

# AQUANEWS



Sustainable Aquaculture  
for a Secure Future

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## Fish Culture and Food Security in the Peruvian Amazon

by Fernando Alcántara Bocanegra (IIAP), Chris Kohler, Sue Kohler, William Camargo (SIUC), and Marco Colace (Terra Nuova)

The PD/A CRSP Peru Project began in 1996 with a Memorandum of Understanding between the Instituto de Investigaciones de la Amazonía Peruana (IIAP), the Universidad Nacional de la Amazonia Peruana, and Southern Illinois University at Carbondale (SIUC). Research activities have dealt mostly with establishing sustainable pond aquaculture practices for fish species indigenous to the region. In addition, an investigation conducted by Auburn University CRSP researcher Joseph Molnar examined producers' perceptions, practices, and attitudes toward technical assistance. The story of these CRSP participants' partnership with the nongovernmental organization Terra Nuova exemplifies the way collaborative relationships can tap each partner's strengths to increase the benefits of aquaculture research.

Fish culture has been practiced for over three decades in the Peruvian Amazon and, in the region along the Iquitos Nauta Road, for the past ten years. However, aquaculture development in the region has focused on pond construction, with limited and sometimes no attention to production processes.

daily while the pond construction took place. Many of these ponds were not constructed with adequate attention to elements such as levees. In addition to poor pond construction, fish culture operations often failed due to improper stocking densities, limited and sometimes no food supplied to the chosen species, lack of predator

control, and essentially no water quality management. Not surprisingly, much of the population in the region lost faith in aquaculture and the institutions that promoted this form of farming.

the Italian NGO Terra Nuova, beginning in April 1999. The Food Security Program for Productive Family Units (known by its acronym in Spanish, PROSEAL), was initiated along the Iquitos Nauta Road and in the Santa Helena and Huayococha indigenous communities in Tigre River (Maynas Province, Loreto Department, Peru). The Food Security Program is largely based on research and extension outcomes of PD/A

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WILLIAM CAMARGO

Fish pond constructed along the Iquitos Nauta Road.

Pond construction was achieved through organized cooperative work, locally known as *minga*, whereby the population voluntarily participated in the construction of one another's ponds without monetary remuneration although they did receive food

Fortunately, the situation has been turned around as a result of a partnership with the PD/A CRSP institutions, primarily the Instituto de Investigaciones de la Amazonía Peruana (IIAP) and Southern Illinois University Carbondale (SIUC), joining forces with

## Fish Culture in Peru

...from p. 1

CRSP-sponsored activities since 1996.

PROSEAL received financial assistance from the European Union (around US\$600,000) for two consecutive years, with an extension until December 2001. To secure the successful development of the proposed objectives, additional alliances with the Dirección Regional de Pesquería de Iquitos, the NGO Fe y Alegría, and other educational institutions were formed.

The selection of the beneficiaries of this program is based on the following criteria:

- Possession of identification documents;
- Possession of a land title or a certificate of possession;
- Residence on the land;
- Interest in fish culture; and
- Need to receive assistance.

Each PROSEAL beneficiary receives assistance with pond construction using heavy machinery, PVC pipes, wheelbarrows, and shovels. If required, each beneficiary receives assistance with food for the *mingas* and/or prepared fish feed provided they are

willing to return 50% of the feed cost. Additionally, each beneficiary receives 1,500 fish (500 *Colossoma macropomum*, 500 *Piaractus brachypomus*, and 500 *Prochilodus nigricans*).

From these 1,500 fish, it is assumed that 150 fish might die (10% mortality), and it is expected that the fish grower will consume 1,000 fish (67%) and the remaining 350 fish (23%) will be sold in the market to generate an income. From the fish sales, the beneficiary is required to invest 20 % as a contribution for the creation of a social fund to maintain the program in the future.

After two years of the CRSP/PROSEAL project, frustrations previously experienced by fish culture practitioners have largely dissipated and, in fact, most are enthusiastically embracing this alternative, sustainable



LUCIANO RODRIGUEZ

Floating cage for fish culture by the Indian communities from the Tigre River, Peru.

form of agriculture. Most fish farmers prefer selling all their fish rather than eating them.

Members of indigenous Quechua communities were initially receptive to fish culture in cages, especially *C. macropomum* and *P. brachypomus*, which had vanished from their wild catch several years before. Those who expressed an interest in cage culture during preliminary visits were asked to gather wood for cage supports. When project staff returned to the area we found that many had not extracted the wood needed to build the cages, apparently because they doubted that the project would actually come to

## ABOUT THE REGION

The Iquitos Nauta Road is mostly paved and has an approximate length of 95 kilometers, joining the cities of Iquitos and Nauta, both located along the Amazon and Marañón Rivers of Peru. The population along the road is primarily composed of suburban migrant forest exploiters from Iquitos and other Peruvian regions, ranging from the Amazon plains to the high jungle. These migrants arrived in search of work due to the lack of employment opportunities in their places of origin. Many of these inhabitants were food gatherers, lacking a vocation for agricultural activities, whereas migrants from the high jungle and mountains display a strong vocation to cultivate the land. The inhabitants of the Santa

Helena and Huayococha communities are mainly Quechua Indians. They are characterized by being gatherers of natural resources such as fish, game, fruits, and roots.



The majority of the inhabitants along the Iquitos Nauta Road are land owners, possess a “certificate of proprietorship,” and have a low income mainly based on fruit production, wood extraction, yucca farming, small animal husbandry (e.g., pigs, chickens, ducks), and, to a lesser extent, cattle ranching. In contrast, the Indians, who are also land owners, obtain most of their income from extraction of the surrounding natural resources. Both groups are characterized by their rudimentary living quarters consisting of walls constructed out of round logs or *pona*, a straw or palm roof, and no water or sewage. Both groups own few possessions other than their land.

fruition. This wariness disappeared once project staff visits became more frequent and when we began to provide them with the synthetic mesh and other cage construction materials needed to culture fish in lagoons or ponds.

The project's experience in developing aquaculture along the Iquitos Nauta Road has demonstrated that to develop sustainable fish culture community projects in the Peruvian

the obligations they would take on if they chose to become involved.

The project is based on a model of horizontal participation and includes training for the beneficiary populations. The latter involved five day-long workshops in which interdisciplinary courses were held. Sessions covered pond construction and general technological culture processes, particularly the need to provide additional food sources for the fish and the use of

whereas rainforest lands converted to traditional agricultural practices are rarely productive for more than a couple of seasons due to the poor soils. Converted rainforest, once abandoned, usually can no longer support normal jungle growth. Both rural and urban poor benefit by the addition of a steady supply of high-quality protein in the marketplace. Aquaculture of *Colossoma* and/or *Piaractus* should also relieve some of the fishing pressure on these overharvested, native species.

In two years of operation the CRSP/PROSEAL project has yielded some dramatic results:


- 250 producers were trained in fish culture
- 140 culture ponds along the Iquitos Nauta Road were constructed
- 121 ponds were each stocked with 1,500 fish (500 *C. macropomum*, 500 *P. brachypomus*, and 500 *P. nigricans*)
- 15 tons of fish were produced under culture conditions in the first rotation
- 20 additional ponds were stocked in a second rotation
- Fish have become the primary source of income for the producers
- 1,546 students from schools along the road received fish culture training
- A fish culture association was organized
- 48 individuals from the indigenous community were trained in fish culture (60 families with five members per family are beneficiaries of the program)
- A functional hatchery was constructed

Amazon, it is necessary to promote integral projects involving different state institutions and/or private NGOs. Effort needs to be oriented towards participatory production process so that the producer is the agent of his or her own development. In this sense, the producer must participate from the outset, from design to construction of the ponds, from the choice of species to be cultured to feeding strategies, and, of course, to the marketing of the products. These criteria were applied successfully along the Iquitos Nauta Road, beginning with informational meetings and motivational workshops recommended by the CRSP/PROSEAL project but organized by community authorities such as the mayor or governor. In these meetings, interested parties were provided information about the objectives of the project and summaries on the status of fish culture along the Iquitos Nauta Road (Alcántara, 1994, 1996; Molnar et al., 1999). Additionally, project staff described the requirements of and benefits to the participants, as well as

products and by-products generated by participants' own traditional agricultural activities. Accordingly, the producers are learning that it is possible to improve their productivity and increase their income with resources that are within their reach and easily procured.

The development of sustainable aquaculture of native species benefits many sectors of the Peruvian Amazon. Rural farmers benefit by the addition of an alternative form of agriculture. Aquaculture production requires considerably less land than that needed for cattle ranching. Moreover, ponds can be used year after year

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WILLIAM CAMARGO

IIAP hatchery, Quistococha, Peru.

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## Graduate Student Profile: Steve Sempier

by Heidi Furtado

Steve Sempier joined the PD/A CRSP staff as a Graduate Assistant in September 2000 when he started his masters program at Oregon State University. Sempier chose OSU because he found the area to be welcoming and the professors very receptive. Chris Langdon, a PD/A CRSP researcher and one of Sempier's masters project advisors, was one of the people who helped in his decision to attend OSU. Sempier was informed of the PD/A CRSP through a friend of former CRSP Graduate Assistant Matt Niles.

Sempier is working on his masters in marine resource management, with a minor in fisheries science and a focus on aquaculture. His main project will consider potential marine aquaculture species off the Oregon coast. He plans to develop a website that will allow dissemination of the information he gathers on this subject. Through working with the PD/A CRSP, Sempier has found that "there are many websites that address aquaculture, but few that serve as a comprehensive resource." He hopes that this website can serve as a source of information for people interested in aquaculture.

Before arriving at OSU, Sempier received his undergraduate degree at Eckerd College in St. Petersburg, Florida, where he majored in marine science with a concentration in biology. After graduation, Sempier took a three-year break from school to explore job options and learn more about his interests. Indulging his love of travel and the outdoors, Sempier spent time in Utah as a National

Park Ranger, in Idaho with the US Forest Service working with the fisheries hydrology crew, and in Minnesota working as a naturalist and a children's instructor.

Sempier has always loved the ocean, but his interest in aquaculture developed when he took a job as Senior Aquarist at the Catalina Island Marine Institute. Throughout the two years he spent there, Sempier took care of the plumbing system that supplied water to the aquarium tanks and worked directly with the animals and algae. He really enjoyed the hands-on experience and was stimulated by the problem solving involved with interpreting the marine animals' needs. He found it exciting and rewarding when the animals flourished in their environment. In addition to serving as Senior Aquarist, he was also an instructor and part-time administrator on Catalina Island.

Sempier has been working on a number of CRSP activities. He writes articles for Aquanews, researches and publishes EdOp Net, assists in maintaining the CRSP website, and answers frequent emailed questions regarding aquaculture. Sempier has had the opportunity to gain new skills and through his management of EdOp Net to discover the variety of job opportunities available in aquaculture. The PD/A CRSP staff is fortunate to have Sempier as part of our team. His energy and diligence are much appreciated as part of the Information Management and Networking Component.

Sempier hopes to complete his masters degree by Summer 2002 and plans to continue in aquaculture.



HEIDI FURTADO

PD/A CRSP Graduate Assistant  
Steve Sempier

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## EdOp Net-Working Really Works!

by Steve Sempier

A recent example of the far-reaching effects of EdOp Net is demonstrated through a recent success story that crossed our desk. Daniel Jalil of the Republic of Panama is a subscriber of EdOp Net. The PD/A CRSP extends congratulations to Daniel Jalil as he begins his new job.

The audience for EdOp Net has continued to grow and diversify throughout its five-year life span. The goal of EdOp Net is to connect those interested in the aquaculture field to relevant educational and career opportunities. EdOp Net serves as a comprehensive resource that reaches almost 2,000 people each month and draws international attention with subscribers from India to Egypt to Honduras as well as numerous individuals in North America.

As always, EdOp Net is offered free of charge via email and paper mail; it is also featured on the web at: <pdacrsp.orst.edu/edops/edop.html>. Not only are subscriptions free, it is also free to post an opportunity on EdOp Net. If you would like to share an EdOp Net success story, receive a free monthly subscription, or post a position or workshop, please contact Steve Sempier at sempiers@ucs.orst.edu.

Dear Steve,

This letter is intended to thank you for this very useful vehicle of information and to let you know that thanks to your monthly edition of EdopNet, my husband got a job in Florida at Chu Farms. He is starting soon at the hatchery and is traveling overseas from Republic of Panama to the US in July.

We both are very happy to have this beautiful opportunity and want to thank you for your efforts which surely is giving this same happiness to several people around the world.

We also believe it should be interesting to you to receive some feedback from subscribers.

Sincerely,  
Eliane da Silva and Daniel Jalil

## NGOs and Aquacultural Development: Lessons from Honduras and Peru

by Joseph J. Molnar, Auburn University

**N**ongovernmental organizations (NGOs) are important but often-overlooked components of the institutional structure supporting aquacultural development. International and domestic NGOs have close and enduring connections to communities and families. They often have a pervasive involvement in the lives and livelihoods of rural people, an involvement that extends beyond one farm enterprise or any one single aspect of human need. This note considers the relationship between the PD/A CRSP and NGOs in light of the experience of two countries where mutually beneficial relationships between CRSP projects and NGOs have evolved.


In Peru, the PD/A CRSP has been working in Amazonia, focusing on the reproduction of an indigenous species, *Colossoma*. Several different governmental units produce fingerlings and provide technical services, but these efforts are largely confined to the locales surrounding the various installations. Moving beyond the regional city of Iquitos, fish farmers must look to NGOs for assistance.

In partnership with the CRSP research activities, CARE/Peru is an international NGO that supports more than a dozen technicians who are working in rural communities along the Amazon and its several tributaries surrounding Iquitos. CRSP researcher Fernando Alcántara and his colleagues at the Universidad Nacional de la Amazonia Peruana have taught training courses attended by the technicians, as well as farmer-oriented training courses for which CARE/Peru technicians have identified participants. In addition, the technicians participated in the baseline socioeconomic survey of practicing fish farmers that profile the practices and species cultured in the area.

In Honduras, governmental services to fish culture have been uneven at best. Financial and organizational problems

narrow the quality and scope of extension services to select locales. PD/A CRSP investment in the research program has produced an extended body of research findings, yet the public sector has been unable to realize the promise of fish culture due to funding limitations and high personnel turnover. NGOs offer the best promise for enduring support for small- and medium-scale producers throughout the country.

A number of Honduras NGOs support technical assistance in aquaculture, while there is growing interest among other organizations in enhancing capabilities to support fish culture activities when it is appropriate to do so. Under CRSP researcher Dan Meyer's leadership, the Escuela Agrícola Panamericana at Zamorano has provided training courses and technical assistance to producers. As a result, NGOs are expanding their interest and awareness of fish culture as an alternative farm enterprise. Responding to new opportunities presented by the Internet, PD/A CRSP has partnered with Red Desarrollo Sostenible-Honduras to develop a website and information portal to support fish culture activities. The United Nations Development Program has invested heavily to develop an extensive NGO capability to use the Internet in Honduras. New efforts by the PD/A CRSP are using these networks to realize the possibility of fish culture in many locales across Honduras.

The central insight from these experiences is that NGOs have a longer and more lasting reach to rural people and rural communities than PD/A CRSP researchers and their staffs can ever have. Partnering with NGOs has extended fish culture strategies and science-based understandings to a broader set of fish farmers than would otherwise have been possible. 

### THE PD/A CRSP AND NGOS: GETTING RESULTS, GETTING RESULTS TO THE COMMUNITY

NGOs programs to enhance the well-being of and promote sustainable livelihoods among rural people in developing nations often center on agricultural development and resource conservation as objectives for their activities. Often, fish culture is—or could be—a component of the portfolio of activities that are guided and supported by NGO efforts. NGO technicians make regular visits to farms and rural communities, teaching, advising, and solving problems in rural communities. It is this diverse and dispersed cadre of technicians that comprises a real and immediate target audience for the information and findings of PD/A CRSP experimental findings and trials.

Training NGO technicians in the basics of fish culture is a central task for the PD/A CRSP if it is to leave behind lasting impacts and consequences for the rural people and communities in the countries where it is working. The NGOs have enduring relationships to their target populations and are likely to continue to support and extend aquaculture development long after the PD/A CRSP has moved on to other locales and topics. A partial list of NGOs with whom the CRSP has cooperated includes:

- Cáritas del Perú, Iquitos, Peru
- Comite para la Defensa y Desarrollo de la Flora y Fauna del Golfo de Fonseca (CODDEFFAGOLF), Tegucigalpa, Honduras
- CARE, Bangladesh, Peru, and Atlanta, Georgia
- Fe y Alegria, Lima, Peru
- Global Village, Honduras
- Nuestros Pequeños Hermanos (NPH), Honduras
- SAO Cambodia Aquaculture at Low Expenditure (SCALE) Project, Cambodia
- Sustainable Agricultural Centre for Research and Development in Africa (SACRED-Africa), Kenya
- Terra Nuova, Lima, Peru
- Uganda Wetlands and Resource Conservation Association (UWRCA), Uganda
- Winrock International, Lima, Peru
- World Neighbors, Honduras

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## CASA VI Approaches

The 6th Central American Symposium on Aquaculture (CASA 2001) will take place 22 to 24 August 2001 at Honduras Maya, in Tegucigalpa, Honduras. The theme of the symposium this year is "Productivity and Sustainability through Best Management Practices."

The symposium's main objective is to report the most efficient and sustainable practices available for use in the shrimp-production process, as well as highlighting the best in tilapia production technology. A team of experts from around the world will be presenting papers for GAA's new *Global Shrimp OP: 2001*



program. CRSP researcher Claude Boyd will chair one of the sessions, entitled "Effluent Water Quality." Following each presentation of a *Global Shrimp OP:2001* paper, a round-table discussion will be held, giving participants an opportunity to ask questions and comment on the material. All comments will be compiled for the author's consideration while revising their article to

submit to the final "Global Shrimp OP: 2001—Operating Procedures for Responsible Shrimp Aquaculture" report.

Other highlights of CASA 2001 will include a Commercial Exhibition with

booths showcasing aquaculture equipment and supplies. An inauguration cocktail party will kick off the event on the first night, and the closing ceremony and dinner will bring it to a close on the last. Two all-day bus tours are scheduled for the day after the symposium for all interested parties. The Shrimp Tour will visit the ponds, labs, and hatchery of Grupo Granjas Marinas, while the Tilapia Tour will view the major tilapia farms on Yojoa Lake.

Anyone interested in attending CASA should visit the GAA website, located at <[www .gaalliance.org/ symp.html](http://www.gaalliance.org/symp.html)>, or write to:

Susan Chamberlain, Office Manager  
Global Aquaculture Alliance  
5661 Telegraph Road, Suite 3A  
St. Louis, MO 63129

Information is available in Spanish at the ANDAH website, <[www.andah.org/intro.html](http://www.andah.org/intro.html)>. The early registration deadline is 22 July. 🐟

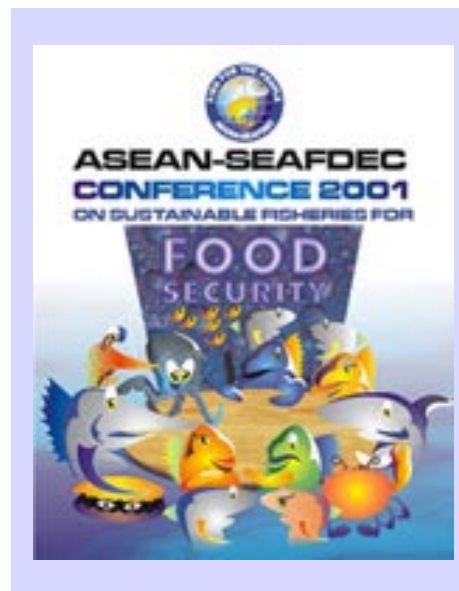
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## "Fish for the People" to Include Aquaculture Focus

The Southeast Asian Fisheries Development Center (SEAFDEC), the Association of Southeast Asian Nations (ASEAN), and the Food and Agriculture Organization of the United Nations (FAO) have collaboratively organized the ASEAN-SEAFDEC Conference on Sustainable Fisheries for Food Security in the New Millennium. The conference titled, "Fish for the People," will take place from 19 to 24 November 2001 in Bangkok, Thailand.

Aquaculture is one of the main themes of the conference. Subthemes under the aquaculture heading include: Supply of Quality Seed Stock; Environment-Friendly Aquaculture Technologies; Getting Out of the "Fish Meal Trap"; Healthy and Wholesome Aquaculture; Biotechnology for Aquaculture; and Aquaculture for Rural Development.

In addition to aquaculture, major topics include: Outlook on Fish Supply and Demand; Fisheries Management; Fish Trade; Fisheries Post-Harvest Technology; Fisheries Statistics; and Fisheries Cooperation.



The ASEAN-SEAFDEC Millennium Fisheries Exhibition will concur with the conference. The exhibition will take place from 21 to 24 November 2001 and will be the region's first major fishing industry event for at least a decade. The purposes of the exhibition are to 1) promote the business of fisheries related products (equipment and materials), 2) promote sustainable fisheries issues with national booths to be presented for ASEAN and SEAFDEC Member Countries, and 3) exhibit the outcomes of the drawing contest on "Fish and the Culture" pre-selected at national levels.

Registration for the conference is required by 30 September 2001. To register contact:


SEAFDEC Conference Secretariat  
Fish for the People 2001  
PO Box 1046  
Kasetsart Post Office  
Bangkok 10903 Thailand  
Email: [secretariat@seafdec.org](mailto:secretariat@seafdec.org)  
Website: <[www.seafdec.org](http://www.seafdec.org)> 🐟

## Reuse, Recycle, and Donate for a Worthy Cause

A new PD/A CRSP initiative aims to provide colleagues in developing countries with textbooks, academic journals, and other reference materials that facilitate successful research. Unfortunately, many institutions in developing countries lack the budgets and resources enjoyed by scholars elsewhere. Access to books and information is fundamental to education and development. To make this initiative work, donations of materials would be provided by researchers both from and beyond the CRSP community. Please look in your book and journal collection for items related to natural resource management—specifically in the area of aquatic sciences—that no

longer meet your needs and that could be donated to one of the many PD/A CRSP-sponsored researchers around the world, based on his or her particular area of interest.

Beyond the immediate interest in providing needed books to colleagues abroad, we hope this new book and journal donation program will also open doors to broader sorts of collaboration and exchange that will benefit all involved.

If you have materials to donate or would like more information about the program, please contact PD/A CRSP Assistant Director Cormac Craven via email at [cravenc@ucs.orst.edu](mailto:cravenc@ucs.orst.edu) or by telephone at 541-737-6423. 

## All the Tilapia Chat That's Fit to Print

by Jeff Burright

One of the best things about the Internet is the way it can create communities across great distances. The online tilapia discussion group now hosted by Yahoo! is a case in point. With almost 600 members, this group hosts lively conversations about tilapia genetics, reproduction control, feeds, production systems, and markets. Tom Frese, president of AquaSol, Inc., founded the list and has moderated the group since its outset. Active members include CRSP researchers, individuals affiliated with nongovernmental organizations in developing countries, and tilapia


farmers from such locations as the US, Thailand, Philippines, Brazil, Zimbabwe, and Jamaica.

This global platform hosts numerous collaborations and discussions on aquaculture-related issues worldwide. Recent topics have included immediate advice to a producer regarding the reduction of off flavor in brackishwater tilapia, a debate on the current prices and production capabilities for Brazilian tilapia exported to the US, and numerous instances of collaboration and sharing of aquaculture experiments and findings between various projects. People have even added outside

articles related to aquaculture to the list as a method of spreading news and outreach information to their fellow aquaculture enthusiasts.

The tilapia mailing list has an archive of over 1,800 messages dating back to the list's inception in August of 1999. Each post is numbered and dated, with a message title and the author's name, and they can be viewed by month or through a keyword search of message content. This search feature can be extremely helpful when searching for old correspondence considering that some months have had nearly 200 postings. Membership is free to anyone who establishes a Yahoo! username identity (also free), and the four options for message delivery include individual emails sent to your specified account (the best way to receive instant messages); a Daily Digest, which sends all of the day's posts in a single email (to avoid clutter); periodic special messages and updates from the group's moderator; and a direct interface with the mailing list website in lieu of receiving email.

To join, visit [groups.yahoo.com/group/tilapia](mailto:groups.yahoo.com/group/tilapia) or send an email to: [tilapia-subscribe@yahoogroups.com](mailto:tilapia-subscribe@yahoogroups.com).

Yahoo! also hosts a 600-member shrimp mailing list which benefits those involved in all aspects of shrimp farming. Access it by visiting [groups.yahoo.com/group/shrimp](mailto:groups.yahoo.com/group/shrimp) or sending an email to: [shrimp-subscribe@yahoogroups.com](mailto:shrimp-subscribe@yahoogroups.com). 

Since the webhost of the tilapia mailing list changed from egroups to Yahoo! in late 2000, a variety of new services became available to the subscriber that can increase the capabilities of online aquaculture collaboration.

- Chat capabilities allow the possibility of online real-time conferencing about selected topics.
- A file repository and database allow the user to place common files or discussion-related tables, figures, etc. in a centralized location for easy downloading. Current files include fish photographs and a fish farm simulation.
- A listing of bookmarks will guide users to related aquaculture sites, or they can add their own websites.
- A polling feature allows subscribers to vote on important aquaculture topics. Poll questions include: "Do you feel that a monthly price survey for all major tilapia products would be a valuable tool to help you determine a fair market price for your tilapia product?"; and "Has a tilapia farm or hatchery that you own, work for, or affiliated with experienced a major disease outbreak within the last year that resulted in significant mortality and/or economic loss?"

## PD/A CRSP Database: A Great Resource for Aquaculture

by Jeff Burright

What aquaculture instructor wouldn't like to provide students the opportunity to learn by conducting research? However, with most aquaculture grow-out experiments requiring six months or more to complete, few classes can afford that luxury. With the help of the PD/A CRSP Central Database, an instructor can allow students to design "virtual experiments" and test the hypotheses using results extracted from the Database. Through creative experimental design, results can be used in ways the original investigator never imagined. This "hypothetical" is only one of many practical uses for the Database in aquaculture.

The Database was originally established to support analysis of variance among research sites from all over the globe and the development of predictive models for aquaculture processes. It is a centralized storage and retrieval system for data and information stemming from CRSP research, and it currently contains results from over 100 aquaculture production studies conducted at sites in Egypt, Honduras, Indonesia, Kenya, Mexico, Panama, Peru, the Philippines, Rwanda, Thailand, and the US. The majority of data derives from studies on the production of Nile tilapia in sub-tropical and tropical regions, in solar algae ponds receiving inputs of plant materials, inorganic/organic fertilizers, and prepared feeds. Studies of other pond fishes and penaeid shrimp under monoculture and polyculture management are also available. Specifically, the Database includes:

- descriptions and specifications of CRSP research studies;
- physical descriptions of research sites and facilities;
- standard analytical methods;
- comprehensive results of fish production studies; and
- CRSP publications.

The entire Database is available on CD by request, but the typical user interface to the Database is via its website <[biosys.bre.orst.edu/crspdb](http://biosys.bre.orst.edu/crspdb)>.

A Database user can find measurements of site weather, pond soils, water quality and biological productivity, fish culture management, and fish growth and productivity. Together, these linked materials, methods, results, and publications provide integrated packages of site-specific information that the user can access to aid in aquaculture research or planning. The global scope of the Database offers a wide range of conditions so that users can find a region with climate and soil conditions similar to their own.

The Database is organized by information type. Each category is

further arranged by geographical location, period of study, and additional criteria. The structure of the search engine is currently evolving to a new interface, so prospective users should periodically consult the Database website's feature, "How to Use the Database," at <[biosys.bre.orst.edu/crspdb/techSupport/usermanual.htm](http://biosys.bre.orst.edu/crspdb/techSupport/usermanual.htm)>, for updated instructions. All searches produce listings or tables of results that appear on screen and can be easily saved to a local computer. Datasets may be viewed in raw or summary form and in graphical or tabular format, or the user can download them as delimited files for spreadsheet applications. 🐟



The Central Database homepage, <[biosys.bre.orst.edu/crspdb](http://biosys.bre.orst.edu/crspdb)>, features a map of research sites around the globe, availability of datasets, and links to the publications and project sections and to user manuals.



## What's New on the PD/A CRSP Website?

by Mary Nidiffer

Have you seen the PD/A CRSP website lately? Located at <pdacrsp.orst.edu>, the site is a valuable source of CRSP information and research material.

On the website, users can browse or search for PD/A CRSP publications including Aquanews, Administrative and Technical Reports, Research Reports, Work Plans, Site Descriptions, Global Experiment literature, and more.

The primary purpose of the website's publication section is to make those documents available for downloading as PDF files. Recent issues of Aquanews, and the Eighteenth Technical and Administrative Reports can now be read online as well. However, if hard copies of the publications are needed, they can be downloaded and printed or ordered free of charge from several links located in the publications section.

The EdOp Net link on the homepage leads to the recently refurbished web version of EdOp Net, a database containing listings related to education, training, and employment opportunities. These opportunities may be of interest to PD/A CRSP participants, aquaculture researchers, students, and practitioners in general aquaculture and development fields.

Click on the Data Tools link to access the Central Database or download POND® software. The Central Database is a large public aquaculture clearinghouse of standardized experiment results, containing over one million observations of pond variables obtained from over one hundred production studies conducted at PD/A CRSP research sites. Datasets may be searched and retrieved based on geographical location, fish culture methods and species, and desired types of data. (See story, p. 8.) POND® is a computer program developed to guide decision-making processes relevant to warmwater pond aquaculture. Version 4.0 can be downloaded from a link on the site.

From the PD/A CRSP website, you can also learn more about our projects and people. In this section, you can find information about the CRSPs current projects, and read up on the goals and purpose of the CRSP. A link will also take you to information about the External Evaluation Panel, Technical Committee, and Board of Directors; a complete list of the PD/A



The PD/A CRSP homepage, <pdacrsp.orst.edu>, features links to the EdOp Net database, publications such as Aquanews, listings of program participants, and much more.

CRSPs principal investigators; and links to participating US institutions.

We'd like to hear any success stories or anecdotes you may have about how you've benefited from the work of the PD/A CRSP. Let us know by email how our research, publications, or outreach efforts have affected you. The PD/A CRSP web-site is continually being updated, so be sure to check back often to see what's new. We encourage repeat visitors. 🐟

## CRSP Impacts-At-A-Glance

### Research Achievements

The amount by which the biological oxygen demand of environmental effluents was reduced at a CRSP research site in Thailand after researchers identified minor alterations to traditional pond harvest techniques: 1/2

Number of fish farmers who received assistance from the extension service of Rwanda during a four-year period of assistance from the CRSP: 3,000

Factor by which Rwandan farmers improved pond productivity: 4

### Publications

Number of CRSP titles produced by the Program Management Office since program inception: 265

Number of publications electronically available via the CRSP Web page: 211

Number of individuals from the US and abroad including students, researchers, aquaculturists, and administrators who receive PD/A CRSP scientific, technical, and programmatic publications: 925

Number of countries represented by these students, researchers, aquaculturists, and administrators: 60

## Cummings and Goings in the Pond

regon State University Graduate Assistant Xena Cummings left the CRSP offices on June fifteenth to complete her thesis for her graduate degree in Electrical Engineering and to start the search for a career in her field, and the absence of her presence and abilities is poignantly felt around the office. This 25-year-old Guam native left almost five years to the day from when she was hired as a student worker in June of 1996, and she carries many memories with her. "I remember my first assignment well," remarked Cummings, "I knew almost nothing about aquaculture, so Hillary [Egna, PD/A CRSP Director] asked me to make a photo album of pictures from the Rwanda site for a family that had been forced to leave the country because of their civil war." Since then, Xena's role expanded to include the maintenance and editing of the layouts for the PD/A CRSP website, the address database, and the EdOp Net website, as well as the administration of several aspects of the annual report. She also took on countless behind-the-scenes projects and maintenance activities in her time here. Xena, you are deeply missed, and we wish you the very best with your future.

Jose Falck, postdoctoral researcher with Upton Hatch's Marketing and Economic Analysis Research Project at Auburn University, has moved on to a position at the International Service for National Agricultural Research (ISNAR), where he will be evaluating the economic benefits of Consultative Group on International Agricultural Research (CGIAR) projects.

Welcome to new Research Associate Htin Aung Kyaw, who has joined the CRSP Thailand Project at the Asian Institute of Technology. Kyaw is an alumnus of AIT from Myanmar. He received his masters degree under the supervision of Amrit Bart in 1999 with

a thesis entitled: "An evaluation of existing freshwater fish seed production in Yangon Division of Myanmar." He is now working with Bart on a part-time basis to gain additional training in research methodology and fish culture techniques which he hopes to bring back to his home country.

Marcos De Jesus has left Southern Illinois University at Carbondale and the PD/A CRSP and is now employed by the Florida Department of Natural Resources. William Camargo replaces De Jesus as the project coordinator for the Peru Project, and he comes from an extensive background in marine studies. A native of

Colombia, Camargo obtained his bachelors degree from Florida Institute of Technology, and a masters in aquaculture from the University of Ghent, Belgium, and Wageningen Agricultural University, the Netherlands. He is currently near completion of a Ph.D. in larviculture (artemiculture) from the University of Ghent. Camargo brings to the CRSP experience gained as an assistant researcher and wildlife biologist in Florida and as a water resource projects consultant, a mariculture coordinator, an associate professor, and a research project director in Colombia. Camargo looks forward to renewing his research of *Colossoma*, a species he last studied in the 1980s, and to cooperating for the development of aquaculture in the Amazon Basin.

CRSP researcher Claude Boyd, Auburn University, presented water quality monitoring data from the CRSP Honduras Project at workshops in Choluteca, Honduras, and Managua, Nicaragua. The workshops were funded by USDA Hurricane Mitch Recovery Funds, but nearly all of the data discussed were collected

under the CRSP Honduras Project. Workshops were held 5 to 12 February in Honduras and 26 February to 6 March in Nicaragua.

CRSP Philippines Project personnel Remedios Bolivar and Eddie Jimenez served as resource persons on a recently concluded Training on Tilapia Production and Hatchery Management at the Freshwater Aquaculture Center, Central Luzon State University, Philippines from 17 to 19 April 2001. The presentation was on tilapia production in ponds. The training was attended by six participants (two females and four males) from the private sector.

Amrit Bart, CRSP researcher on the Thailand Project, gave a keynote address at the International Conference on Advanced Technologies in Fisheries and Marine Sciences entitled "The use of novel techniques such as ultrasound to deliver compounds of various size and density into fish for mass marking, drug delivery and cryopreservation." The conference was held in Tamil Nadu, South India, from 2 to 4 February 2001.

Two graduate students working with CRSP researcher Carole Engle gave talks at the Annual Research Forum 2001 at University of Arkansas at Pine Bluff.

- Monestime, D., I. Neira, and C. Engle, 2001. Tilapia marketing in Nicaragua: A descriptive analysis of open-air fish markets. Annual Research Forum 2001, UAPB.
- Neira, I. and C. Engle, 2001. Markets for tilapia in Nicaragua: A descriptive analysis of restaurant markets. Annual Research Forum 2001, UAPB.

Congratulations to Taworn Thunjai and Oscar Zelaya, recent graduate students of CRSP researcher Claude Boyd, who have both been accepted into the Ph.D. program at Auburn University. Thunjai will continue to work on the CRSP soil data. 🐟



HEIDI FURTADO

Departing CRSP Graduate Assistant Xena Cummings



Taworn Thunjai will continue Ph.D. work with the CRSP at Auburn University.

## Athauda Defends Reproduction Control Thesis

**E**ongratulations to A.R.S.B. Athauda, who successfully defended his masters thesis at the Asian Institute of Technology in Thailand in December 2000. Athauda, a native of Sri Lanka, returned to his home and has been accepted into a doctoral program in Australia.

### ULTRASOUND-IMMERSION TECHNIQUES TO IMPROVE THE EFFICIENCY OF SEX REVERSAL OF MALE TILAPIA POPULATION (abstract of A.R.S.B. Athauda's MS thesis)

Recent studies on sex reversal have shown that immersion technique requires substantially shorter exposure period compared to feeding. The present study was conducted in order to determine the best treatment combination using immersion techniques. Furthermore, this study used ultrasound with immersion treatment to achieve high sex inversion and more consistent production of mono sex male population of *Oreochromis niloticus*.

The first experiment was carried out as a preliminary study to determine the best immersion duration of one or two hour as for immersion in Methyltestosterone (MT) and Androstenedione (AN) at concentrations of 100 µg/L, 500 µg/L. The second experiment was conducted with immersion solutions of Methyltestosterone (MT), Methylidihydrotestosterone (MDHT) and Trenbolone acetate (TBA) hormones with concentration levels of 50, 100 and 250 µg/L each. The third experiment was carried out with two hormones, MDHT and TBA 100 µg/L and 250 µg/L each. All the other conditions were similar to experiment two. Immersion periods of 2 h were applied for all treatment combinations of ultrasound, non-ultrasound and control.

Of the two time periods (1 h and 2 h) applied in the preliminary trial, 2 h immersion resulted in higher (91.75%) and consistent male percentage with ultrasound, while 1 h gave lower (73.5 %) and highly variable results. Both concentrations (100 µg/L, 500 µg/L) of MT and An showed similar results (83%, 82.3%) with ultrasound treatments. Between two hormones, MT resulted in higher male percentage (90.25%) with ultrasound compared to An (75%). Ultrasound immersion resulted 82.63 % males, while non-ultrasound gave 69.5%. In experiment two, ultrasound resulted in significantly higher ( $P < 0.05$ ) male percentage (96%) than non-ultrasound (87.5). Highest ( $P < 0.05$ ) percentage of males resulted with ultrasound treated with MT 50, MDHT 100 and TBA 250 µg/L. The male percentages were similar (97, 96, and 96). Without ultrasound treatment, percentage males were 86, 87 and 88. In experiment three, significantly higher ( $P < 0.05$ ) percentage of male population was found with ultrasound (93.35%) treatments than non-ultrasound (89%) in experiment three. Highest ( $P < 0.05$ ) percentage of males resulted with ultrasound treated with MDHT 100, TBA 100 and 250 µg/L. The male percentages were 91, 94 and 98, respectively. Without ultrasound treatment, percentage males were 83, 88 and 94. Furthermore rest of the treatment combinations (MT 100 µg/L, MDHT 250 µg/L) also achieved high sex reversal rate, but were not significantly different from non-ultrasound.

This study indicated that the ultrasound treatment with immersion was more effective in sex reversal of *Oreochromis niloticus* than treatment with immersion alone.

### Vietnamese Grilled Tilapia, with Dipping Sauce

2 lb. whole tilapia	2 cloves garlic, chopped	cayenne to taste
1-1/2 c. water	1 tsp. sugar	2 T. crushed peanuts
1 c. coconut milk	juice of 1 lime	1/4 c. fish sauce

#### Directions:

Add boiling water and coconut milk to a blender and mix for at least a minute. Strain the blended mixture through a sieve or cheesecloth. Add chopped garlic. Marinate the fish for 2 hours in the coconut mixture.

Grill the tilapia for about 4 minutes on one side. When brown, turn it over and grill the other side for about 3 more minutes. Serve with dipping sauce.

#### Dipping Sauce

Combine the lime juice, sugar, crushed peanuts, cayenne, and fish sauce to make the dipping sauce.

(recipe submitted by Kenny Duong)



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# 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.

## Research Report 01-169

### POND SOIL pH MEASUREMENT

Taworn Thunjai and Claude E. Boyd  
Department of Fisheries and Allied Aquacultures  
Auburn University, Alabama 36849 USA

Karen Dube  
Central Institute of Fisheries Education  
Verosa, Mumbai 400061 India

Soil pH often is measured in samples from the bottoms of aquaculture ponds. Several different techniques for soil pH are used. This study considered the differences in pH obtained by the different methods and determined which methods appeared most useful. Dual electrodes (indicating and reference) and a single-probe combination electrode gave similar pH values when inserted into 1:1 mixtures of dry soil and distilled water. There were slight differences in pH between readings with dual and combination electrodes when the dual electrodes were arranged with the indicating electrode in the sediment phase and the reference electrode in the supernatant phase of the mixture. The two-phase method with the dual electrode does not appear warranted because of greater difficulty in making measurements. Dry soil : distilled water ratios of 1:2.5, 1:5, and 1:10 had progressively greater pH readings than obtained at a 1:1 ratio. Measurements made in 0.01 M CaCl<sub>2</sub> and 1.0 M KCl had much different values than those made in distilled water. Higher pH resulted when pH was measured without stirring or in filtrates of soil-water mixtures. A 20-min period of intermittent stirring before making measurements was necessary for a stable pH value. Particle size did not influence pH in aliquots passing 0.053 to 2.36-mm sieves. Drying temperature had a strong influence on pH, and measurements made on samples dried at 40 to 60 C are probably most reliable. Measurements of *in situ* pH in wet soil with standard pH electrode or a portable acidity tester differed greatly from those made in 1:1 dry soil to distilled water mixtures. Pond bottom soil pH measurement should be standardized. Based on findings of this study, the following method 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.

This abstract was based on the original paper, which was published in *Journal of the World Aquaculture Society*, 32(2):141–152.

## Research Report 01-170

### NONPARAMETRIC ESTIMATION OF RETURNS TO INVESTMENT IN HONDURAS SHRIMP RESEARCH

Siddhartha Dasgupta and Carole R. Engle  
Aquaculture/Fisheries Center  
University of Arkansas at Pine Bluff  
1200 N. University, Mail Slot 4912  
Pine Bluff, AR 71601 USA

Economic returns to the investment in shrimp research in Honduras by Auburn University researchers, as a part of the Pond Dynamics/Aquaculture Collaborative Research Support Program (1993 to 1998), were estimated using a nonparametric approach. A survey of shrimp growers in Honduras provided data on yield, input application, and prices for their first year of production and for the year 1997. Research investment data included funding from both public and private sectors. Results showed that total factor productivity indices increased from 1995 to 1997 indicating technical progress due to research. When both private and public investment were considered, the internal rate of return to the investment in research was 46%. However, the internal rate of return to public-sector investment alone was above 6,681%. This indicated that the public funds invested in shrimp research in Honduras have been leveraged effectively with private-sector capital to generate technological progress.

This abstract was based on the original paper, which was published in *Aquaculture Economics and Management*, 4(3–4):141–156.

## Research Report 01-171

### RISK ANALYSIS OF SHRIMP FARMING IN HONDURAS

Diego Valderrama and Carole R. Engle  
Aquaculture/Fisheries Center  
University of Arkansas at Pine Bluff  
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Honduras is the leading producer of pond-raised shrimp in Central America, but profitability of operations is affected by fluctuating yields and prices which generate economic risk. An analysis of the financial risks associated with different management strategies would provide useful

## Notices of Publication (cont.)

management guidelines. Data from a 1997 survey were used to develop enterprise budgets and a risk analysis for three farm-size scenarios (73, 293, and 966 ha) and for a group of farms exhibiting an alternative, more intensive level of semi-intensive technology (AST farms). Economies of size related to fixed costs and to feed, repair, and interest costs were identified. Net returns/ha were highest for the AST farms while low net returns/ha reported by the other

farm groups were connected with low yields, conservative input usage rates, poor survivals, and economies of size. To minimize potential for loss, farms should target a minimum acceptable yield that would vary with farm size.

This abstract was based on the original paper, which was published in *Aquaculture Economics and Management*, 5(1-2):49-68.

### Kenya Investigation of Pond Effluent for Crops Yields Recommendations

by C. Wesley Wood, Bernard M. Meso, Karen L. Veverica, and Nancy Karanja

Fertilizers are often applied to ponds to increase nutrient concentrations that favor phytoplankton growth, enhancing production of fish and crustaceans. During harvesting, ponds are drained to levels where fish can be recovered via nets. A result of pond draining is effluent that is often allowed to run into natural waterways. Effluents from fertilized ponds have relatively high nutrient concentrations, particularly of nitrogen (N) and phosphorus (P), and can be potential sources of pollution and eutrophication for receiving waters. Thus, pond effluents present an environmental management challenge, but they may also present an agricultural opportunity in the form of nutrient-laden irrigation water for crops.

Given the challenge and opportunity for managing pond effluent, CRSP researchers Wes Wood and Karen Veverica began a project at the Sagana Fish Farm in Kenya looking at the use of tilapia pond effluent for producing French bean (*Phaseolus vulgaris*) and kale (*Brassica oleracea*). Nancy Karanja, Head of the Soil Science Department at the University of Nairobi, collaborated on the project. A masters student in the Soil Science Department at the University of Nairobi, Bernard Meso, used this research for his thesis project. Karanja and Wood served as co-major professors for Meso's thesis work.

A limited amount of previous research indicated that CRSP researchers would likely get a favorable crop response to applied pond effluent. Previous reports suggested that crop yields could be doubled with pond water when compared to well water. Improved water use efficiency (measured in kilograms of grain per hectare per millimeter of water) for aquaculture effluent-irrigated crops in comparison to well water treatments has also been reported. Other past research showed that pond effluent could supply much of the N requirement for grain crops.

At Sagana, CRSP researchers studied the effects of irrigation with pond effluent and its interaction with applied fertilizer in a field experiment using French bean

and kale over two growing seasons. Comparisons were made with fresh canal water that had not been cycled through tilapia ponds. Drip irrigation was chosen as the irrigation application method owing to its water conservation benefits in an arid climate such as Kenya's. Fresh and dry matter yields of the crops were recorded at harvest, and samples were collected for determination of tissue nutrient concentration.

In the first season, French bean fresh pod yield for plots receiving canal water and fertilizer at recommended rates had the highest yield (9.1 metric tonnes of fresh pod per hectare) while those receiving no fertilizer or irrigation had the least yield (1.3 metric tonnes fresh pod per hectare). In the second season, differences were observed among treatments in fresh bean pod and fresh kale leaf yield. The highest (4.4 metric tonnes per hectare) fresh pod yield was observed in pond effluent-irrigated and fertilized plots while the lowest (1.3 metric tonnes per hectare) was observed in non-irrigated, unfertilized plots. The highest fresh kale leaf yield (11.5 metric tonnes per hectare) was obtained with irrigation with canal water combined with fertilizer application while the lowest (4.2 metric tonnes per hectare) was observed in non-irrigated, unfertilized plots.

Low nutrient status in the tilapia pond water together with inadequate water supplied to some crops due to emitter clogging was responsible for low yield where pond water was substituted for canal water. Emitter clogging was due to algae contained in pond effluent, and filters to eliminate clogging are necessary when pond effluent is used in a drip irrigation system. Unlike other research previously mentioned, pond water from the Sagana Fish Farm supplied low amounts of N and P for crops, indicating that recommended rates of mineral fertilizers should be used when pond water is used for irrigation.

In summary, application of chemical fertilizers in ponds and activities of fish increase nutrient concentration of pond water. Application of pond water to crops during fish grow-out is feasible, but filters capable of removing particulates will be required if it is to be

...continued on p. 15

## Upcoming Conferences and Expositions

Date	Topic/Title	Event Location	Contact Information
August 4–7, 2001	Aquaculture Europe 2001	Trondheim, Norway	P. Ferlin; Email: ae2001@aquaculture.cc
August 19–23, 2001	131st American Fisheries Society Annual Meeting	Phoenix, Arizona, USA	Betsy Fritz; Phone: 301-897-8616 ext. 212; Email: bfritz@fisheries.org
August 22–24, 2001	6th Central American Symposium on Aquaculture	Tegucigalpa, Honduras	Susan Chamberlain; Office Manager, Global Aquaculture Alliance, 5661 Telegraph Road, Suite 3A, St. Louis, MO 63129; Phone: 314-293-5500; Fax: 314-293-5525; Email: gaa@mo.net; Website: <www.gaalliance.org/symp.html>
August 26–29, 2001	46th Atlantic Fishery Technology Conference	Rimouski, Quebec, Canada	Julie Boyer; Ministère de l'Agriculture, des Pêcheries et de l'Alimentation, 96, Montée Sandy Beach, bureau 205, Gaspé QC, G4X 2V6, Canada; Phone: 418-368-7651; Fax: 418-360-8400; Email: julie.boyer@agr.gouv.qc.ca; Website: <www3.uqar.qc.ca/aftc2001>
August 27–30, 2001	Aquaculture Canada 2001	Vancouver, British Columbia, Canada	Nigel Haggan; Email: n.haggan@fisheries.ubc.ca; Website: <www.fisheries.ubc.ca>
September 3–6, 2001	Larvi 2001	Ghent University, Belgium	Conference Secretariat; Laboratory of Aquaculture and Artemia Reference Center, Ghent University, Rozier 44 B-9000, Ghent, Belgium; Phone: 32-9-2643754; Fax: 32-9-2644193; Email: larvi@rug.ac.be
September 18–20, 2001	Sea Trade 2001	Birmingham, United Kingdom	Carole Ashcroft; East House, 15A East Street, Southport, Merseyside, PR9 0RD, United Kingdom; Phone: 01704-500580; Fax: 01704-500895; Email: caroleashcroft@sea-trade.co.uk
October 1–5, 2001	70th Anniversary of the Japanese Society of Scientific Fisheries	Yokohama, Japan	Toshiaki Ohshima; Phone: 81-3-5463-0613; Email: symp70yr@tokyo-u-fish.ac.jp
October 11–13, 2001	3rd International Fair for Aquaculture and Fisheries	Izmir, Turkey	Ali Civ; FGS Fuarlıçılık AS, Çeliklepe, İnönü cad No 11/3, 4 Levent, Istanbul, Turkey; Fax: 02-12-281-27-13; Email: fgfsfair@fgfsfair.com.tr; Website: <www.fgfsfair.com.tr/english/bilgi.html>
October 17–19, 2001	Trieste Aqua 2001 Conference	Trieste, Italy	FAO Eastfish; Phone: 45-35467193; Fax: 45-35467181; Email: FAO@eastfish.org
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
October 24–27, 2001	5th Latin American Conference and Exposition and the 6th Ecuadorian Aquaculture Conference	Guayaquil, Ecuador	Phone: 760-432-4270; Fax: 760-432-4275; Email: worldaqua@aol.com; Website: <www.cenaim.espol.edu.ec/eventos/index.html>
November 7–12, 2001	"Fish for the People 2001" ASEAN-SEAFDEC Conference on Sustainable Fisheries in the New Millennium	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>
November 25–30, 2001	6th Asian Fisheries Forum	Kaohsiung, Taiwan	John Cooksey; Phone: 760-432-4270; Email: meetingmanager@aol.com
January 27–30, 2002	Aquaculture America 2002	San Diego, California, USA	George B. Brooks, Jr.; Phone: 520-562-6706; Fax: 520-562.6791; Email: gbbrooks@gilariver.com; Website: <www.was.org>

## Workshops and Short Courses

Date	Title/Topic/Site	Contacts
July 23–27, 2001	Recirculating Systems/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>
July 25–27, 2001	Design and Operation of Aquaculture Facilities/Roanoke, Virginia, USA	Greg Boardman; Phone: 540-231-2013; Email: gboard@vt.edu
August 7, 2001	Better Use of Water, Nutrients and Space Workshop/Occurs between Aquaculture Europe 2001 Conference and AquaNor International Exhibition/Trondheim, Norway	Hilde Joncheere; European Aquaculture Society; Phone: 32-0-5932-3859; Fax: 32-0-5932-1005; Email: h.joncheere@aquaculture.cc; Website: <www.easonline.org>
August 13–17, 2001	Intensive Shrimp Culture/Ft. Pierce, Florida, USA	ACTED (see above)
August 26–31, 2001	Practical Short Course on Aquaculture Feed Preparation, Nutrition, and Feed Management/Texas A&M University, College Station, Texas, USA	Mian N. Riaz, 2476 TAMU, Food Protein R&D Center, Texas A&M University, College Station, TX 77843; Phone: 979-845-2774; Email: mnriaz@tamu.edu Website: <www.tamu.edu>
August 30–31, 2001	Production Planning/Ft. Pierce, Florida, USA	ACTED (see above)
September 5–12, 2001	Texas Shrimp Farming Short Course/Port Aransas, Texas, USA	Sea Grant College Program Office, 2700 Earl Rudder Freeway South, College Station, TX 77845; Phone: 979-845-7524; Fax: 979-845-7525; email: lpropes@unix.tamu.edu
September 19–21, 2001	Opportunities in Aquaculture/Ft. Pierce, Florida, USA	ACTED (see above)
September 20, 2001	Tilapia Farming/Ft. Pierce, Florida, USA	ACTED (see above)
September 21, 2001	Shrimp Farming/Ft. Pierce, Florida, USA	ACTED (see above)
October 4–5, 2001	Live Feeds Culture/Ft. Pierce, Florida, USA	ACTED (see above)
November 12–15, 2001	Aquaponics Course/Sponsored by Aquaculture International/Bryson City, North Carolina, USA	Charlie Johnson; Phone: 828-479-6294; Email: cwjohnson@graham.main.nc.us
January 28–February 15, 2002	Assessment and Reduction of Environmental Impacts of Aquaculture/Wageningen, Netherlands	International Agricultural Centre (IAC), PO Box 88, 6700 AB Wageningen, Netherlands; Phone: 31-317 495 495; Fax: 31-317 495 395; E-mail: training@iac.agro.nl; Website: <www.iac.wageningen-ur.nl>
Ongoing	Auburn University Customized Training Programs/Auburn University, Alabama, USA or On-Site	Len Vining; Phone: 334-844-9328; Fax: 334-844-9208; Email: lvining@acesag.auburn.edu
Ongoing	The Oceanic Institute Programs/Oahu, Hawaii, USA or On-Site	Gary Karr; Email: gkarr@oceanicinstitute.org

### Pond Effluent Investigation

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delivered through a drip irrigation system. CRSP research suggests that nutrient enrichment of pond water during aquaculture production is insufficient to meet crop nutrient demand, and fertilizer recommendations for crops should not be altered when pond water is used as an irrigation source.

#### ABOUT THE AUTHORS

Wood is a Professor in the Department of Agronomy and Soils at Auburn University; Meso is a former graduate student in the Department of Soil Science at the University of Nairobi; Veverica is a Research Associate in the Department of Fisheries and Allied Aquaculture at Auburn University and was formerly located at the Sagana Fish Farm in Sagana Kenya; Nancy Karanja is Head of the Department of Soil Science at the University of Nairobi.

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