



Regional Beneficiaries of Honduras Project Training Program

by Daniel Meyer, Escuela Agrícola Panamericana El Zamorano

One of the principal approaches we employ in working towards the long-term goals of the PD/A CRSP is to provide opportunities for effective technology transfer. PD/A CRSP-sponsored training events serve to improve and enhance local research and production capabilities, hence contribute to development of the aquaculture infrastructure. Our goal as PD/A CRSP team members is to build local competencies so that our presence and assistance are no longer required. We are working towards the eventual goal of making ourselves unnecessary and superfluous!

During October and November 2002,

the PD/A CRSPs Honduras Project held several important training events in Nicaragua, El Salvador, and Honduras. These courses provided useful information, advice, and practical experience on the varied techniques for producing tilapia with low cost inputs. Attending the courses were more than 150 individuals interested in tilapia culture as potential additional income from their farm operations.

The courses offered in Nicaragua and El Salvador included the following major topics:

- Use of internet-based information and an overview of our website on tilapia, <acuacultura-ca.org.hn/> (Verma, Maldonado, Aleman).
- Tilapia biology and culture, water quality, nutrition and feeding, processing, production costs, and

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Undergraduates Energize Aquaculture Research

by Roger Harris

It is often assumed that only graduate students have the skills and commitment to make significant contributions to a research program.

The approach being taken by the PD/A CRSP Mexico Project at Universidad Juárez Autónoma de Tabasco (UJAT) is challenging that assumption.

At UJAT, Wilfrido Contreras-Sánchez, himself a PD/A CRSP-sponsored Masters and Ph.D. graduate, manages a lab focused on aquaculture research. His present interests include the fate of sex change hormones, both *in vivo* and environmentally, and tilapia-shrimp polyculture. Aside from the quality of work done, what sets Contreras' lab apart is the large number of undergraduate students participating in the lab's various research projects.

In December 2002, I asked Contreras about the benefits and challenges of working with so many undergraduates. His replies suggest that other researchers could benefit significantly from adopting his approach.

AQUANEWS: How many undergraduates have you worked with since you became a PD/A CRSP principal investigator?

CONTRERAS-SÁNCHEZ: At present we have 19 undergraduate students working in the lab. We began with five students, of whom one has finished, another is on leave, and three are still working on projects. Altogether I would say we have worked with

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DANIEL MEYER

Course participants and PD/A CRSP team members at Ave María College of the Americas in San Marcos, Nicaragua, last October.

Undergraduates in Research

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about 26 undergraduate students, either wholly or partly supported by CRSP funding.

AQUANEWS: How does working with a large number of undergraduates influence your research direction and scope?

C-S: First of all, the lab runs because of them. They have a huge impact, comparable with Masters students in the US and are an important influence on the way we address specific questions or problems. We provide them the information and techniques, but many times they come up with new ideas and new topics to work with. They bring a fresh perspective and contribute original ideas, some of which get us working on new projects.

AQUANEWS: What are the prospects for your undergraduate students? For example, how many go on to graduate studies or go on to careers in aquaculture?

C-S: About a quarter will go on to graduate school. It could be more, but here in Mexico, there are few Masters programs that offer scholarships—there is little funding for postgraduates—and many students are expected to go and work to support their families. But that figure, a quarter, is much higher than the average in Mexico, and many of our students will remain in aquaculture careers. I would say at least eighty percent will stay in aquaculture.

AQUANEWS: That's impressive.

C-S: And we have several of our students already working here in Tabasco. One is the manager of the region's biggest tilapia farm, and two others are in charge of the reproductive biology section of that same farm. We emphasize connecting with the farmers, so our students can go on to work in aquaculture with them.

AQUANEWS: What are key features of

your approach to managing a large number of undergraduates, with their varying interests and strengths?

C-S: Use of lab meetings for communication and feedback is very important, and we have a few graduate students who act as team leaders. But communication is the most important thing.

To decide which students are most promising, we focus on those who want to do research. They go through selection and then we pick the best students who want to collaborate on our projects.

The students are required to learn about everything—the different research projects and the different species and systems. The average training period is four to six months for students who have already taken classes. Only after that are they allowed to decide what to do. I think that's something that allows us to work with lots of people with different capabilities and different visions.

AQUANEWS: And what would you say are significant challenges of working with a large group of undergraduates?

C-S: Again, keeping communication open is very important, and then team work. It's better now, but at the beginning, we realized it was important to keep communicating, and that was a learning experience! And also we are addressing gender issues so that men and women are able to work well together on teams.

AQUANEWS: Do you prefer to work with undergraduates compared with graduate students?

C-S: I like to work with both; it's not a preference. Grad students are more independent, you get more feedback, and they tend to work faster. But here in Mexico, because of funding issues, it is difficult to have many graduate positions—the graduate programs are generally small. Again, it's partly a cultural difference. In Mexico, recruitment starts with volunteers. Those that enjoy the work and show promise may then be offered a paid position. This is different from the US where the undergraduates working in a lab expect to be paid.

AQUANEWS: What is it about your work and lab that attracts undergraduate students?

C-S: We have the biggest group in our university, and with us the students feel they can participate in science—they're part of the research team, and they really learn the topics they're working on. As they work with farmers a lot, they like getting involved in science research that's applicable to real life, and they like to take part in the running of the lab, and contributing directly to the research. They know there's lots of potential to be actively involved. It's good experience for them. Our lab offers the best potential in our university for hands-on learning experiences. We have the most undergraduate students of any lab here. We also have a variety of projects offering a wide choice of topics. And they're aware of aquaculture as a promising field of study. We provide students with everything they need for their research—it's an umbrella for our students. Because of

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LABORATORY OF AQUACULTURE, UJAT



Members of the Laboratory of Aquaculture at UJAT, Mexico.

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poor support for science many labs can't do that—a problem in all of Latin America.

AQUANEWS: What advice would you give to a scientist who is considering working with undergraduate students?

C-S: If you are selective and choose the best, devoting resources to undergraduates can be as beneficial to your work as having grad students. Working with undergraduates is a really great experience and allows us to work in many different fields. They are generally an untapped potential, rarely used in many countries. You end up with students that really want to be in the field [of aquaculture].

AQUANEWS: Anything else you think might be important or relevant?

LABORATORY OF AQUACULTURE, UIAT



Wilfrido Contreras-Sánchez, Gabriel Real, and Gisela Filigrana discuss the protocol for *Artemia nauplii* enrichment with steroids used to masculinize fry of the native cichlid *castarica* (*Cichlasoma urophthalmus*).

C-S: The PD/A CRSP program has changed perspectives in this university, for all students. The students have tremendous learning opportunities and can develop skills in aquaculture research. The program is like an engine, driving things forward, and I think the undergraduates of today will be the main part of that engine in a few years, carrying the momentum. I think

a great deal of the success of our undergraduates is due to the support provided by the PD/A CRSP.

AQUANEWS: Thank you for taking the time to talk with us about your experience with undergraduate students. The information is sure to provide valuable insights for many aquaculture researchers and *Aquanews* readers. 🐟

Program News

USAID Administrator Andrew Natsios last year identified agriculture as a priority planning area for the agency. As part of this effort, USAID commissioned evaluations of three subsectors within its agricultural portfolio: aquaculture and fisheries, integrated pest management, and sustainable agriculture. The reviews are slated to be completed by mid-year.

Although the PD/A CRSP had planned to submit a new five-year proposal to USAID this spring, this work has been deferred pending the aquaculture and fisheries subsector review; new priority areas and directions identified by the reviewers will now be able to be incorporated into our new proposal.

For the time being, the PD/A CRSP has received a one-year extension of its current grant, through July 2004. Program activities through then will center on ongoing Tenth Work Plan investigations and selected new work to be carried out under the Eleventh Work Plan. (Because of the one-year

extension, new work will necessarily be limited to investigations lasting one year or less.) Program administrators are working with researchers now to craft individualized one-year extension plans.

The program's commitment to students and to host country counterparts remains foremost as we look into ways to maintain and strengthen capacity and existing relationships through the end of the current grant and beyond.

Twentieth Annual Administrative Report

The Pond Dynamics/Aquaculture CRSP *Twentieth Annual Administrative Report* is hot off the press and ready for ordering. The publication features summaries of and abstracts from the technical reports, as well as an overview of the program's activities and accomplishments during the period 1 August 2001 to 31 July 2002.

This report, as well as an array of other published material, can be downloaded as PDF files or viewed

online at <pdacrsp.orst.edu/pubs/annual_reports>. Printed copies can be ordered by sending an email to <harrirog@onid.orst.edu> or by mailing a request to:

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Native Peruvian Plants as Ingredients for Practical Diets in Juvenile Pacu

by Maria Esther Palacios, Kyeong-Jun Lee, Mary Ann G. Abiado, and Konrad Dabrowski, The Ohio State University

Among the interesting aspects of nutritional studies on frugivorous fishes in the Amazon is the potential of native Peruvian plants to supplement diet formulations. Other than being good sources of protein and vitamins, these plants contain phytochemicals, such as catechins and flavonoids, that could improve nutrient utilization, prevent degradation of vitamins and lipids, and enhance the general health condition of the fish.

The Ohio State University (OhSU) Aquaculture Laboratory recently hosted Maria Esther Palacios from Universidad Nacional de San Marcos (UNSM), Lima, Peru, as a visiting scholar to study the effects of dietary supplementation with Peruvian plants, such as maca (*Lepidium meyenii*), camu-camu (*Myrciaria dubia*), and aguaje (*Mauritia flexuosa*). Parameters of interest include the enhancement of food acceptance, growth, and metabolic efficiency of the Amazon River fish, pacu (*Piaractus brachyomus*).

At UNSM, Palacios had worked previously on determining the effects of diet containing maca meal on maturation and gamete quality of

rainbow trout (*Oncorhynchus mykiss*). This research, completed in field conditions on a farm in El Ingenio, Huancayo Province, explored the potential for maca meal use in aquaculture. Therefore, Palacios has an excellent background to continue her work on nutrition of native Peruvian fish. She is currently working on her master's degree dissertation at UNSM: "Conditioning, management, and optimization of reproductive and nutritional characteristics using native traditional feed ingredients for *Colossoma macropomum*," supervised by Professor Guillermo Alvarez. In addition to her involvement with academics, Palacios has also established contacts with the private

sector, including the Peruvian Maca Producers Association. Because of Palacios' academic experience and connection with the private sector, scientists at OhSU are delighted that she will play a key role in promoting the economic viability of the aquaculture and maca industries in Peru.



MARY ANN ABIADO

Maria Esther Palacios samples pacu for biochemical and histological analyses.



MARY ANN ABIADO

Juvenile pacu (ruler units are centimeters).

Briefly, the experiment at OhSU involved replicated tank systems stocked at a density of 20 fish per tank. Three tanks were randomly assigned to one of four diets. Diets contained the identical protein source (casein-gelatin) and were supplemented with 15% wheat meal (diet 1 as a control); 15% freeze-dried camu-camu meal (diet 2); 15% freeze-dried aguaje mesocarp (diet 3); and 15% pulverized and dried maca root (diet 4). The fish (2 g initial weight) were fed experimental diets three times per day, seven days per week, at a decreasing rate, with feeding restricted from 4 to 2.6% body weight.



MARY ANN ABIADO

Recirculating tank system used for the pacu feeding experiment.

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Graduate Student Profile: Alejandro MacDonal Vera

By Ian Courter

Growing up in Palenque, in Chiapas State in southern Mexico, Alejandro MacDonal Vera spent much of his time enjoying the outdoors. His interest in nature and animals, particularly fish, led him to the field of science. Today, he studies aquaculture at the Universidad Juárez Autónoma de Tabasco (UJAT), Tabasco, in southeastern Mexico.

After completing his undergraduate degree in biology at UJAT, Vera decided to continue his education under the supervision of Wilfrido Contreras-Sánchez. Many professors at UJAT helped Vera along the way, but Contreras-Sánchez was the most significant influence on his decision to get his Masters degree. Prior to being accepted into the UJAT Aquaculture graduate program, Vera volunteered in Contreras-Sánchez' lab.

As a graduate student in 2001, Vera began working on the CRSP-sponsored investigation titled "Diversification of Aquaculture Practices by Incorporation of Native Species and Implementation of Alternative Sex Inversion Techniques." Currently, Vera is working on an investigation with Kevin Fitzsimmons, a CRSP principal investigator from the University of Arizona, titled "Sustainable Polyculture of Tilapia and Shrimp." The project is scheduled to finish in July

2003. For this project Vera is responsible for organizing and conducting a survey of tilapia-shrimp polyculture in Northern Mexico. He is also designing a study on stocking densities for tilapia-shrimp polyculture in Mexico. Even though he's working on several projects at once, Vera expects to finish his studies in early 2004.

LABORATORY OF AQUACULTURE, UJAT



Alejandro MacDonal Vera

According to Vera, the most challenging aspect of his research on tilapia-shrimp polyculture is that few farmers in Mexico are aware of the opportunity to have a polyculture of tilapia and shrimp. However, he finds it exciting to be working on an unexplored idea and to generate information that can be used by aquaculture producers. The data collected from farmers can later be brought to Tabasco and be applied as alternatives to monoculture.

Despite optimal climatic conditions, an abundance of natural resources, and plenty of good aquaculture species, Vera feels that aquaculture in Mexico struggles because of the lack of

modern facilities for research and development of aquaculture, as well as lack of facilities for training personnel with the necessary knowledge to develop aquaculture.

In particular, he feels that Mexico is in need of people with fish breeding knowledge. These are problems that he believes are echoed throughout much of Latin America. Vera feels that aquaculture has not developed at the same rate in developing poor countries, particularly in Latin America, compared to other parts of the world. However, he does feel that in countries with more trained personnel and institutional resources, aquaculture has developed substantially in recent years.

After graduation Vera plans on continuing his graduate studies, with hopes of procuring a Ph.D. in Mexico. In addition, he hopes to have the opportunity to study sharks, but he has yet to have the opportunity to work with any of those species. He also wishes to settle down in Southeastern Mexico, preferably somewhere quiet and in a rural setting where he would like to apply the knowledge he has gained at UJAT and perhaps start his own aquaculture farm. At the minimum, Vera plans on staying in the aquaculture or fisheries field.

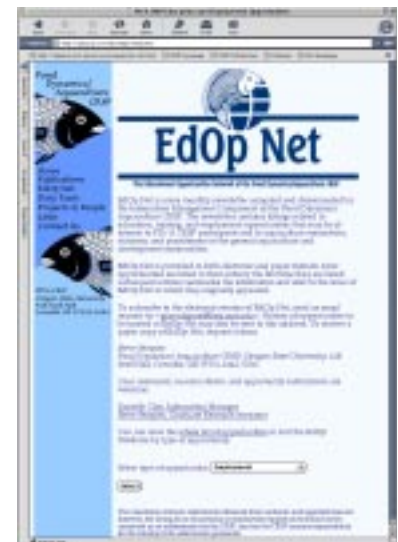
When not working on his studies, Vera enjoys fishing, soccer, listening to music, and spending time in the outdoors. He expresses a sincere love for exploring and learning about new places. 🐟

EdOp Net a Window on Opportunities

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

educational or employment opportunities in the aquaculture field, let us know.

EdOp Net is a great way to find new graduate assistants, postdocs, interns, or people with general experience in aquaculture, and it allows you to reach potential applicants from around the world. To subscribe electronically to EdOp Net or to post an opportunity, email CRSP graduate student Ian Courter at <courteri@onid.orst.edu>. We also invite you to check out opportunities online at <pdacrsp.orst.edu/edops/edop.html>. 🐟



Training in Central America

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- marketing tilapia (Meyer, Hughes).
- Pond construction and use of the PD/A CRSP computer models for pond design (Tollner).
- Social and economic factors for promoting tilapia culture in development projects (Molnar, Triminio, Martínez, Trejos).

At the conclusion of each training event, the participants were asked to evaluate the course.

Nicaragua

The course was held 1–4 October on the campus of the Ave María College of the Americas, San Marcos. This private university provided us with logistical and other support during the four-day event that was attended by 58 participants. Most participants were agricultural producers, government and NGO extension agents, students, and university faculty, all with a strong interest in farming tilapia.

The course was well received by the enthusiastic group who showed much interest in tilapia culture. More than

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In addition to the above, David Hughes, Professor of Aquaculture Business at Ave María College of the Americas in Nicaragua, was contracted to participate in the Nicaragua and El Salvador training events. During the 1980s, Hughes, then with Auburn University, was a PD/A CRSP principal investigator in Panama.

90% of participants responded that all topics were important. Their overall evaluation was that the course was very good or excellent. Some felt that the course should include some practical experiences with live fish and visits to operating fish farms.

El Salvador

The course was held 7–10 October at the Luis Poma Training Center in San Salvador. We had a total of 83 participants in the course from all areas of the country and one from Guatemala. Many of the attendees represented NGOs operating in El Salvador, government agencies, private farmers and investors, students and university faculty.

In this instance, more than 95% of participants evaluated the event overall as very good or excellent. As with the Nicaragua group, many thought they would benefit from practical experience with tilapia and visiting operating fish farms to complement the theoretical knowledge acquired during the course.

In both workshops, the number of participants that registered for

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Third National Aquaculture Extension Conference

The Third National Aquaculture Extension Conference is scheduled for 7–11 April 2003 and will be hosted by the University of Arizona and the Western Regional Aquaculture Center at the Marriott University Park Hotel in Tucson, Arizona.

Conference sponsors include USDA Cooperative State Research, Education and Extension Service's (CSREES) five Regional Aquaculture Centers, the National Sea Grant College Program, and the National Association of

County Agriculture Agents (NACAA). This event has been held about every five years since 1992 and seeks to strengthen professional development and growth for all levels of experience and years of service in extension education. The conference program is aimed at organizations and individuals who have extension education and outreach responsibilities in the diverse disciplines associated with aquaculture: production, marketing, economics, risk management, processing, engineering, and public policy. Dr. Colien Hefferan, Administrator of CSREES, and Dr. Ron Baird, Director of the National Sea Grant College Program, will make keynote presentations.

The conference will focus on innovative techniques, current issues, and emerging technologies of interest to extension educators who work with diverse aquaculture clientele. The program includes two

days of technical presentations, a full day for participation in several hands-on workshops, and a day devoted to field tours of various aquaculture operations and facilities in Arizona.

Participants are encouraged to submit an expanded abstract for all oral and poster presentations. The collected abstracts will be published as conference proceedings in a CD format.

A special area will be reserved for the display of posters and exchange of educational resource materials from the different states.

The deadline for submission of the abstracts is 31 January 2003.

Instructions to authors for the format and submission of abstracts can be found at the conference website (see below).

The conference registration fee is \$100, which covers the cost of confer-

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each event and their high level of enthusiasm greatly exceeded our expectations. We were impressed by the local support we received for our efforts, and the commitment of the participants to implement tilapia culture using PD/A CRSP-generated information and locally available expertise. In each country, part of the training event's final session was dedicated to exchanging information so that interested individuals and the PD/A CRSP team members could remain in contact.

Following the two events in Nicaragua and El Salvador, we organized a five-day practical course (24–29 November) on the Zamorano campus to complement the previously covered topics. This event attracted nine participants (five from El Salvador and four from Nicaragua). The aim here was to provide practical experience with feeding fish, fertilizing ponds, evaluating and managing water quality, integrated pig/fish production, sexing of tilapia, and reproduction and sex-reversal procedures. A central feature of this approach was to visit two fish farms in Honduras.

Honduras

In support of NGOs and other local organizations, during 2002 we held several one-day theoretical and practical courses in Honduras at the Escuela Agrícola Panamericana El Zamorano campus. These events included the following:

- A visit to the campus for twenty Peace Corps Volunteers (PCVs) that work in the Peace Corps' agriculture program in Honduras.
- A visit to the campus for eight extension agents and 10 fish farmers from the Rural Reconstruction Program, an NGO that operates in the Santa Barbara Department.

DANIEL MEYER



The PD/A CRSP Honduras Project team at the training course in Nicaragua, 2 October. (Back row left to right: Marco Aleman, Suyapa Triminio, Bill Tollner, and Pablo Martínez; bottom row left to right: Daniel Meyer, Jennifer Maldonado, Juana Ayestas, and Brahm Verma.) Juana Ayestas helped with logistics and participant registration, and Marco Aleman presented the talk on internet-based information access. Both are Zamorano employees.

- A one-day training session with over 50 participants for members of a women's group and high school students from Alubaren (Francisco Morazán Department) in support of the efforts of two PCVs working in this community.
- A one-day hands-on course with 18 farmers and extension agents from the community of Vallecillos. (These farmers had previously attended a short course with us in November of 2001.) This workshop included demonstrations of

techniques for feeding fish and fertilizing ponds, determining the sex of adult tilapia, and water quality evaluation and management.

At each of these events we distributed copies of our tilapia production manual, *Producción de Tilapia en Fincas Integradas Utilizando Insumos de Bajo Costo*, developed and published with support from the PD/A CRSP.

To date we have distributed more than 1,000 copies of this manual in five countries.

Feedback from all of these training events

has been very positive. A tilapia farmers' group has been formed in each country.

Additionally, we have been invited to do similar courses in Guatemala, Ecuador, and the Dominican Republic during 2003.

DANIEL MEYER



Course participants visiting with Santiago Mejia (far right), a commercial fish farmer from Olanchito, Honduras, during the 27 November practical course held in Zamorano. The plastic tanks contain adult tilapia for stocking into 500m² ponds for reproduction.

- A visit to the campus for eight extension agents and 25 farmers (women and men) who are beneficiaries of the "Action against Hunger" program in Eastern Honduras (El Paraíso Department).

Graduate's Corner

Congratulations to Master's graduate Ulises Hernández Vidal on completion of his degree from Universidad Autónoma de Nuevo León (UANL), Mexico, in November 2002. His advisors were Roberto Mendoza Alfaro at UANL and Gabriel Márquez-Couturier at Universidad Juárez Autónoma de Tabasco (UJAT). Márquez is a co-Principal

Investigator in the PD/A CRSP Mexico Project.

In the early 1990s Hernández worked as an undergraduate volunteer in the aquaculture lab at UJAT. He conducted his graduate research with the PD/A CRSP project at UJAT in 2001 and 2002. Hernández is presently teaching two courses at UJAT as well as serving as a technician in the PD/A CRSP Mexico Project.

TROPICAL GAR (*TRACTOSTEUS TROPICUS*) SEX IDENTIFICATION AND HORMONAL INDUCED SPAWN EVALUATION (abstract of Ulises Hernández Vidal's M.S. thesis)

The purpose of this study was to identify the sex and evaluate induced spawning of the tropical gar, *Atractosteus tropicus*, using plasmatic vitellogenin (VTG) concentrations as reference. Purified vitellogenin was obtained from estrogen treated males, which in turn was used to obtain polyclonal antibodies. These antibodies were used to measure the plasmatic concentrations of VTG in gars. Female VTG levels were used to separate groups of animals with similar levels. Spawning was then induced with intraperitoneal injections of D-Ala⁶-LHRHa, Des-Gly¹⁰-LHRHe, Estradiol, and OvaprimTM. Antiserum reactions between plasma samples and VTG were used along with VTG levels to identify the sex of wild and domesticated gars. Using the induction of reproduction and VTG-quantification methodologies, we have been able to obtain spawns for four consecutive months. The use of LHRH analogs and OvaprimTM were effective inducing spawning, providing high fertilization and hatching rates. High larvae quality was observed and the lowest survival rate was 80% at a density of 20 larvae per liter. The results of this study indicate that sex identification and spawning control is possible in tropical gars. The quality of the larvae obtained from early spawns was similar to that obtained during the normal period spawns. With this protocol, the reproduction events can be scheduled for several months instead of the previously restricted two-week period used in past years. The results obtained in this study are very important for hatchery optimization, broodstock management, and personnel efficiency in farms.

Aquaculture Extension Conference

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ence materials, several meals, and transportation for workshops and field visits.

For complete details on the conference including online registration, hotel reservations, program agenda, workshops, and more, visit: aquacultureextension.org.

For any additional information please contact the conference chair:

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We're fishing for your opinion!

Have you seen the PD/A CRSP website pdacrsp.orst.edu recently? If so, you may have noticed minor changes as we upgrade the website to better meet user needs. Our aim is to develop the site's features so we can provide the resources you need and ensure you find them quickly.

Whether you're a seasoned surfer or new to the website, we'd like to know your opinion. We have posted a web-based survey form that will help us to learn about your impressions of our pages and the services offered.

The survey is straightforward and takes about 5 to 10 minutes to complete. Most questions are multiple-choice, but there is also the opportunity to offer your own suggestions, which are greatly welcomed. Your input is highly valued and will be carefully considered during our ongoing efforts to improve the visitor experience. (All information is voluntary and strictly confidential, and will be used only by PD/A CRSP staff to improve the website. No personally identifiable information is required.)

To access the survey, go to pdacrsp.orst.edu/surveys/websurvey.html or follow the link on the home page.

Notices of Publication

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.

CRSP Research Report 03-186

EVALUATION OF NILE TILAPIA POND MANAGEMENT STRATEGIES IN EGYPT

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Five pond management strategies for Nile tilapia *Oreochromis niloticus* L. production were evaluated in 0.1-ha earthen ponds in Egypt during a 145-day production cycle. Pond management strategies developed by the Pond Dynamics/Aquaculture Collaborative Research Support Programme (PD/A CRSP) were compared with a traditional and a modified Egyptian pond management strategy. Young-of-year Nile (mixed-sex or sex-reversed) tilapia were stocked into ponds at 20,000 fish ha⁻¹. Sex-reversed tilapia were stocked into chemical fertilization, organic fertilization plus formulated feed and feed only treatment ponds, whereas mixed-sex tilapia were stocked into organic fertilization plus formulated feed and chemical plus organic fertilization plus formulated feed treatment ponds. Nile tilapia yields ranged from 1,274 to 2,929 kg ha⁻¹. Nile tilapia yields in organic fertilization plus formulated feed treatments were significantly greater than the yield from chemical fertilization ponds. PD/A CRSP pond management strategies did not produce significantly greater Nile tilapia yields than the traditional Egyptian system, but a larger percentage of harvested tilapia in the organic fertilization plus feed treatments were classified in the first and second class size categories compared with the traditional Egyptian system. Organic fertilization plus formulated feed pond management strategies had the highest net returns, average rate of return on capital and the highest margin between average price and break-even prices to cover variable costs or total costs.

This abstract is excerpted from the original paper, which was published in *Aquaculture Research*, 33 (2002):1037–1048.

CRSP Research Report 03-187

TECHNIQUES TO MITIGATE CLAY TURBIDITY PROBLEMS IN FERTILIZED EARTHEN FISH PONDS

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An experiment was conducted in fifteen earthen ponds at the Asian Institute of Technology (AIT), Thailand, during June to November 1998 to identify the source of clay turbidity mitigation techniques and their effects on fish growth and water quality, and to find a suitable approach for turbidity mitigation during the rainy season. There were five treatments: (A) control; (B) covering upper 50 cm pond dikes with black plastic material to prevent turbidity from run-off (edge-covered); (C) covering pond bottoms with small mesh (1 cm) net to prevent turbidity from fish disturbance (bottom-covered); and (E) covering pond dikes with rice straw (straw-covered). All ponds were fertilized weekly with chicken manure at a rate of 500 kg ha⁻¹ (dry matter basis) supplemented with urea and triple superphosphate (TSP) to provide 28 kg N per ha per week and 7 kg P per ha per week. Sex-reversed all-male Nile tilapia (*Oreochromis niloticus*) were stocked at two fish per square meter at a size of 19.0±1.0 g. Results showed clearly that clay turbidity was mainly from the run-off of pond dikes but not from fish disturbance of pond bottom during the rainy season and indicated that covering pond dikes was effective in mitigating clay turbidity caused by the run-off in fish ponds. No significant differences of fish survival were found among all treatments. The straw- and weed-covered treatments resulted in significantly higher fish growth and yield. In contrast, the edge- and bottom-covered treatments did not increase fish yield, compared with the control. Covering pond dikes with rice straw not only reduces clay turbidity caused by run-off but also enhances Nile tilapia growth probably through microbial biofilm developed on the rice straw. Therefore, covering pond dikes with rice straw is a cost-effective technique for clay turbidity mitigation in fish ponds during the rainy season.

This abstract is excerpted from the original paper, which was published in *Aquacultural Engineering*, 27 (2003):39–51.

Upcoming Conferences and Expositions

Date	Topic/Title	Event Location	Contact Information
February 18–21, 2003	Aquaculture America 2003	International Convention Center, Louisville, Kentucky	Conference Manager; 2423 Fallbrook Place, Escondido, CA 92027; Fax: 760-432-4275; Email: worldaqua@aol.com; Website: <www.was.org>
February 20–22, 2003	Asian Fisheries, Aquaculture and Seafood	Bangkok, Thailand	Baird Publications; 135 Sturt Street, Southbank, Melbourne 3006, Australia; Fax: 61-3-9645-0475; Email: marinfo@baird.com.au; Website: <www.baird.com.au>
March 19–21, 2003	Primer Foro Internacional en Acuicultura Guadalajara	Guadalajara, Jalisco, Mexico	Phone: 52-644-414-7915; Email: elimachuca@panoramaacuicola.com; Website: <www.panoramaacuicola.com>
March 19–22, 2003	AquaSur 2003	Club de Deportes Náuticos Reloncavi, Puerto Montt, Chile	Sue Hill; Highway Events, Telephone House, 69-77 Paul Street, London EC2A 4LQ, UK; Fax: 44-0-20-7017-4537; Email: sue.hill@informa.com; Website: <www.heighwayevents.com>
April 20–23, 2003	Middle East Aquaculture and Fishing Show 2003	UAE, Dubai	Abdulla A. Abulhoul; Mediac, PO Box 5196, Dubai, UAE; Fax: 9714-2691296; Email: mediac@emirates.net.ae
May 19–23, 2003	World Aquaculture 2003	Salvador, Brazil	Conference Manager; 2423 Fallbrook Place, Escondido, CA 92027; Phone: 760-432-4270 Fax: 760-432-4275; Email: worldaqua@aol.com
June 15–17, 2003	Organic Aquaculture and Sea Farming 2003	Legend Hotel, Ho Chi Minh City, Vietnam	Infofish; PO Box 10899, 50728 Kuala Lumpur, Malaysia; Fax: 603-2691-6804; Email: infish@po.jaring.my; Website: <www.infofish.org>
September 22–25, 2003	Asian-Pacific Aquaculture	Miracle Grand Convention Hotel, Bangkok, Thailand	World Aquaculture Conference Management; 2423 Fallbrook Place, Escondido, CA 92027; Fax: 760-432-4275; Email: worldaqua@aol.com; Website: <www.was.org>
October 15–17, 2003	Acquacoltura International 2003	Verona, Italy	Verona Shows; Highway Events, Telephone House, 69-77 Paul Street, London EC2A 4LQ, UK; Phone: 44-0-20-7017-4529; Fax: 44-0-20-7017-4537; Email: sue.hill@informa.com; Website: <www.heighwayevents.com>


Native Plants Diets

...from p. 4

After eight weeks of feeding and over ten-fold body weight increase, the growth rate was significantly higher in the fish fed the diet supplemented with maca meal. Growth rate increased by 35.3%. Voluntary food intake increased by 91.8% when fish were fed maca meal compared with the control diet. This result suggests that diets supplemented with maca meal can increase growth rate and

feed utilization in pacu and could potentially improve utilization of other plant ingredients in order to replace fish meal. Other, non-CRSP funded, studies conducted in our Aquaculture Laboratory (Lee and Dabrowski, in preparation) support this conclusion as first-feeding larval rainbow trout also showed enhanced growth when fed maca meal. This is an important finding for the Peruvian aquaculture industry, considering that over 50% of production costs in fish farming is for feeds because of the

soaring cost of fish-based feeds. Use of the new plant-based feed will also open new markets for the Peruvian maca meal industry.

The positive effects of maca meal need to be explored further in other frugivorous fishes of the Amazon rainforest. We are also working to understand the physiological and biochemical basis of the effects of maca meal supplement. This promising field of research could have broad practical applications to the aquaculture and maca industries in Peru. 

Workshops and Short Courses

Date	Title/Topic/Site	Contacts
February 6-7, April 22-23, June 11-12, 2003	Opportunities in Aquaculture/Harbor Branch Oceanographic Institution, Ft. Pierce, Florida	Ken Riley; Harbor Branch Oceanographic Institution, Aquaculture Center for Training, Education, and Demonstration, 5600 US 1 North, Ft. Pierce, FL 34946; Phone: 772-465-2400 ext.416; Fax: 772-466-6590
February 19-21, 2003	Speaking for the Salmon Workshop/Vancouver, BC	The World Summit on Salmon; Website: < www.sfu.ca/cstudies/science/salmon.htm >
March 10-14, June 2-6, 2003	Recirculating Aquaculture Systems: Principles of Design and Operation/Harbor Branch Oceanographic Institution, Ft. Pierce, Florida	Ken Riley; Harbor Branch Oceanographic Institution (see above)
March 17, 2003	Introduction to Shrimp Farming/Harbor Branch Oceanographic Institution, Ft. Pierce, Florida	Ken Riley; Harbor Branch Oceanographic Institution (see above)
March 18-21, 2003	Shrimp Health Management/Harbor Branch Oceanographic Institution, Ft. Pierce, Florida	Rolland Laramore and Susan Laramore; Harbor Branch Oceanographic Institution (see above)
March 27, June 13, 2003	Holding Systems for Live Bait, Seafood, and Backyard Aquaculture/Harbor Branch Oceanographic Institution, Ft. Pierce, Florida	Ken Riley; Harbor Branch Oceanographic Institution (see above)
March 28, 2003	Water Gardening/Harbor Branch Oceanographic Institution, Ft. Pierce, Florida	Ken Riley; Harbor Branch Oceanographic Institution (see above)
April 21-25, 2003	Fish Immunology Workshop, Wageningen University, The Netherlands	G. F. Wiegertjes; Cell Biology & Immunology, PO Box 338, NL-6700 AH Wageningen, The Netherlands; Phone: 31-317-482732; Fax: 31-317-483955; Email: fish.workshop@wur.nl ; Website: < www.zod.wau.nl/cbi/ >
April 23-29, 2003	14th International Pectinid Workshop/St. Petersburg, Florida	Beth Miller-Tipton; Email: bmiller-tipton@mail.ifas.ufl.edu
April 24-25, 2003	Tropical Aquaculture/Harbor Branch Oceanographic Institution, Ft. Pierce, Florida	Megan Davis, John Scarpa, Kevin Gaines; Harbor Branch Oceanographic Institution (see above)
April 28-30, 2003	Hard Clam Aquaculture/Harbor Branch Oceanographic Institution, Ft. Pierce, Florida	John Scarpa and Everette Quesenberry; Harbor Branch Oceanographic Institution (see above)
May 8-9, 2003	Microalgae and Live Feeds Culture/Harbor Branch Oceanographic Institution, Ft. Pierce, Florida	John Scarpa, Andy Leingang, and Megan Davis; Harbor Branch Oceanographic Institution (see above)
July 15-18, 2003	Shrimp-Med/Harbor Branch Oceanographic Institution, Ft. Pierce, Florida	Rolland Laramore and Susan Laramore; Harbor Branch Oceanographic Institution (see above)

In Memory of Clarence (Cal) McNabb

We are saddened to note the passing of Michigan State University Professor Clarence (Cal) Duncan McNabb on 19 December 2002, at his home in Littleton, Colorado.

Prof. McNabb was professor emeritus at MSU, where he served on the faculty of the Department of Fisheries and Wildlife from 1968 to 1997. Prior to joining MSU, he was assistant professor of biology at St. Mary's College in Winona, Minnesota. He earned his Master of Science in Botany and Zoology and Doctor of Philosophy

degrees at the University of Wisconsin in 1956 and 1960, respectively. He earned a Bachelor of Arts from Loras College, Dubuque, Iowa. At the time of his passing, Prof. McNabb was serving as research consultant for the US Department of the Interior Bureau of Reclamation and resided in Highlands Ranch, Colorado. His pioneering work addressed water quality issues around the globe.

Prof. McNabb served as a Principal Investigator in the PD/A CRSPs Indonesia Project from 1983 to 1987 and in the Thailand Project from 1988 to 1991.

He will be greatly missed by colleagues at home and throughout the world.

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