

# AQUANEWS



Sustainable Aquaculture  
for a Secure Future

## AQUACULTURE COLLABORATIVE RESEARCH SUPPORT PROGRAM NEWSLETTER

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### From Wild Harvest to Aquaculture: The Missing Link?

By Roger J. Harris

Without agriculture, civilization is impossible. Thus, historians and archeologists have devoted a lot of research effort to understanding agriculture's origins—how a hunter-gatherer lifestyle evolved into the systematic cultivation of food.



ROGER J. HARRIS

Young boy in the Peruvian Amazon spearfishing for fish trapped in a riverbed pool. (Note the barrier to prevent trapped fish from escaping.)

In contrast, the origin of aquaculture has received little attention. So how did people learn to cultivate fish? Ideas on this seem rather speculative.

For example, "There is folklore evidence that basic aquaculture was first practiced in Canada by aboriginal peoples through the transfer of fish between streams and rivers."<sup>1</sup> Others suggest that aquaculture in Asia "...most likely originated when fish were trapped in some type of enclosure after monsoon floods receded."<sup>2</sup>

During a recent trip to the Amazon region of Peru, I observed a practice that is a plausible model for how aquaculture began.

By a riverside village, a small river had almost completely drained due to the receding flood of the main stream of the Amazon River into which the tributary flowed. Small temporary pools were left behind, filling natural depressions in the riverbed.

Villagers had placed barriers in some of the pools to prevent escapes of trapped fish. These fish are caught by hand or speared, a task young children could accomplish (see photo 1). This is the first step toward cultivating fish.

What is the next step? Throughout the year, fishermen venture in dug-out canoes into the forest's maze of streams and tributaries to catch wild fish. During high water (when the river by their village ran freely) small fish would normally be thrown back. However, at this time of year, villagers keep the small fish from their wild harvest. These small fish are placed in the natural pools to be grown to larger size suitable for consumption. Vegetation is placed in and around the pools to mimic the natural habitat to

### Goings On

We are pleased to announce a new resource for USAID missions and Aquaculture CRSP Ambassadors—the Strategic Objective "Solution Finder" website. To access the website, please go to: <http://pdacrsp.oregonstate.edu/missions.shtml>.

The "Solution Finder" website was developed by the Aquaculture CRSP Management Entity to present the depth and breadth of Aquaculture CRSP capabilities available to USAID missions and to assist Aquaculture CRSP Ambassadors as they interact with USAID Mission officials.

Using the Solution Finder, visitors explore how the capacity and experience of the Aquaculture CRSP can assist USAID missions in meeting their strategic objectives. The site also provides a list of the many services the program can bring to bear to solve specific problems in a wide range of topics varying from food security to health concerns to economic development, among others, with links to applicable CRSP research.

The website is a dynamic resource that will increase in size and further evolve over time. We envision a broader launching of this new resource soon and hope that it will be a new conduit between the CRSP and those who can benefit from our expertise and our desire to help.

More than 800 scientists, policymakers, businesspeople, and civil society representatives participated in the National Conference on Science, Policy, and the Environment:

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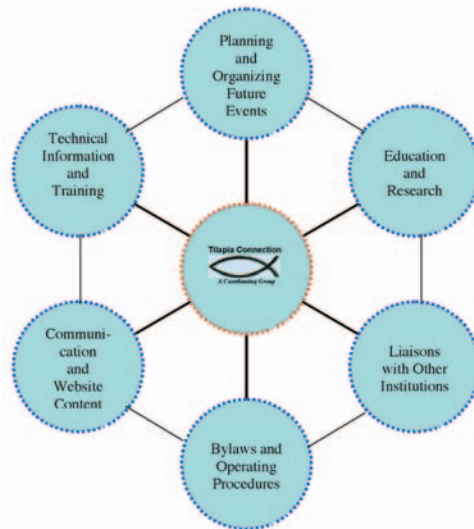
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## Tilapia Connection — A Coordinating Group for Honduras and Central America

By Brahm Verma, University of Georgia

A primary goal of the CRSP Honduras project is to train small- and medium-scale tilapia farmers, nongovernmental organization workers, extension agents, and service providers on several aspects of tilapia culture and decision-making methodology to institutionalize tilapia culture in Honduras and Central America. Two major activities in the project have been 1) training workshops and on-site visits with tilapia farmers to advise on all aspects of tilapia culture, through which over one thousand people have been reached and 2) development of a web-based information delivery and communication system, which is beginning to find much use in the region. These contacts with participants began to identify the need for an organization that could become

“the voice” for tilapia in the Central America region. It was during training sessions in Honduras, Nicaragua, and El Salvador in October–November 2002 and June 2003 when several participants engaged in impromptu discussions and encouraged us to help form a consortium.



Network Organization of the Tilapia Connection  
— A Coordinating Group for Central America.

On 18 February 2004 I facilitated a day-long meeting in Zamorano, Honduras where 19 invited volunteers (2 from Nicaragua, 3 from El Salvador, 3 from Guatemala, 10 from Honduras, and 1 from the US) addressed the question: “How can we be build and maintain an organization and effectively use the web-based systems for enabling success of small- and medium-scale Tilapia farms in Honduras and Central America?”

The group included 4 producers, 3 government representatives, 4 NGO representatives, and 5 educators. The meeting concluded with the creation of the *Tilapia Connection*, a group for promoting tilapia in Central America, and the 19 attendees agreed to become charter members of the organization. The overall objective of the Tilapia Connection is to coordinate the efforts of various tilapia constituencies and increase communication and access to knowledge for institutionalizing tilapia. Specifically, Tilapia Connection is meant to improve:

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## Aquaculture CRSP holds Workshop on “Application of GIS and Remote Sensing for Assessing Watershed Ponds for Aquaculture Development” in Vietnam

By Dao Huy Giap and Yang Yi,  
Asian Institute of Technology

As a follow-up activity for the Aquaculture CRSP study “Assessing Watershed Ponds for Aquaculture Development in Thai Nguyen, Vietnam” conducted during November 2001 to April 2003, a one-day workshop on “Application of GIS and Remote Sensing for Assessing Watershed Ponds for Aquaculture Development” was held at Thai Nguyen, Vietnam on 4 September 2003. Thirty participants from the Thai Nguyen Provincial Department of Agriculture and Rural Development and the Research Institute for Aquaculture No. 1 (RIA-1) of Vietnam attended the workshop. The main purposes of this workshop were to present the findings of the study and introduce the application of GIS and Remote Sensing for aquaculture to the local researchers and government officers.



Workshop participants gather for a photograph.

Nguyen Xuan Cuong of RIA-1 presented the current status of the livelihood and socio-economic conditions of the farmers in the study area, while Dao Huy Giap of the Asian Institute of Technology (AIT) presented the application of GIS and remote sensing in assessing watershed ponds for aquaculture development—a case study in Thai Nguyen province. Then, Yang Yi of AIT shared Chinese experiences in enhancing fish production in watershed ponds through using appropriate fertilization and stocking strategies.

Pham Anh Tuan, deputy director of RIA-1, indicated that he thought this workshop was very useful for Vietnamese researchers as it brought out the linkage between “high-tech” tools and aquaculture development. It has also provided local people and Aquaculture CRSP researchers at AIT an opportunity to exchange information and discuss the potential ways to improve aquaculture production in watershed ponds.

Tran Mai Thien, coordinator of NORAD project and former director of RIA-1, proposed the further collaboration between Aquaculture CRSP and RIA-1 in applying GIS and remote sensing for identifying potential areas and managing the development of coastal and marine aquaculture, which

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## Workshop on Fertilization Strategies for Pond Culture in Bangladesh

By Yang Yi, Asian Institute of Technology, and Md. Abdul Wahab, Bangladesh Agricultural University

**A** one-day workshop on Fertilization Strategies for Pond Culture in Bangladesh

was held in Dhaka on 26 June 2003. This workshop was organized by the Aquaculture CRSP and AIT in cooperation with

its partners, namely, Bangladesh Agricultural University (BAU) and three NGOs (BRAC, CARITAS, and PROSHIKA), to disseminate results of on-station and on-farm trials of fertilization strategies sponsored by the Aquaculture CRSP and to enhance cooperation between the Aquaculture CRSP and academic institutions, government agencies, NGOs, and international organizations in Bangladesh.

Fifty participants included government fisheries officers, researchers, university teachers and students, NGO extension workers, and international organization staff from the Bangladesh Department of Fisheries (DOF), Bangladesh Fisheries Research Institute, Universities (Bangladesh Agricultural University, Dhaka University, Rajshahi University), NGOs (BRAC, CARITAS, PROSHIKA, PBAEP, TMSS), and international organizations (World Fish Center, SUFER Project/DFID).

The workshop started with a welcoming address from Abdul Wahab of BAU and a brief introduction of Aquaculture CRSP activities in the past two decades by Yang Yi of AIT. Aatur Rahman, former Director General of the DOF, chaired technical sessions. In the first technical session, Mr. Khaleque, Project Director of the DOF, and Mr. Uddin of BAU overviewed the current

status of pond aquaculture in Bangladesh, while Anwara Begum, Director of the CARITAS Fisheries Program, presented pond fertilization practices of NGOs, BAU, BFRI, and DOF in Bangladesh.

On behalf of the Bangladesh team of the Aquaculture CRSP-sponsored project, Wahab and Abdur Rahman, Senior Fisheries Development Program Co-

ordinator of PROSHIKA, presented the results of on-station and on-farm trials of different fertilization regimes used in Bangladesh and conducted

by the Aquaculture CRSP, respectively, in the second technical session. The trials indicated that the fertilization regime developed by BAU is the best for carp polyculture ponds in Bangladesh.


In the third technical session, Yang Yi presented fertilization strategies for tilapia culture developed by the Aquaculture CRSP, and Aminul Islam and Mostafa Hossain of BAU talked about environmental impacts of the intensification of pond culture.

Dr. Akhteruzzaman, Technical Manager of the SUFER Project, and Mostafa Hossain summarized and presented the recommendations from a different technical session. Then, Dr. Mazid, Director General of the Bangladesh Fisheries Research Institute, together with Wahab and Yi, moderated the general discussion and open discussion on disseminating strategies.

The Aquaculture CRSP was thanked for providing an excellent opportunity to participants from academic institutions, government agencies, NGOs, and international organizations to "standardize" fertilization strategies in Bangladesh, where the same farmers often receive very different recommendations on fertilization regimes from different extension partners. This workshop was very fruitful, and was the first workshop agreeing on the best fertil-

### Acronyms

BAU	- Bangladesh Agricultural University
BFRI	- Bangladesh Fisheries Research Institute
SUFER	- Support for University Fisheries Education and Research
PBAE	- Patuakhali Barguna Aquaculture Extension Project
TMSS	- Thengamara Mahila Sabuj Sangha


ization regime by all participants. This workshop will enhance knowledge and capabilities of the institutions involved in aquaculture and fisheries outreach in fertilization strategies for pond culture in Bangladesh and increase impacts of the Aquaculture CRSP to Bangladesh. Bangladesh researchers, extension staff of government agencies and NGOs, and fish farmers will benefit from the experiences, research results, technologies, and approaches of Aquaculture CRSP through this workshop. 

### Vietnam Workshop

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has been growing rapidly in Vietnam.

Duong Van Lanh, director of Thai Nguyen provincial Department of Agriculture and Rural Development, thanked the Aquaculture CRSP and AIT for their excellent work conducted in Thai Nguyen and said that the workshop gave a good opportunity for local government officers to learn new tools for aquaculture assessment, which will help decision-making and planning in aquaculture development. He also appreciated Yang Yi for sharing Chinese experiences with local people.

In general, the participants understand GIS and remote sensing as potential tools for integrating socio-economic and environmental data for detecting land use change and identifying and estimating the potential of a watershed area for aquaculture development. The participants expressed the hope that the Aquaculture CRSP will provide further training on the use of GIS and remote sensing for aquaculture development in order to further build their capacity. 



Workshop participants gather for a photograph.

MAHMUD HASAN

## The Missing Link

...from p. 1

provide shade for the fish (see photo 2). Types of fish used this way are primarily various species of catfishes and characins.

This practice could be the "missing link." These activities represent simple and logical steps humans could have taken to adapt natural systems to cultivate fish.

It is a straightforward progression from these methods to artificial pond systems.

For poor villagers raising fish in natural depressions enables them to supplement wild catches without the time and effort. They may not rely greatly on this food source, since wild fish catches usually peak during the low water season in any case. Perhaps

labor saving is the main motive.

The above observations imply that, like agriculture, aquaculture originated from adapting natural systems to the needs of people. However, it is possible the villagers developed the practice following efforts by aquaculture extension workers in the recent past. Thus, formal studies

are needed to confirm whether this is a plausible mechanism representing a transition from wild fisheries to aquaculture.

### References

1. [http://www.bcsqa.ca/industry\\_history.html#two](http://www.bcsqa.ca/industry_history.html#two)
2. <http://www.masla.com/beginner/history.html>



ROGER J. HARRIS

*Natural depression in riverbed used by Peruvian Amazon villagers to stock wild-collected fish and grow to harvest size (note the vegetation placed to provide shade).*

## Tilapia Connection

...from p. 2

- effectiveness of communication among members
- accessibility of new knowledge and technical training
- ability of sharing local experiences
- contacts with policy makers for influencing resource allocations for tilapia
- accessibility of market information, and
- ability of identifying and expressing future needs for training and technical assistance

The Tilapia Connection is structured as a network organization connecting six working groups, each with a primary area of activities:

### Planning and Organizing Future Events

Activities: regularly survey emerging opportunities for the tilapia industry, identify industry needs, organize forums and meetings with decision makers and industry leaders, and plan other such events that will benefit members.

### Communication and Website Content

Activities: update the content of the

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## CRSP Researchers Awarded TIES Project

The CRSP is pleased to announce that two Aquaculture CRSP collaborators, Kevin Fitzsimmons of the University of Arizona (UA) and Wilfrido Contreras-Sánchez of the Universidad Juárez Autónoma de Tabasco (UJAT), are the recent awardees of a Training, Internships, Exchanges, and Scholarships (TIES) grant.

The US-Mexico Training, Internships, Exchanges, and Scholarships (TIES) Partnership Initiative is a program initiated by the State Department as an adjunct to the North American Free Trade Agreement (NAFTA). It covers all fields of education with the goal of increasing academic interactions between US and Mexican institutions of higher education. The intention is that the TIES will address a variety of issues including job creation, environmental stewardship, food security, as well as education.

Fitzsimmons and Contreras-Sánchez developed an aquaculture focused program that will provide two scholarships per year for graduates from Mexican institutions to earn a Masters degree at UA. The project will also provide funding for a Mexican faculty member

and a student to attend the Shrimp Pathology summer short course at UA. Two aquaculture internships will be provided through the program each semester. These 5-month positions will be split between Panorama Acuicola magazine in Mexico and a commercial tilapia farm in Southern California. Five scholarships will be provided per year for Master's students at Mexican Universities.

In addition, each summer a UA aquaculture faculty member will teach a summer short course in Mexico. The project will also support an extension conference in Mexico to disseminate results of research from the project and a bi-lingual Aquaculture website with Aquaculture TIES information and Spanish language aquaculture extension documents. Finally, the project will support participants to attend professional aquaculture meetings in Mexico and help to organize the International Symposium on Tilapia in Aquaculture VII conference in Mexico City in 2007. The lead institutions on the project are Universidad Autónoma de Tamaulipas, UJAT, and UA.

## Tilapia Fingerling Producer Training Course in Honduras

By Daniel E. Meyer, Suyapa Triminio Meyer, and Joseph J. Molnar

As part of the follow-up of the fingerling production study in Honduras, in December 2003 we organized and held a four-day fingerling producers training course with nine fish farmers selected from throughout Honduras. The results of the previous interviews with these farmers helped to tailor the course content to the needs and deficiencies they feel were constraints to their efficiency in producing fingerlings.

The participants came from different areas of Honduras, including farmers and extension agents from NGOs and the local government. All were already locally producing and distributing tilapia fingerlings. Whether selling or distributing them as part of the NGOs mandate, these producers play an important role in the development of tilapia production from backyard ponds to commercial operations. Approximately 50% of the hotel and food costs were paid for by the participants and the rest of the course was financed with Aquaculture CRSP project funds.

The course consisted of two days in Zamorano in the aquaculture station and two days visiting tilapia producers in Olancho, Comayagua, and Lake Yojoa. The participants received classroom-type presentations on tilapia biology, reproduction, protocols for producing all-male fingerlings, definition and estimation of production costs, and information on market-

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CARLITOS ARITA

Fingerling producers and instructors with diploma participation presented at the end of the course.

## Graduate Student Profile: Carlos Leyva

By Ian Courter

Carlos Leyva, native to Honduras, became interested in aquaculture while attending the Escuela Agrícola Panamericana (EAP), Zamorano. "I was amazed going through a production cycle from stocking to harvest and astounded by the large amounts of succulent products resulting from it," said Leyva. After graduation in 1986, Leyva worked as an extension agent. He went on to receive a B.S. from Kansas State University and began working for a shrimp farm in Choluteca, Honduras. During his time in Choluteca, he received invaluable technical support from Dan Meyer, a CRSP host country Principal Investigator based at EAP, who would ultimately influence Leyva to pursue a graduate degree in aquaculture. Leyva returned to Zamorano in 1991 and worked in the aquaculture department at EAP.

In the fall of 2002, Leyva began working on a graduate degree at the University of Arkansas at Pine Bluff (UAPB). His thesis project, titled "Central American Aquaculture Markets: Optimizing Tilapia Marketing in Honduras," focuses on the shortcomings of domestic marketing of tilapia in Honduras. Leyva has been responsible for gathering information from small- and medium-scale farmers for use in a model that aims to optimize marketing efforts in the region.

The most challenging aspect of Leyva's studies has been learning to use the mathematical programming tools involved in the modeling process, although, in addition to networking with other aquaculture enthusiasts, Leyva finds mathematical programming to be the most exciting and useful facet of his studies thus far.

According to Leyva, "Tropical conditions and the country's natural resources are factors that favor aquaculture in Honduras." Both marine and freshwater species thrive in the warm, wet climate year-round.




However, Leyva believes that the infrastructure of the Honduran market is a stumbling block for small producers. There is little organization among growers, which gives the middlemen excessive control over prices. Through his research, Leyva hopes to shed some light on the constraints to tilapia culture in Honduras.

When asked about the state of aquaculture globally Leyva replied, "Aquaculture is expanding rapidly; technology can hardly catch up with commercial needs." However, Leyva believes that advocates for capture fisheries are overly critical of aquaculture in an attempt to lower market interest in cultured products.

Leyva was born and raised in Tegucigalpa, Honduras, and he plans to return to Honduras after graduation in May 2004. He will be working for Mountain Stream Tilapia, a past employer who has maintained close contact with him. More specifically, he will start a market support department that will focus on quality and research and development.

In the future, Leyva plans to start his own farm, but not for tilapia. He hopes to raise red snapper in sea cages. Ocean cage culture is one of the most exciting and rapidly developing fields in the industry.

In addition to his own research, Leyva spends time helping his fellow students in the laboratory and in the field. He also finds time to go fishing, hunting, play soccer and racquetball, and spend time with his family. 

## Training in Honduras

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SUYAPA TRIMINIO MEYER



Fingerlings harvest for sell at the Rufino Martínez farm in Olancho.

ing tilapia locally. These sessions were run as open discussions to evaluate the level of knowledge and identify missing information or misinformation that each participant brought to the course.

One-half of each day at Zamorano was dedicated to practical training and handling of fish. Participants learned to harvest and grade fry with plastic mesh graders, and to prepare feed with methyl-testosterone while utilizing adequate techniques and personal protection. We discussed the techniques and then practiced calculating the amount of feed to offer the fry, stocking densities, and MT dosage using recommendations from previous CRSP research efforts. We also discussed techniques and practiced proper handling of fry for counting and transport in Honduras.

Each participant was given a plastic mesh fingerling grader (3 mm mesh) to be used for separating fry by size to improve the effectiveness of the hormone treatment. Each participant prepared a stock solution of methyl-testosterone (one liter at 1 mg MT/ml) that they took to their farm for use in sex-reversal procedures.

Much of the course content was derived from CRSP research carried out at the El Carao Fish Station in Hon-

duras, other CRSP sites around the world, and the results of work done on the Aquaculture Station in Zamorano. Each participant was given a copy of the CRSP publication entitled "Tilapia Production on Integrated Farms."

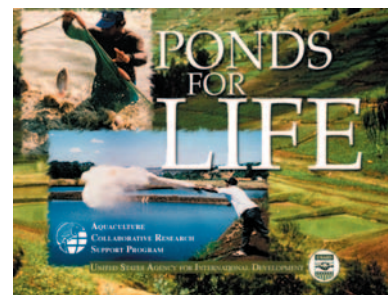
Several positive outcomes of the event were:

- A dynamic and productive interaction among the farmers themselves was created. After the course we have spoken with several of the participants and they have informed us that they keep in contact and help each other with advice and sharing of inputs;
- They each learned from each other's experiences as well as from the members of the Zamorano team; and
- The host country CRSP team gathered new insight into the problems and limitations these farmers are attempting to manage (the need for more technical training, difficulty obtaining MT, interest in new genetic lines of tilapia, and alternatives to locally available expensive feeds).

We concluded the course with a lunch at Lake Yojoa. Each participant

## Ponds for Life DVD

The Aquaculture CRSP recently completed production of a DVD. *Ponds for Life* combines factual information and interviews with CRSP researchers in a framework that explains the challenges of small-scale aquaculture and some of our successes that make it easier and safer.




received a diploma of participation and was requested to write down his/her impressions of the course content and the experience at Zamorano.

Some of these comments were:

"Excellent course, we learned a lot, well organized and good combination of theory and practice."

"Very interesting course, very useful information and experience for my work in extension; I am dedicated to involving more farmers in fish culture, a very special course that has helped me better understand tilapia culture and improve the quality of my fish."

"I am totally satisfied with the course and with Zamorano and the CRSP, I am more motivated to assist small farmers to culture tilapia utilizing my new knowledge and experience derived from this course. We hope to continue learning more."

We are planning to hold another course for fingerling farmers this year. For this course the participants will be identified strategically in areas of Honduras where there is tilapia culture but no local sources for fingerlings. In the future we plan to offer similar training to tilapia producers from the other Caribbean and Central American countries. 

## Tilapia Connection

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Website <[www.aquacultura.org](http://www.aquacultura.org)> periodically, train members on the use of the web for communication, facilitate virtual meetings between members, and connect with other relevant institutions and organizations.

### Education and Research

Activities: identify critical research needs of the industry and engage in guiding local and national research priorities, identify and prepare relevant education materials and provide them for updating the website, and offer courses that will prepare candidates for jobs in the tilapia industry.

### Technical Information and Training

Activities: identify critical technical needs of the industry and engage local and national leaders and industry in providing the latest tools of the trade, prepare pamphlets and educational materials and provide information for updating website content, and design and offer practical "hands-on" training courses.

### Liaisons with Other Institutions

Activities: identify and develop working relationships with critical organizations and institutions and create a network of collaborating organizations.

### Bylaws and Operating Procedures

Activities: draft bylaws and operating procedures of the Tilapia Connection that promote participation of all individuals in the tilapia industry and ensure effective functioning and smooth transitions of leadership.

A coordinating group made up of a member of each of the six working groups will provide a common node to link all activities and communications, and its members will serve as official representatives on behalf of the Tilapia Connection. The Tilapia Connection's organization is illustrated in Figure 1.

## Aquaculture CRSP Makes a Splash at Earth Day 2004

By Chris Flemming

"Sustainable Aquaculture for a Secure Future," was the message the Aquaculture CRSP was trying to get across to the Oregon State University community during the annual Earth Day celebration on April 21.

CRSP Staff members showcased a booth educating the OSU community about the benefits of aquaculture all over the world, and why it is important to many rural communities in other countries. Also, a giant life-sized tilapia with its face cut out was put on display. Those who wished could have their picture taken and see themselves as a tilapia.

Recent publications of Aquanews and EdOp Net were also handed out to give people a better understanding about aquaculture and the work done by the CRSP. 🐟



CRSP graduate student Ephraim Temple poses inside our giant fish cut-out.

The formation of the Tilapia Connection is a capstone achievement that may prove to be a pivotal action in the institutionalization of tilapia

Meyer, Suyapa Meyer, Alberto Zelaya, and Brahm Verma (ex-officio). The tilapia website is regularly updated with the current contents and facilities for virtual meetings, and electronic communication for the members of Tilapia Connection will be added soon.

For stability, reliability, and quality control, the website will be hosted in the Zamorano computer center. Tilapia Connection encourages individuals with interest in tilapia and the Central America region to become members through the website <[www.aquacultura.org](http://www.aquacultura.org)> or by sending an email to Ing. Carla Garces

<[cgarcesm@yahoo.com](mailto:cgarcesm@yahoo.com)>. This model may be useful for building local capacity in other regions of the world as well. 🐟

Co-Investigators on this project are: Dan Meyer, Suyapa Meyer, and Carla Garces at Escuela Agricola Panamericana Zamorano, and Bill Tollner at the University of Georgia



Tilapia Connection coordinating group.

in Honduras and Central America because of the increased ability of the people of the region to self-identify needs, access current information and technology, communicate effectively on a timely basis, and influence policy makers. Three to five Tilapia Connection members in each working group are initiating activities. The members of the coordinating group are: Francisco Avalos, Carla Garces, Dan

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# Notice of Publication

Notices of Publication announce recently published work carried out under Aquaculture CRSP sponsorship. To receive a full copy of a report, please contact the author(s) directly.

## CRSP RESEARCH REPORT 04-199

### GAMITANA (*COLOSSOMA MACROPOMUM*) AND PACO (*PIARACTUS BRACHYPOMUS*) CULTURE IN FLOATING CAGES IN THE PERUVIAN AMAZON

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In April 1999, the Institute for Investigations of the Peruvian Amazon (IIAP) located in Iquitos (Loreto region) with the Italian NGO Terra Nuova and Southern Illinois University at Carbondale (SIUC), through the auspices of the PD/A CRSP-USAID program, initiated the Food Security Program for Familiar Productive Units (PROSEAL) between the Iquitos-Nauta Road and the Tigre River (Santa Helena and Huayococha). The goal of this program was to produce fish in ponds and floating cages as a way of providing tools to improve the animal protein intake of the Quichuas indigenous population and other rural poor.

This article is restricted to the experiences gained through a demonstration project on floating cages. Fish culture in cages floating directly in the natural environment in the Peruvian Amazon has not been reported previously; thus many issues had to be resolved for it to be successful. The two predominant concerns were: 1) the behavior of major predators, such as dolphins (*Inia geoffrensis* and *Sotalia fluviatilis*), crocodiles (*Caiman sclerops*), and pirañas (*Serrasalmus nattereri*) towards the unprotected floating cages containing large numbers of fish; and 2) the sociological fact that natives of the region possessed a strong traditional hunting and gathering tradition, with fish culture activities being alien to them.

The fishes selected for cage culture were the gamitana

(*Colossoma macropomum*—also known as black cachama or tambaqui), and paco (*Piaractus brachypomus*—also known as pacú, white cachama, pirapitinga, or morocoto). The two species have the advantage of being well known to the local population, although recent captures have decreased dramatically as a result of excessive fishing pressure on natural stocks by the Iquitos-based commercial fishing fleet. In this article, we report preliminary results obtained from gamitana and paco culture in floating cages in the Tigre River.

This abstract is excerpted from the original paper, which was published in *World Aquaculture*, 34(3): 22-24.

## CRSP RESEARCH REPORT 04-200

### EFFECT OF OXYGEN SATURATION IN WATER ON REPRODUCTIVE PERFORMANCES OF PACU *PIARACTUS BRACHYPOMUS*

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Broodstock pacu *Piaractus brachypomus* as well as their eggs during their embryonic development were exposed to either normoxia (5.5–7.5 mg O<sub>2</sub>/L) or hypoxia (2.0–4.5 mg O<sub>2</sub>/L) conditions. The plasma concentrations of 11-ketotestosterone in males and estradiol-17β in females, as well as that of their precursor testosterone (T) were significantly ( $P < 0.01$ ) higher in fish maintained under normoxic conditions than in fish exposed to hypoxia. After ovulation and spermiation induced by hormonal treatments, the plasma concentrations of T and 17,20β-dihydroxy-4-pregnen-3-one (17,20βP) significantly ( $P < 0.05$ ) increased in both sexes under both normoxic and hypoxic conditions. The plasma levels of T and 17,20βP achieved under normoxic conditions were higher than the ones recorded under hypoxia, except for those of 17,20βP in



males. Males responded positively to the hormonal treatments, and the concentration of spermatozoa was  $10.5 \pm 0.8 \times 10^9$ /mL under both oxygen conditions. Hypoxia resulted in significantly lower survival of embryos ( $17.3 \pm 28\%$ ) in comparison to normoxic conditions ( $68.5 \pm 25\%$ ). Moreover, larval deformities were found when exposed to hypoxia ( $91.6 \pm 6\%$ ). During embryonic development of this species 4 mg/L of oxygen is tolerated at 26–27 C without negative impact. We conclude that despite the highly adaptable nature of adult pacu to environmental hypoxia, oxygen concentrations below 4 mg/L severely impacted survival of embryos.

This abstract is excerpted from the original paper, which was in *Journal of the World Aquaculture Society*, 34(4):441–449.

### CRSP RESEARCH REPORT 04-201

#### WASTE RECYCLING IN FISH POND CULTURE THROUGH INTEGRATED CULTURE SYSTEMS

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Two new culture strategies, have been developed to recycle feeding waste derived from intensive aquaculture within a single pond, enhance nutrient utilization efficiency, reduce the nutrient contents in effluents discharged from intensive culture ponds, and mitigate eutrophication in receiving waters.

In the integrated cage-cum-pond culture system, high value species are stocked in cages suspended in ponds, and filter-feeding species are stocked in open water outside the cages. While in the integrated pen-cum-pond culture system, high valued species and filtering-feeding species are segregated by plastic netting, which partitions a pond into two compartments. High-value species in both systems are fed a high protein diet, while the filtering feeding species depend solely on natural foods generated from feeding wastes.

In the integrated culture systems, nutrients contained in wastewater of intensive fish culture can be effectively reused by filtering-feeding species, giving compatible yields with those achieved in organically or inorganically fertilized ponds. The integrated culture systems recycle wastes from intensive culture into semi-intensive culture, thereby reducing the nutrient input for pond fertilization, and minimize the impacts of pond effluents on environments. The integrated culture systems can also be used in polyculture ponds to confine costly high protein diets to the high valued

species to achieve higher economic returns. The integrated culture systems can be adapted by small-scale farmers, especially suitable for low capital investment.

This abstract is excerpted from the original paper, which was published in the Proceedings of the Third World Fisheries Congress: Feeding the World with Fish in the Next Millennium—The Balance between Production and Environment. American Fisheries Society, Symposium 38, Bethesda, Maryland, pp. 265-270.

### CRSP RESEARCH REPORT 04-202

#### STOCKING DENSITIES OF NILE TILAPIA IN TILAPIA-SHRIMP POLY CULTURE UNDER FIXED FEEDING REGIME

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An experiment was carried out in nine 200-m<sup>2</sup> earthen ponds at the Asian Institute of Technology, Thailand, to investigate the growth performance of Nile tilapia (*Oreochromis niloticus*) and shrimp (*Penaeus monodon*) and water quality in different stocking combinations of tilapia-shrimp polyculture under fixed feeding regime. There were three treatments in triplicate each: shrimp alone at 30/m<sup>2</sup> (monoculture, control); shrimp at 30/m<sup>2</sup> and Nile tilapia at 0.25/m<sup>2</sup> (low tilapia density polyculture); shrimp at 30/m<sup>2</sup> and Nile tilapia at 0.50/m<sup>2</sup> (high tilapia density polyculture). The fixed same feed ration for all ponds was determined by a feeding table during 75-day culture period.

Results showed that the low tilapia density polyculture resulted in significantly higher shrimp yield than the monoculture and high tilapia density polyculture ( $P < 0.05$ ). FCR of 1.44 in the low tilapia density polyculture was significantly better than those (1.73 and 1.69) in both monoculture and high tilapia density polyculture, respectively ( $P < 0.05$ ). Nile tilapia showed fast growth (4.64–4.70 g/fish/day). There was no significant difference in growth and survival of Nile tilapia between the low and high tilapia density polyculture ( $P > 0.05$ ), while fish yields were significantly higher in the high tilapia density polyculture than those in the low tilapia density polyculture ( $P < 0.05$ ). Partial budget analyses indicated that the low tilapia density polyculture gave the highest net return, followed by the high tilapia density polyculture and shrimp monoculture and the ratio of added return to added cost in the low tilapia density polyculture reached 22.69, which

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## Aquaculture CRSP Award Winners

The Aquaculture CRSP sponsored numerous awards at the 2004 meeting of the World Aquaculture Society in Honolulu, Hawaii, in early March. In conjunction with the opening day ceremonies at the main WAS meeting, long-time CRSP researcher C. Kwei Lin, from The University of Michigan and the Asian Institute of Technology, was presented with an Aquaculture CRSP Lifetime Achievement Award for his many years of service.

In addition to sponsoring 7 student and 3 professional pre-conference awards, the CRSP also awarded prizes for the best and two runner-up Student Posters. Eligibility rules for a pre-conference award included that the work presented be based on CRSP-sponsored work, but the Student Poster Award was open to all presenters. Winners' names are presented below.

### Student Pre-conference Awards

Fred W. Chu-Koo, Southern Illinois University at Carbondale

*Seed Dispersal by Frugivorous Amazonian Fish*

Eddie Boy T. Jimenez,

Central Luzon State University

*Cost Containment Option in Semi-Intensive Tilapia Culture: Evaluation of Alternate Day Feeding Strategy*

M.E. Palacios, The Ohio State University

*Growth and Morphological Changes in Digestive Tract of Rainbow Trout and Paku due to Fish Meal Protein Replacement with Soybean Products*

Gustavo Rodriguez,

The Ohio State University

*Evaluation of Two Phytochemicals, Genistein and Quercetin as Possible Sex Differentiation-affecting Agents in Tilapia nilotica by Dietary Administration*

Kom Silapajarn, Auburn University

*Particle Size and Reaction of Agricultural Limestone*

Orawan Silapajarn,

Auburn University

*Nitrogen and Phosphorus Concentrations and Loads in Stream Receiving Catfish Farm Effluents*

Elizabeth Trejos-Castillo,



Auburn University

*Income, Food Security, and Poverty Reduction: Case Studies of Small-Scale Aquaculture Procedures in Santa Barbara, Honduras*

### Professional Pre-conference Awards

Suyapa Meyer,

Escuela Agrícola Panamericana

*Tilapia Fingerling Producers in Honduras: Characteristics, Practices and Needs*

Christopher Knud-Hansen,

Michigan State University

*Potential for using Clinoptilolite Zeolites for Ammonia-N Transfer and Retention in Integrated Aquaculture Systems*

Ivano Neira,

University of Arkansas at Pine Bluff

*Restaurants Markets for Aquaculture Products in Peru: A Descriptive Analysis*

### Student Poster Awards

#### First Place

Anthony Ilano,

Hokkaido University, Japan

*The development and hatching, growth, and survival of juvenile Japanese whelk Buccinum isaotakii in different temperatures and diets*

#### Second Place (two awards)

Nilton Massuo Ishikawa,

Aquaculture Center of UNESP, Brazil

*Safe concentrations of mercury in waters destined to Oreochromis niloticus rearing*

Antonio Lozano-Leon,

University of Santiago de Compostela, Spain

*A qualitative study of marine phytoplankton in the coastal areas of Honduras of interest for the bivalve molluscan culture*

## Goings On

...from p. 1

Water for a Sustainable and Secure Future conference in Washington, D.C., on 29-30 January 2004. The Aquaculture CRSP Program Management Office presented a poster entitled, "Sustainable International Aquaculture Research: A Focus on Low Food Chain Species" at the session on Advances at the Interface Between Water Science and Water Policy.

The Aquaculture CRSP was well represented at the annual American Academy for the Advancement of Science meeting in Seattle, Washington, on 12-16 February 2004. Joe Molar, CRSP Lead Principal Investigator of the Honduras Project, chaired the session entitled, "Aquaculture: Recent Advances in Fish Culture, Breeding and the Mitigation of Environmental Impact." CRSP presenters at the session included Claude Boyd from Auburn University and Chhorn Lim from USDA. In addition to the aquaculture session, the CRSP Program Management Office presented a poster entitled, "International Aquaculture Research: A Focus on Low Trophic Species," which detailed recent CRSP work with native, low trophic species.

The CRSP played a prominent role at the 2004 meeting of the World Aquaculture Society in Honolulu, Hawaii, in early March, sponsoring a great number of competitive awards (see p. 10) and one very special recognition award for Dr. C. Kwei Lin. Besides the individual presentations made by CRSP researchers, the program also sponsored a day-long special session that was specifically dedicated to highlighting CRSP research findings. The 2004 CRSP Annual Meeting, held in conjunction with WAS, will go down as having the highest attendance of any on record. We especially were thankful to have so very many host country researchers present, as well as External Evaluation Panel Member Dr. Christine Crawford, University of Tasmania.

The ACRSP is sponsoring a new initiative that brings prominent researchers in aquaculture, aquatic sciences, and international develop-

## Goings On

...from p. 10

ment to Washington, D.C., to present up-to-date information on water-related issues to the USAID community, including the Water Team within USAID's Office of Natural Resources Management. Among the presenters so far have been:

- Dr. Barry Costa-Pierce, Director of Rhode Island Sea Grant at the University of Rhode Island, presented "Aquaculture Status and Trends" in late January;
- Dr. Hillary Egna, Aquaculture CRSP Director, presented, "Overview of the Aquaculture Collaborative Research Support Program" in March; and
- Dr. Kevin Fitzsimmons, Aquaculture CRSP Principal Investigator at the University of Arizona presented "Markets for African Tilapia Products and Impacts on Local Supplies" in April.

Electronic copies of these PowerPoint® presentations are available at the CRSP website <<http://pdacrsp.oregonstate.edu/miscellaneous/WTpresentations/WTpresentations.html>>.

## Notice of Publication

...from p. 9

is higher than that (5.04) in the high tilapia density polyculture. The present study indicated that the addition of Nile tilapia into shrimp ponds can improve feed utilization efficiency, resulting in better economic returns and less environmental pollution. The present study showed that the tilapia-shrimp polyculture with appropriate feeding strategy is technically feasible, economically attractive and environmentally friendly.

This abstract is excerpted from the original paper, which was published in Proceedings of the 5th National Symposium on Marine Shrimp, BIOTECH, Thailand, pp. 100-113.

## ISTA 6

Sept 12-16, 2004

Manila, Philippines

The Sixth International Symposium on Tilapia in Aquaculture will be held at the Philippines International Convention Center and the Westin Philippine Plaza in Manila. The ISTAs are held every four years and are the only international conference devoted to this rapidly growing industry. Past symposia have highlighted the advances in various regions of the world, and now after 16 years it will return to Asia.

ISTA 6 will be hosted by the Bureau of Fisheries and Aquatic Resources of the Philippines Department of Agriculture. Other major sponsors include the Aquaculture CRSP, the World Aquaculture Society, Schering-Plough Aquaculture, Global Aquaculture Alliance, and FYD International. Central Luzon State University and the University of Arizona will assist with planning and organization.

The focus of the meeting will be the exploding trade in tilapia products and the role of Asia, and especially the Philippines, as a center of advancement in technology as well as production for the international markets. The conference will include technical presentations, producer workshops, an industry trade show, and farm tours.

Additional conference details are available at <<http://ag.arizona.edu/azaqua/ista/announce2.htm>>.

## IIFET 2004 Conference

26-29 July 2004

Tokyo, Japan

The International Institute of Fisheries Economics and Trade (IIFET) will hold its next biennial conference, IIFET 2004 Japan: What are Responsible Fisheries? This conference is co-sponsored by the Aquaculture CRSP.

Conference topics on a wide variety of seafood markets, fishery management, and aquaculture-related issues will attract the world's foremost fisheries economists from academia, industry, government management agencies, and international agencies. Seafood processing, marketing, and consumption issues, medical and ornamental substances from the sea, and international seafood trade issues will be covered, as well as policy issues including capacity reduction, fishery management by cooperatives, ecosystems approaches to management, and bio-economic models.

The conference will be held at the Tokyo University of Fisheries, 26-29 July 2004. Additional options will include a pre-conference professional tour 21-23 July visiting fishery management/marketing cooperatives, and 24 July visiting Tsukiji market and other links in the Japanese seafood market chain in Tokyo, plus a post-conference symposium.

For more information on IIFET or the Japan conference, or to join, please visit <<http://oregonstate.edu/Dept/IIFET>>.



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# AQUANEWS

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