



PD/A CRSP and UJAT Working Together for Sustainable Aquaculture in Tabasco, Mexico

by Wilfrido M. Contreras Sánchez and Gabriel Márquez Couturier

The Laboratory of Aquaculture of the Biological Sciences Division at the Universidad Juárez Autónoma de Tabasco (UJAT) has played an important role in promoting aquacultural development in Mexico. Founded in the early '90s the laboratory has focused on training students and technicians and on generating scientific information about the biology and culture of native and introduced species with potential for aquaculture in the region.

Three main research thrusts have guided the laboratory: 1) food production; 2) ornamental production; and 3) restoration and enhancement. The philosophy of the laboratory is centered on developing sustainable aquaculture under the principles that rule UJAT's mission: Education, Research, and Outreach. Efforts have aimed toward the development and transfer of technologies for small-scale fish farmers with the intention of increasing their income and ultimately their food supply.

In 1999 UJAT joined the PD/A CRSP through a collaborative research effort between Oregon State University (OSU) and the Laboratory of Aquaculture, under a Memorandum of Understanding between the two educational institutions.

The work conducted has already had a significant impact on both theory and practice of aquaculture in Tabasco. The involvement of professors, technicians, students, and producers in the use of safe handling practices for the masculinization of Nile tilapia fry with synthetic steroids has brought a fresh perspective to aquaculture producers. Mexico as a whole just recently started using single-sex populations of tilapia. Despite the use of tilapias in extensive and semi-intensive culture systems for more than two decades in Tabasco, the practice of sex inversion started only one year ago. Probably the most important impact of the PD/A CRSP has been in the training of undergraduate students from both the aquaculture and biology programs at UJAT.

The studies being conducted at UJAT under the CRSP project are focused on reproductive control research and environmental impacts. One series of experiments is



Farmers from Ejido Rio Playa, Tabasco, Mexico, collecting juvenile tilapia and gars, used to stock grow-out earthen ponds

evaluating the fate of 17α -methyltestosterone (MT) in sex inversion ponds, and people are trained on the safe handling of MT-impregnated food. Another series of experiments is investigating the potential of using short-term immersions in synthetic steroids to masculinize Nile tilapia at the farm level. If successful, this approach can minimize the risks of unintended exposure of hatchery workers as well as fish or other non-target organisms.

A major interest in the Laboratory of Aquaculture is the development and transfer of technology for the culture of native species. This issue was brought up during the 2000 CRSP annual meeting in New Orleans by several CRSP researchers and may be considered in future proposals. At UJAT, we have studied the requirements for the culture of the tropical gar (*Atractosteus tropicus*) for more than 10 years, and currently we are in the process of evaluating the transfer of this technology to a small-scale farm located in a rural area of Tabasco. With the participation of producers from the community of Rio Playa, municipality of Comalcalco, researchers, technicians, students, and farmers are implementing the first tropical gar farm in Mexico. This

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effort aims to produce gar fry for restoration and enhancement of the surrounding lagoons and rivers, grow-out for food and craft production, and juvenile production for ornamental purposes. The first products of this endeavor are just coming out. Juvenile samples have been sent to Japan for ornamental purposes, and more than 10,000 juveniles were released in the surrounding habitats for stock enhancement. Finally, 5,000 juvenile gars are being cultured in grow-out earthen ponds to evaluate food production. 🐟

Aquaculture Resources and Potential in Mexico

The State of Tabasco, with a population of 1.5 million habitants, is located in the southeastern region of Mexico and spans a territory of 25,267 square kilometers. The climate in Tabasco is humid tropical with intense rain during most of the year and a dry season that lasts from April to June. Tabasco has the most important hydrological basin of the country, composed by the rivers Usumacinta, Grijalba, Tonalá, and Mezcalapa, and contains about 30% of the hydrological resources of the entire country. This basin provides a substantial food resource for the local population and a significant amount of food for Mexico City's fish market.

Inherited from the Olmec ancestors, fish consumption constitutes a lifestyle in Tabasco, and many restaurants are praised by national and international tourists because of the quality and variety of their traditional seafood plates.

At the national level, Tabasco is considered among the States of Mexico with the highest potential for both intensive and extensive aquacultural development. The combination of weather, water availability, and soil quality has attracted the attention of national and international investors, and many new aquaculture projects have been proposed recently. Species identified for aquaculture development include the native cichlids (genera *Petenia* and *Cichlasoma*); snooks (*Centropomus*); gars (*Atractosteus*); the introduced tilapias (*Oreochromis*); and several species of crabs, prawns, and mollusks.



Fisherman from Ejido Rio Playa, Tabasco, with the catch of the day—tropical gars.

Laboratory of Aquaculture Staff

Professors ~

Gabriel Márquez Couturier
Wilfrido Miguel Contreras Sánchez
Salomón Páramo Delgadillo

Technicians ~

Alejandro Mcdonal Vera
Laura Escobar Casillas
Heleodoro Reyes Reyes

Projects Underway in the UJAT Lab

- Productive projects for the sustainable use of biological richness of the Ejido Rio Playa, Comalcalco, Tabasco.
- Masculinization of Nile tilapia fry using the synthetic steroid trenbolone acetate and fate of the masculinizing agent 17 α -methyltestosterone in the pond environment.
- Sustainable management of wetlands: strategies for biodiversity conservation by campesinos of the Ejido Rio Playa, Comalcalco, Tabasco.
- Population study and sustainable management strategies for the tropical gar *Atractosteus tropicus* in the Biosphere Reserve Pantanos de Centla.

NAAFE to Kick Off Inaugural Meeting in April

On 1–4 April 2001, the North American Association of Fisheries Economists (NAAFE), a new group affiliated with the International Institute of Fisheries Economics and Trade (IIFET), will hold its first forum at the Pontchartrain Hotel in New Orleans, Louisiana. The forum's goals are to strengthen communication among North American fisheries economists in industry, government, and education, as well as to provide opportunities for the discussion of research progress, results, and future planning.

The NAAFE was instituted by Gunnar Knapp and other attendees of the biennial IIFET summit in July 2000 in an attempt to strengthen communication across the professions involved with fisheries economics in North America.

To learn more about the first Forum or about the NAAFE itself, contact Gunnar Knapp, Program Chair, University of Alaska Anchorage (Phone: 907-786-7717; Email: afgpk@uaa.alaska.edu) or visit the NAAFE website at www.naafe.uaa.alaska.edu. 🐟

Graduate Student Profile: Taworn Thunjai

by Anu Gupta

Diverse may be the best word to describe Taworn Thunjai's interests and accomplishments. He has a diverse background, having lived in both Thailand and the US, a diverse education, with two bachelor's degrees and two master's degrees, and diverse experience, with past work in both the scientific and extension realms. He is currently a Ph.D. candidate working with PD/A CRSP researcher Claude Boyd at Auburn University, Alabama, on characteristics of pond soils.

Thunjai first became involved with CRSP work in 1997, when he met Boyd during one of his visits to Thailand. At the time Thunjai was working with the Thai Ministry of Agriculture and Cooperatives, Department of Fisheries. The two were interested in working together, and in June of 1997 Thunjai moved to Auburn University for eleven months. During that time he conducted research on pond soil samples from CRSP sites and developed an interest in the environmental aspects of aquaculture. He is particularly concerned with sustainable practices and aquaculture development and has thus focused on pond soil quality and water quality. In June 1998 Thunjai returned to Auburn University to pursue a second master's degree.

The focus of his master's thesis was on soil pH measurements. There are a variety of methods used to measure soil pH, and Thunjai found that the methods had never been compared. One of the goals of his project was to determine the best methods for measuring pH. He has done most of his research using samples from CRSP sites. His results show that the most accurate method for measuring pH is to insert a dual or combination electrode into a stirred slurry consisting of a 1:1 ratio of pulverized, dried soil and distilled water. Thunjai, who finished his master's degree in November 2000, will continue working on characteristics of pond soils as he further pursues a Ph.D.

The road to Auburn has been long, with many turns and twists. Growing up in Chiang Mai, a small village in northern Thailand nestled in a setting of abundant natural resources, may have been the spark that ignited Thunjai's interest in the life sciences. He began his studies in fisheries, attending Kasetsart University, at the time the only university in Thailand with a Fisheries Department. He graduated in 1987 with a major in fisheries biology and a minor in aquaculture and then began to work at the Ministry of

Agriculture and Cooperatives as a fisheries biologist and extension officer.

It was while at the Ministry that he noticed that scientists and farmers often had different approaches for solving the same problems. This dichotomy between methods led Thunjai to want to know how to link fisheries sciences with the social sciences. He went back to school in 1994 to get his first master's degree in Social Development and Management from the National Institute of Development Administration.

Simultaneously, Thunjai worked on his second bachelor's degree, a B.A. in Public Administration from Sukhothai Thammathiraj University, an "open" university that allowed students to study at home. He finished the degrees in 1996 and 1997, respectively. As if working on two degrees simultaneously did not keep him busy enough, he continued working with the Ministry while he was in school.

Thunjai notes that both the natural sciences and the social sciences must be integrated with each other before advances in environmental quality and productivity can occur. He hopes that his training in both the natural and social sciences will enable him to address some of the aquaculture problems in Thailand and around the world. A blend of natural and social science—combining flexibility and open communication—can often lead to more productive results when working with traditional aquaculturists, who may initially be resistant to changing long-practiced methods.

Leaving Thailand in 1997 was quite a change for Thunjai, as it was his first time abroad. However, he was excited to work with Boyd and wanted to learn about different cultures. Given that the US and Thailand are quite different, he had to adapt to the different culture and weather patterns. He still misses home, especially the food and his family.

Thunjai spends a lot of time in the lab, but he loves to travel and collect field samples. When he is not working he likes to garden, swim, or visit the nearby Appalachian mountains. Before he returns to Thailand he hopes to visit Alaska in order to see some of the diversity of the US and to see real snow. This diversity that Thunjai thrives on, in both his interests and his experiences, is sure to make quite a difference when this CRSP student enters the world. 🐟



Auburn University graduate student Taworn Thunjai


Pond Dynamics/Aquaculture: One Member of the CRSP Family

Pond Dynamics/Aquaculture is one of nine active Collaborative Research Support Programs (CRSPs). The purpose of the CRSPs is to increase international food production and incorporate scientific developments to minimize food and nutrition problems in developing countries. CRSPs were formed to benefit collaborating countries and the United States through the active participation of US universities and institutions in host countries. To date 55 US universities and academic, governmental, and nongovernmental institutions from 55 countries, as well as over 2,000 scientists from the US and abroad, are working with one or more CRSPs.

The following are among the major benefits of CRSP activities:

- Exchange of ideas and application of research developments to host country and US farms and ponds.
- Training and education for host country individuals and post-graduate education for students abroad and in the US.
- Formation of international networks that benefit researchers, consumers, and producers.
- Enhancement of food production in developing countries and the US from the results of collaborative research.

The CRSPs were developed through an amendment to the Foreign Assistance Act of 1961. The amendment, entitled "Famine Prevention and Freedom from Hunger," was passed by the US Congress in 1975. Congress created this amendment after recognizing the positive impacts US land grant institutions had on agriculture in the US. The objective was to apply this information to developing countries in order to address food production and consumption issues, prevent hunger, and build an economic foundation for future growth. The Board for International Food and Agricultural Development (BIFAD), a presidentially appointed committee, was created to implement this important foreign assistance program. Funding for CRSP activities are provided by the United States Agency for International Development (USAID) and participating institutions.

The nine CRSPs that are currently active address topics from pest management to peanuts. The following website has more information about the CRSPs and links to individual CRSP websites: <www.ianr.unl.edu/crsp/intro.htm>. 

Goings-On in the Pond

Claude Boyd has been selected to be the Butler/Cunningham Eminent Scholar Chair in Agriculture at Auburn University. This five-year appointment includes responsibilities to develop strong research, teaching, extension, and outreach programs that integrate agricultural and environmental issues for improving the quality of life in rural and urban communities. Congratulations to Claude who has also been working with PD/A CRSP since the late 1980s.

Congratulations to Bill Shelton on his election to vice president of the Fish Culture Section of the American Fisheries Society. Bill Shelton was also an invited speaker in the lecture series


"Global Changes in Aquatic Food Production" organized by Konrad Dabrowski at Ohio State University. He spoke on "Management of Fish Reproduction in Aquaculture."

We bid a fond farewell to Anu Gupta, whose brief stay in the Information Management and Networking Component belied her crucial role in keeping the publications flowing smoothly. She successfully defended her master's project in Marine Resource Management at Oregon State University at the end of November and has been offered a Peace Corps assignment in "Capacity Building for Environment Management in the Pacific" on the island of Palau. Many thanks to Anu for her capable and efficient efforts and the best of luck in her next big adventure. 

Small-Scale Aquaculture Workshop

ECRSP researcher Yang Yi of the Asian Institute of Technology was a formal invitee to and participant of a workshop held 18 to 28 September 2000 at the International Institute of Rural Reconstruction (IIRR), James Yen Center, Cavite, Philippines. It was organized by IIRR, the International Development Research Center (IDRC), the Network of Aquaculture Centres in Asia-Pacific (NACA), the Food and Agriculture Organization of the United Nations (FAO-Rome), the International Center for Living Aquatic Resources Management (ICLARM), Deutsche Welthungerhilfe (DWW), and the Netherlands Embassy in the Philippines. The purpose of the workshop was to produce a resource book entitled, "Utilizing Different Aquatic Environments for Small-Scale Aquaculture" and to facilitate the exchange and documentation within the Southern Hemisphere of best practices or good management practices that are productive, equitable, and sustainable. Yi presented three papers:

- Yang Yi and C.K. Lin, 2000. Role of low-cost fertilization in inland pond aquaculture.
- Yang Yi, C.K. Lin, and J.S. Diana, 2000. Recycling feeding wastes through integration of intensive and semi-intensive culture.
- Yakupitiyage, A. and Yang Yi, 2000. Feeds in small-scale aquaculture.

The publication that emerges from the workshop will be copyright-free and will feature technologies, strategies, processes, and tools that are built on existing knowledge, have been field-tested, are replicable for wider sharing, and address real community needs. This publication will be available in April. 



PD/A CRSP External Evaluation Panel Takes Onsite Tour of Kenya Project

In November the PD/A CRSP External Evaluation Panel (EEP) completed its site tours of CRSP research locations with a visit to Sagana Fish Farm in Kenya, about 65 miles northeast of Nairobi. EEP members Christine Crawford and David Cummins were joined by CRSP Director Hillary Egna on the visit.

The Kenya trip included a tour of the Embu area. Crawford and Egna—along with Jim Bowman, Kenya Project US Regional Coordinator, Oregon State University, William Njaremwe, African Bulldozer, and others—toured the area, visiting four ponds sites, three on-farm trials, and one new pond construction. The visitors had an opportunity to speak directly with farmers from the region about their aquaculture activities.

A tour of the Sagana Fish Farm itself on another day included meetings with students, Moi University faculty, and Kenya Fisheries Department staff.

The visitors dropped in on a workshop for new trainees at Moi University coordinated by Charles Ngugi, lecturer in the Department of Fisheries and CRSP Kenya Project co-principal investigator. Among others, Egna and Kenya Project co-principal investigators Karen Veverica, Auburn University, and Mucai Muchiri, Kenya Department of Fisheries, each made a short presentation at the opening ceremony of the workshop.

Crawford, Cummins, and Egna, joined by Muchiri, also



DAVID CUMMINS

Christine Crawford, Ziporah Hiuko Mariga, Mucai Muchiri, and Hillary Egna during a visit to a women's farm cooperative in Kenya

had an opportunity to visit a government trout farm and a women's cooperative farm. As a finale before leaving again for Nairobi, the visitors observed a pond construction workshop at Sagana.

Before the Kenya arrival of EEP members Crawford and Cummins, Egna met with Kenya Fisheries Department Director Nancy Gitonga and Deputy Director Mr. Ayagu in Nairobi. Gitonga is Host Country Project Leader for the CRSP activities at Sagana.

Egna also stayed on in Kenya after the EEP's departure, presenting a poster at the USAID Bureau for Africa Workshop for Agriculture, Environment, Private Sector and Food for Peace Officers in mid-November.

Earlier EEP site visits this year were to Thailand in June and Peru in September. The EEP review process will continue through the CRSP annual meeting in Orlando, Florida, in January 2001, where EEP members will have the opportunity to meet with CRSP project participants whose sites were not visited and those whose work is not associated with a particular overseas CRSP research site. This in-depth five-year program review is required by BIFAD (Board of International Food and Agriculture Development). 🐟



H. EGNA

Kiswahili sign encourages local people to eat farm-raised tilapia

Joint ASA, SSSA, CSSA Meeting Exhibits Multi-CRSP Cooperation

Members of the nine CRSPs had a chance to display their respective and collaborative efforts recently at the Joint Annual Meeting of the American Society of Agronomy, Soil Science Society of America, and Crop Science Society of America. Held in Minneapolis, Minnesota, from 5 to 9 November 2000, the meeting featured talks that highlighted the progress of many multiple-CRSP research endeavors. The CRSPs as a group presented a poster titled "Collaborative Research Support Program: Vital Links" in the session on Global Research and Education. The exhibit included several photos and captions to show the activities of the nine CRSP organizations, and it was attended by, among many others, several CRSP principal investigators, board of directors members, and members of management entities. In the Nutrient Management and CRSP Achievements symposium, a group from the Soil Management CRSP presented observations from a multi-CRSP assessment of agricultural research needs and capabilities in Ethiopia. The Sorghum/Millet (INTSORMIL) CRSP added an overview of the purpose and functions of the CRSPs in general and their collaborative efforts in West Africa, Ethiopia, and Mozambique. Members of other CRSPs presented papers on their own research areas, but this meeting's main draw was its showcasing of overall CRSP impacts and accomplishments worldwide. 🐟



THOMAS CRAWFORD

INTSORMIL Director John Yohe, CRSP exhibit Minneapolis, Minnesota

Notices of Publication

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

CRSP Research Report 00-162

BIO-ENERGETIC MODELING OF GROWTH AND WASTE PRODUCTION OF NILE TILAPIA (*OREOCHROMIS NILOTICUS* L.) IN RECIRCULATION SYSTEMS

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A bio-energetic fish growth simulation (FGS) model was developed for *Clarias gariepinus* and subsequently adjusted for the culture of *Oreochromis niloticus*, *Oncorhynchus mykiss* and *Colossoma macropomum*. The FGS model was extended with a fish waste module (FWM) to calculate the total waste production due to feeding by tilapias grown in indoor recirculation systems. Wastes calculated included the amount of uneaten feed, feces and NH_4^+ production. The amounts of wastes produced were expressed as g nitrogen (N). The model was calibrated and validated using 3 independent data sets, together comprising 175 aquarium experiments, monitoring growth in all cases and changes in proximate body composition of *O. niloticus* between stocking and harvesting in 51 cases. Fishes were grown in the individual weight range of 1–290 g using 32–54 % protein diets and feeding levels between 5 and 35 g $\text{kg}^{-0.8} \text{d}^{-1}$. The principal read-out parameters for calibration and validation of the model were final weight and final body fat level. Because waste production is the result of the same metabolic processes that lead to protein and fat deposition, it was assumed that waste production was simulated well when protein and fat deposition are. The calibrated model was used to review the effect of

feeding level and dietary protein level on N-waste production per kg tilapia produced. Finally, tilapias were grown in 2 different types of recirculation systems and stagnant water ponds, quantifying N-inputs and the amount of N-wastes recovered from each system. The latter was defined as the sum of N-waste discharged (sludge and sludge water drained) and within system accumulation of N-wastes (organic and inorganic nutrients) during culture. After model calibration, the agreement between simulated and observed final weight and body fat level for all data sets was visualized. In recirculation systems different types of N-wastes were estimated well by the model. Care must be taken when applying the model to pond systems. More insight is needed on feeding ecology of tilapias in these systems.

This abstract was excerpted from the original paper, which was published in K. Fitzsimmons and J. Carvalho Filho (Editors), *Tilapia Aquaculture in the 21st Century, Fifth International Symposium on Tilapia Aquaculture*. American Tilapia Association and Departamento de Pesca e Aqüicultura/Ministério da Agricultura e do Abastecimento, Rio de Janeiro, Brazil, pp. 368–381.

CRSP Research Report 00-163

A PILOT STUDY ON THE SPATIAL AND TEMPORAL SOIL MOISTURE DISTRIBUTION IN INTEGRATED CROP-FISH-WETLAND AND CROP-WETLAND AGROECOSYSTEMS IN ZOMBA-EAST, MALAWI

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Integration of aquaculture into existing agricultural systems has been reported to improve productivity and ecological sustainability through better water management, improved soil fertility arising from waste recycling and synergies occurring between the aquaculture and agricultural components, and extension of the crop growing season. While information is available on the role of integrated systems in improving soil fertility and waste recycling, quantitative data on the influence of fishponds on the length of the crop growing season, and the temporal and spatial distribution of soil moisture around fishponds is not available. I therefore quantified the influence of fishponds on soil moisture regimes on six farm systems in Zomba district by comparing the spatial and temporal distribution of soil moisture between farm subsystems with fishponds (integrated crop-fish-wetland) with that from adjacent sites without fishponds (crop-wetland). Four sampling transects, each with five sampling sites placed at

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2, 4, 6, 8 and 10m from the pond dike were established at four cardinal points of the pond. Soil samples were obtained biweekly from each sampling site for gravimetric soil moisture determination. Sampling was terminated when soil moisture content fell below the permanent crop wilting point, which for this study was 13%. A similar procedure was adopted for the crop-wetland subsystem; however, a predetermined axis in the subsystem was used as a reference point for the placement of transects. Soil moisture content was measured gravimetrically. A paired t-test was used to determine differences in soil moisture content between the integrated crop-fish-wetland and crop-wetland subsystem. The length of the crop-growing season was defined as the period during which soil moisture content was above the permanent wilting point and below field capacity (23% moisture content). One-way ANOVA was used to determine significant differences ($P < 0.05$) in the spatial distribution of soil moisture between the four cardinal points of each subsystem. Significant differences ($P < 0.05$) in soil moisture content between the two subsystems were detected at five of the six farms sampled. At two of the sites where significant differences were detected, the crop-wetland subsystem had significantly higher soil moisture content than the integrated crop-fish-wetland subsystem. Placement of a fishpond in a seasonal wetland did not influence the length of the crop-growing season. These initial results appear to suggest that although integration of fishponds in crop-wetland systems may significantly affect soil moisture regimes, these differences are not important in so far as the extension of the crop-growing season is concerned. Since the study used a small sample size and soil samples from the top 15cm of the soil, and the fishpond may influence soil moisture below this zone, further studies that incorporate more farms and sample at depths greater than 15cm are needed before definitive conclusions on the influence of fishponds on soil moisture regimes in seasonal wetlands are drawn.

This abstract was excerpted from the original paper, which was published in K. Fitzsimmons and J. Carvalho Filho (Editors), *Tilapia Aquaculture in the 21st Century, Fifth International Symposium on Tilapia Aquaculture*. American Tilapia Association and Departamento de Pesca e Aqüicultura/Ministério da Agricultura e do Abastecimento, Rio de Janeiro, Brazil, pp. 582–587.

CRSP Research Report 00-164

EVALUATION OF TILAPIA CULTURE BY RESOURCE LIMITED FARMERS IN PANAMA AND GUATEMALA

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Mixed-sex and male Nile tilapia, *Oreochromis niloticus*, were cultured in family and communally managed fish ponds in Guatemala and Panama in the 1980s. Fish were used to improve family nutrition and meager incomes of the pond managers. Tilapia culture systems were designed to permit farmers with no fish culture experience to produce their own tilapia fingerlings on-farm and grow the fingerlings using available household by-products and animal manures to sizes required for home consumption and sale. The author returned to Guatemala and Panama in 1998 to evaluate the ability of pond managers to learn and sustain tilapia culture as a farm activity.

Mixed-sex culture of Nile tilapia was the culture system introduced to Guatemalan pond managers in the 1980s and continues as the only culture system employed by those farmers still growing fish. Forty-three percent of the pond projects were abandoned between 1989 and 1998. Seventy-two percent of Guatemalan farmers produced small tilapia for pond stocking on-farm or obtained them from neighbors. Use of the predacious guapote tigre, *Cichlasoma managuense*, to control tilapia offspring in grow-out ponds increased from 14% in 1989 to 36% in 1998.

Pond managers in Panama were shown how to grow either mixed-sex Nile tilapia with the guapote tigre or monosex male Nile tilapia to reduce tilapia offspring during grow-out and permit harvest of a 200 to 400 g fish. Twenty-nine percent of the pond projects polycultured mixed-sex tilapia with a predator and 71% grew male tilapia in 1984. Forty-eight percent of the pond projects were abandoned between 1984 and 1998. Of the projects still culturing tilapia in 1998, 36% cultured mixed-sex tilapia with a predator and 64% cultured male tilapia. Sixty-four percent of the projects still growing fish in 1998 stocked guapote tigre, indicating that some of the projects stocking male tilapia were also stocking guapote to control tilapia offspring. Most pond managers did not produce tilapia fingerlings on-farm as 82% of the fish pond projects received their tilapia fingerlings from the government hatchery.

Economic and nutritional impacts from fish culture as documented for Panama in 1984 and Guatemala in 1989 were not sustained. The failure of fish culture in Guatemala and Panama does not rest solely with tilapia but with a complex of economic, social, technical and political issues

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that combined to limit the intended impact of fish culture on impoverished pond managers and their families.

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CRSP Research Report 01-165

MASCULINIZATION OF NILE TILAPIA WITH STEROIDS: ALTERNATE TREATMENTS AND ENVIRONMENTAL EFFECTS

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Steroid-treated food is widely used to masculinize tilapia. We have previously shown that short-term immersion in steroids can also masculinize Nile tilapia. In the following study, we determined that a single immersion of tilapia fry in Trenbolone Acetate for 3 hr on 12, 13, or 14 days post-fertilization (dpf) or multiple immersions in combinations of days between 12 and 15 dpf, can result in masculinization. However, effectiveness of immersion treatment varied between experiments, suggesting that sensitivity to treatment may differ between individual broods. We also found that the use of 17 α -methyltestosterone (MT)-treated food to masculinize Nile tilapia results in accumulation of MT in sediments even after cessation of treatment.

This summary was excerpted from the original paper, which was published in B. Norberg, O.S. Kjesbu, G.L. Taranger, E. Andersson, and S.O. Stefansson (Editors), *Proceedings of the 6th International Symposium on the Reproductive Physiology of Fish*. Institute of Marine Research and University of Bergen, Bergen, pp. 250–252.

CRSP Research Report 01-166

MANAGING THE ACCUMULATION OF ORGANIC MATTER DEPOSITED ON THE BOTTOM OF SHRIMP PONDS . . . DO CHEMICAL AND BIOLOGICAL PROBIOTICS REALLY WORK?

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Accumulation of organic matter increases oxygen demand and the development of reducing and acidic conditions in bottoms soils. Deterioration of soil and water quality in aquaculture systems is often associated with decomposition of organic matter over time. Several commercial products currently used in shrimp ponds in Ecuador to accelerate decomposition of organic matter during the fallow period were evaluated. Two ponds were used, one with a salinity of 10–20 ppt and the other with 30 ppt. Soil respiration rates were evaluated in situ and in the laboratory. Each treatment was replicated four times. All experiments resulted in a similar drop in soil pH, although differences in soil moisture content occurred for the different evaluations. No statistical differences were found among treatments. No benefits were found by applying bacterial inocula or enzymatic suspension to enhance the decomposition of organic matter during fallow periods. Failure of probiotics to enhance organic matter decomposition probably resulted because soils were not extremely high in organic matter content or deficient in microorganisms or extracellular enzymes.

This abstract was based on the original paper, which was published in *World Aquaculture*, 31(3):24-28.

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CRSP Research Report 01-167

ENVIRONMENT, AQUACULTURE, AND FOOD POLICY NEXUS: CASE STUDY OF TWO USAID AQUACULTURE PROJECTS IN RWANDA

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This case study centers on some of the institutional networks that evolved in Rwanda around aquatic food resources and how these networks acted as microcosms of the larger system being played out at the national level. The majority of aquaculture activity throughout the 1980s was led by two US Agency for International Development funded projects, the Pond Dynamics/Aquaculture Collaborative Research Support Program and an extension project, the *Projet Pisciculture Nationale*. Changes brought

about by project networks became embedded in Rwanda's cultural, economic, and political structures. Through 15 years of promotion by donors, nontraditional farming technology was gaining a foothold in Rwanda. The case study demonstrates that institutional networks arose not through organizational preplanning but by default. This resulted in few of the planned objectives being as successful as unanticipated outcomes, such as the emergence of women as new technology adopters, the development of a highly successful water quality laboratory, and the inclusion of aquaculture into national policy. Many of the unanticipated results derived from the efforts of expatriates, who promoted aquaculture both actively and passively. While the expatriates were effective, the study questions whether a few external actors should accumulate so much power and influence over development agendas.

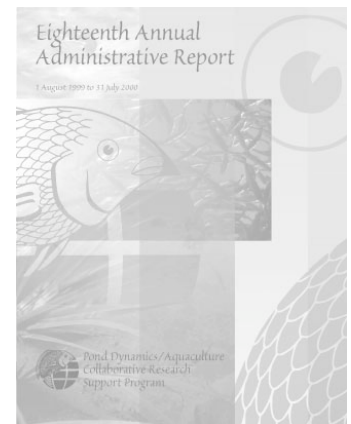
This abstract was based on the original publication, a chapter published in D.L. Soden and B.S. Steel (Editors), *Handbook of Global Environmental Policy and Administration*. Marcel Dekker, Inc., New York, pp. 281–314.

Four New CRSP Publications Now Available

The Pond Dynamics/Aquaculture CRSP annual reports and work plan updates are hot off the press and ready for ordering. The *Eighteenth Annual Administrative Report* summarizes the program's activities and accomplishments during the period 1 August 1999 to 31 July 2000. This 118-page bound volume also includes abstracts of the technical reports. The unbound *Eighteenth Annual Technical Report* contains final or progress reports addressing research accomplishments during the reporting period. Technical reports can be ordered individually or as a set; each order will include a table of contents of the entire set of reports.

Additionally, the latest revisions to both the Eighth and Ninth Work Plans are now available. Copies of the *Third Addendum to the Eighth Work Plan* describe further changes implemented since the publication of the second addendum. The *Addendum to the Ninth Work Plan* contains official changes made relating to schedules and/or methods to the work plans described in the *Ninth Work Plan*.

All four publications will also be available in the near future at the PD/A CRSP website at <pdacrsp.orst.edu/pubs/publications.html>. Printed copies can be ordered by sending an email to claird@ucs.orst.edu or by mailing a request to: Publications/Information Management, PD/A CRSP, Oregon State University, 418 Snell Hall, Corvallis, OR 97331-1643 USA. 🐟



FAO Report Available

A new Food and Agriculture Organization (FAO) fisheries report—No. 611—is currently available. The *Report of the FAO/NACA Consultation on Aquaculture for Sustainable Rural Development* is a 34-page publication on the collaborative activity between the Network of Aquaculture Centres in

Asia-Pacific (NACA) and the Fisheries Department of the FAO in Chiang Rai, Thailand, on 29–31 March 1999. Its goal was to develop a detailed structure for a regional program on aquaculture for sustainable rural development and to propose a strategy for its implementation. Printed copies cost \$12 and may be ordered via the

Internet at the following website: <www.fao.org/icatalog/inter-e.htm> under the keyword “aquaculture” or by mailing a request to:
Director, Information Division
Food and Agriculture Organization
of the United Nations
Viale delle Terme di Caracalla
00100 Rome, Italy 🐟

Upcoming Conferences and Expositions

Date	Topic/Title	Event Location	Contact Information
January 21–25, 2001	World Aquaculture 2001	Orlando, Florida, USA	WAS Conference Manager, World Aquaculture Society, 2423 Fallbrook Place, Escondido, CA 92027; Phone: 760-432-4270; Fax: 760-432-4275; Email: worldaqua@aol.com; Website: <www.was.org/meetings/wasmeetings.html>
February 1–2, 2001	Fish Farming Trade Show	Greenville, Mississippi, USA	Mike McCall; Phone: 601-714-5327; Email: catfisj@aol.com
February 12–16, 2001	ASLO Aquatic Sciences 2001	Albuquerque, New Mexico, USA	ASLO Business Office, 5400 Bosque Blvd., Suite 680 Waco, TX 76710; Phone: 254-399-9635; Email: business@aslo.org; Website: <www.aslo.org/albuquerque2001>
February 15–20, 2001	16 th Annual Meeting of the American Association for the Advancement of Science	San Francisco, California, USA	AAAS Meetings Office, 1200 New York Avenue NW, Washington, DC 20005; Phone: 202-326-6450; Fax: 202-289-4021; Email: aaasmeeting@aaas.org
March 21–23, 2001	Bordeaux Aquaculture	Bordeaux, France	Bordeaux Evenements Congres, BP 105, 33030 Bordeaux Lac Cedex, Bordeaux, France; Fax: 33-556-11-88-22; Email: d.pouvreau@bordeauxcongres.com
April 1–4, 2001	First North American Fisheries Economics Forum	New Orleans, Louisiana, USA	Gunnar Knapp, University of Alaska Anchorage, 3211 Providence Drive, Anchorage, AK 99508; Phone: 907-786-7717; Email: afgpk@uaa.alaska.edu; Website: <www.naafu.uaa.alaska.edu>
April 26–28, 2001	Acquacoltural International 2001	Verona, Italy	Sue Hill, Heighway Events, Haines House, 21 John Street, London WC1N 2BP UK; Phone: 44 20 7505 3608; Fax: 44 20 7831 2509; Email: sue.hill@informa.com; Website: <www.veronafiore.it>
May 6-9, 2001	Aquaculture Canada 2001	Halifax, Nova Scotia, Canada	Linda Hiemstra, Aquaculture Association of Canada, 16 Lobster Lane, St. Andrews, NB, E5B 3T6, Canada; Phone: 506-529-4766; Email: hiemstra@mala.bc.ca
May 20–25, 2001	Indo-Pacific Fish Conference	Durban, South Africa	The South African Association for Marine Biological Research, PO Box 10712, Marine Parade 4056, Durban, South Africa; Phone: 27-31-337-3536; Fax: 27-31-337-2132; Email : seaworld@dbn.lia.net; Website: <www.seaworld.org.za/>
May 28-30, 2001	Tilapia 2001	Kuala Lumpur, Malaysia	Infofish, PO Box 10899, 50728 Kuala Lumpur, Malaysia; Phone: 603-26914466; Fax: 603-26916804; Email: infish@po.jaring.my; Website: <www.jaring.my/infifish/img/tilapia_2001.jpg>
June 17–20, 2001	Open Ocean Aquaculture IV	St. Andrews, New Brunswick, Canada	Chris Bridger; Phone: 228-875-9341; Email: ooa@usm.edu
June 21-22, 2001	Atlantic Aquaculture Exposition, Conference and Fair	St. Andrews, New Brunswick, Canada	Sydney Peacock; Phone: 506-658-0018; Fax: 506-658-0750; Email: show@nbnet.nb.ca
June 21-23, 2001	International Fair for Aquaculture and Fisheries	Izmir, Turkey	Ali Civ, FGS Fuarlcilik AS, Celiktepe, Ionu cad No 11/3, 4 Levent, Istanbul, Turkey; Fax: 90-212-281-2713; Email: fgfsfair@fgfsfair.comtr
August 19–23, 2001	131 st American Fisheries Society Annual Meeting	Phoenix, Arizona, USA	Betsy Fritz; Phone: 301-897-8616 ext. 212; Email: bfritz@fisheries.org
October 1–5, 2001	70 th Anniversary of the Japanese Society of Scientific Fisheries	Yokohama, Japan	JSFS 70 th Anniversary Desk, Kinki Nippon Tourist Co., Ltd., Events & Conventions, Tokyo Kyodo Bldg. 6F 2-2 Kandajimbo-cho, Chiyoda-ku, Tokyo 101-0051, Japan; Phone: 81-3-3263-5581; Fax: 81-3-3263-5961; E-mail: jsfs@knt-tokyo.gr.jp; Website: <www.symp70yr.or.jp>

Workshops and Short Courses

Date	Title/Topic/Site	Contacts
February 7–8, 2001	OSU-ENSIA Surimi Technology School/Paris, France	Jae Park; Email: jae.park@orst.edu or surimischool@aol.com; Website: <osu.orst.edu/dept/seafood/surimi>
March 5–9, 2001	Intensive Shrimp Culture/ACTED	Aquaculture Center for Training, Education, and Demonstration (ACTED); Contact: 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>
March 5–30, 2001	Advances in Tilapia Fry Production and Grow-Out/TCU	Training and Consultancy Unit (TCU), Aquaculture and Aquatic Resources Management Program, Asian Institute of Technology, PO Box 4, Klong Luang, Pathumthani 12120, Thailand; Phone: 66-2-524-5219; Fax: 66-2-524-5484; Email: tcuaasp@ait.ac.th; Website: <www.agri-aqua.ait.ac.th/tcu>
March 21–23, 2001	Opportunities in Aquaculture/ACTED	ACTED (see above)
March 22, 2001	Tilapia Farming/ACTED	ACTED (see above)
March 29–30, 2001	Production Planning/ACTED	ACTED (see above)
April 10–12, 2001	OSU Surimi Technology School/Astoria, Oregon, USA	Jae Park, Email: jae.park@orst.edu or surimischool@aol.com; Website: <osu.orst.edu/dept/seafood/surimi>
April 23–26, 2001	26 th Annual Eastern Fish Health Workshop/Sheperdstown, West Virginia, USA	Dr. Rocco C. Cipriano; Phone: 304-724-4432; Email: rocco_cipriano@usgs.gov
April 23–May 18, 2001	Hatchery Management for Finfish/TCU	TCU (see above)
May 2–4, 2001	Shrimp Health Management/ACTED	ACTED (see above)
May 10–11, 2001	Live Feeds Culture/ACTED	ACTED (see above)
May 12–15, 2001	International Workshop on Artemia/Urmia, Iran	Artemia Workshop, Urmia University, PO Box 165, Urmia 57153, Iran; Email: artemiaworkshop@research.urmia.ac.ir
May 14–25, 2001	Diagnosis and Treatment of Warmwater Fish Diseases/Gainesville, Florida, USA	Dr. Ruth Francis-Floyd, Institute of Food and Agricultural Sciences, 7922 NW 71 st Street, Gainesville, FL 32653-3071; Phone: 352-392-9617; Fax: 352-846-1088
May 14-25, 2001	Shrimp Hatchery Operations/ACTED	ACTED (see above)
June 24 - 30, 2001	Aquaponics and Tilapia Aquaculture Short Course/Kingshill, Virgin Islands	Dr. James Rakocy, RR 2, Box 10,000, Kingshill, VI 00850; Phone: 340-692-4020; Email: jrakocy@uvi.edu; Website: <rps.uvi.edu/AES/Aquaculture/UVIShortCourse.html>
June 25–July 27, 2001	Black Tiger Shrimp Hatchery Techniques/TCU	TCU (see above)
August 14–September 14, 2001	Giant Fresh Water Prawn Hatchery Techniques/TCU	TCU (see above)
June 7–16, 2001	Inland Aquaculture Study Tour/TCU	TCU (see above)
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
Ongoing	Tailor-Made Training Courses/TCU	TCU (see above)
Year-round	Tropical Aquaculture Advanced Training in a Third World Country/Escuela Agrícola Panamericana (EAP), Honduras, and Asian Institute of Technology, Thailand	Zentralstelle fuer Ernährung und Landwirtschaft (ZEL) Feldafing/ Zschortau, Deutsche Stiftung fuer Internationale Entwicklung (DSE), D-82336 Feldafing, Germany; Phone: 49-8157-938-0; Fax: 49-8157-938-777

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<pdacrsp.orst.edu/pubs/publications.html>.

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