.edu/organiza/museums/ripley/simab/start.htm> |
| May 11-14 and October 12-15, 1999 | Aquaculture Business Planning and Management Short Course/Aquaculture Center for Training, Education, and Demonstration (ACTED), Harbor Branch Oceanographic Institution, Fort Pierce, Florida | ACTED; Phone: 800-333-4264 or 561-465-2400 ext. 416; Fax: 561-466-6590; Email: acted@hboi.edu; Internet: <www.hboi.edu/aquaculture/acted.html> |
| May 17-28, 1999 | Diagnosis and Treatment of Warmwater Fish Diseases/University of Florida, Gainesville, Florida | Dr. Ruth Francis-Floyd, Dept. of Fisheries and Aquatic Sciences, University of Florida, 7922 NW 71st St., Gainesville, FL 32653; Phone: 352-392-9617; Fax: 352-846-1088; Email: rff@gnv.ifas.ufl.edu; Internet: <www.ifas.ufl.edu/~conferweb> |
| May 24-June 4, 1999 | Disease Diagnosis and Control in Marine Shrimp Culture/University of Arizona, Tucson, Arizona | Donald V. Lightner, Dept. of Veterinary Science, University of Arizona, Building 90, Room 108A, Tucson, Arizona 85721; Phone: 520-621-8414; Fax: 520-621-4899; Email: wcm@u.arizona.edu |
| June 21-25 and December 6-10, 1999 | Culture of Penaeid Shrimp Short Course/Aquaculture Center for Training, Education, and Demonstration (ACTED), Harbor Branch Oceanographic Institution, Fort Pierce, Florida | ACTED; Phone: 800-333-4264 or 561-465-2400 ext. 416; Fax: 561-466-6590; Email: acted@hboi.edu; Internet: <www.hboi.edu/aquaculture/acted.html> |
| June 22-26, 1999 | 5th Annual Aquaculture Water Re-Use Systems Short Course/Cornell Animal Science and Teaching Center, Hartford, New York, | Brenda Snowberger, Dept. of Agricultural and Biological Engineering, 312 Riley-Robb Hall, Ithica, NY 14853; Phone: 607-255-2495; Fax: 607-255-4080; Email: bls19@cornell.edu |
| July 6-17, 1999 | Marine Finfish Aquaculture Short Course/Aquaculture Center for Training, Education, and Demonstration (ACTED), Harbor Branch Oceanographic Institution, Fort Pierce, Florida | ACTED; Phone: 800-333-4264 or 561-465-2400 ext. 416; Fax: 561-466-6590; Email: acted@hboi.edu; Internet: <www.hboi.edu/aquaculture/acted.html> |
| July 11-17, 1999 | Aquaponics and Tilapia Aquaculture Short Course/University of the Virgin Islands, St. Croix, Virgin Islands | Dr. James Rakocy, RR 2, Box 10,000, Kingshill, Virgin Islands 00850; Phone: 340-692-4020; Email: jrakocy@uvi.edu |
| July 19-30 and July 19-August 6, 1999 | Practical Aquaculture Techniques Short Course/Aquaculture Center for Training, Education and Demonstration (ACTED), Harbor Branch Oceanographic Institution, Fort Pierce, Florida | ACTED; Phone: 800-333-4264 or 561-465-2400 ext. 416; Fax: 561-466-6590; Email: acted@hboi.edu; Internet: <www.hboi.edu/aquaculture/acted.html> |
| July 20-24 and November 8-12, 1999 | Recirculating Systems Short Course/Aquaculture Center for Training, Education and Demonstration (ACTED), Harbor Branch Oceanographic Institution, Fort Pierce, Florida | ACTED; Phone: 800-333-4264 or 561-465-2400 ext. 416; Fax: 561-466-6590; Email: acted@hboi.edu; Internet: <www.hboi.edu/aquaculture/acted.html> |
| September 19-October 22, 1999 | HDNR Smithsonian Conservation Short Course: "Economic and Policy Solutions for Ecosystem Conservation"/Washington, D.C. | Christopher Ros c/o SI/MAB Program, Smithsonian Institution, S. Dillon Ripley Center, 1100 Jefferson Drive SW, Suite 3123, Washington, D.C. 20560-0705; Phone: 202-357-4793; Fax: 202-786-2557; Email: cjr@ic.si.edu; Internet: <www.si.edu/organiza/museums/ripley/simab/start.htm> |
| September 22-25, 1999 | Aquaculture Marketing Seminar 1999/Asheville, North Carolina | Aquaculture Magazine, PO Box 2329, Asheville, NC 28802; Phone: 828-254-7334; Fax: 828-253-0677; Email: aquamag@ioa.com; Internet: <www.aquaculturemag.com> |
| October 31-November 12, 1999 | HDNR Smithsonian Conservation Short Course: "Smithsonian Environmental Leadership & Communication Course"/Washington, D.C. | Christopher Ros c/o SI/MAB Program, Smithsonian Institution, S. Dillon Ripley Center, 1100 Jefferson Drive SW, Suite 3123, Washington, D.C. 20560-0705; Phone: 202-357-4793; Fax: 202-786-2557; Email: cjr@ic.si.edu; Internet: <www.si.edu/organiza/museums/ripley/simab/start.htm> |

Pond Dynamics/ Aquaculture CRSP
Oregon State University
400 Snell Hall
Corvallis OR 97331-1641



Bulk Rate
US Postage
PAID
Corvallis, OR
Permit No. 200

CALL FOR PAPERS

**V CENTRAL AMERICAN
SYMPOSIUM ON AQUACULTURE**

Aquaculture and the Environment: Together Towards the Year 2000

18- 20 AUGUST 1999 *

SAN PEDRO SULA, HONDURAS

PRESENTED BY

LATIN AMERICA CHAPTER

Collaborators: Aquaculture Associations from Central America

PAPERS DUE - 1 JUNE 1999

EARLY SUBMISSIONS ENCOURAGED

* Note change of date - conference originally scheduled for 3-5 March 1999

For contact information, see page 8 (PD/ A CRSP Update).

AQUANEWS

Director: Hillary S. Egna
Aquanews Editor: Danielle Z. Clair
Staff: Kris McElwee, Deb Burke, and Matt Niles

Aquanews is published quarterly by the Information Management Component of the Pond Dynamics/ Aquaculture Collaborative Research Support Program, Office of International Research and Development, Oregon State University, 400 Snell Hall, Corvallis OR 97331-1641.
<www.orst.edu/dept/crsp/homepage.html>

Articles appearing in *Aquanews* may be quoted in other publications. We ask that *Aquanews* be credited and that we receive a clipping of the publication in which quoted material appears.

Mention of trade names or commercial products does not constitute endorsement or recommendation for use on the part of USAID or the PD/A CRSP.

The Pond Dynamics/Aquaculture Collaborative Research Support Program is funded in part by the US Agency for International Development under CRSP Grant No. LAG-G-00-96-90015-00 and by participating US and Host Country Institutions.

Oregon State University is an Affirmative Action/ Equal Opportunity Employer.