AQUANEWS

Sustainable Aquaculture for a Secure Future

POND DYNAMICS/AQUACULTURE COLLABORATIVE RESEARCH SUPPORT PROGRAM NEWSLETTER

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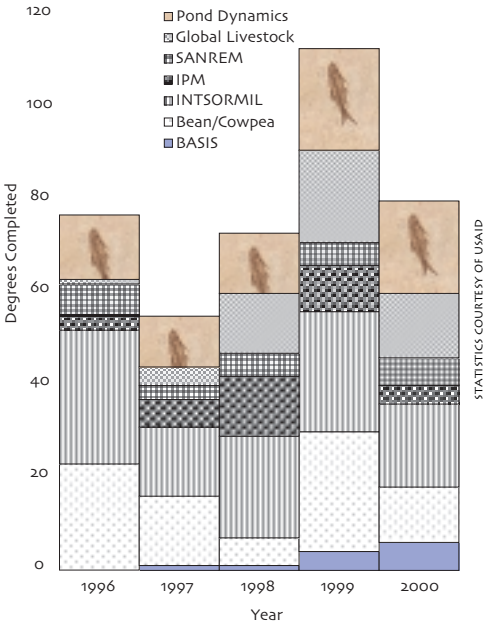
Report Card on Education

One of the goals and greatest benefits of the Collaborative Research Support Programs (CRSPs) is increasing the capacity of individuals in both developing countries and the US. The guidelines for CRSPs state this goal: "While the major thrust of CRSP is the generation of solutions to priority problems through research, a concomitant objective is the generation of a research capability in the countries where the CRSP is functioning so that they can increasingly carry out independent research and help less fortunate neighboring countries. The institutional building component is a natural part of the research activities under the CRSPs."

To this end, each of the nine CRSPs carries out capacity-building activities through both degree and non-degree programs. The chart (left) shows the number of individuals who graduated in each of the last five fiscal years from CRSP degree programs, in which host country and US citizens are sponsored for undergraduate and graduate study at participating universities. By working with CRSP participants, students gain valuable research experience and the ability to pass on to others the knowledge gained through CRSP-sponsored research. PD/A CRSP graduates hold faculty positions in Ecuador, Thailand, Vietnam, Indonesia, and the US. Others work for international programs such as the FAO and the World Bank and for governmental aquaculture agencies. In the past year,



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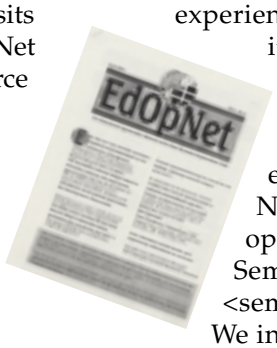
EdOp Net Continues to Grow

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 120 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 Steve Sempier at <sempiers@ucs.orst.edu>. We invite you to peruse the various opportunities at our website, <pdacrsp.orst.edu/edops/edop.html>.

Inside Aquanews…

Report Card

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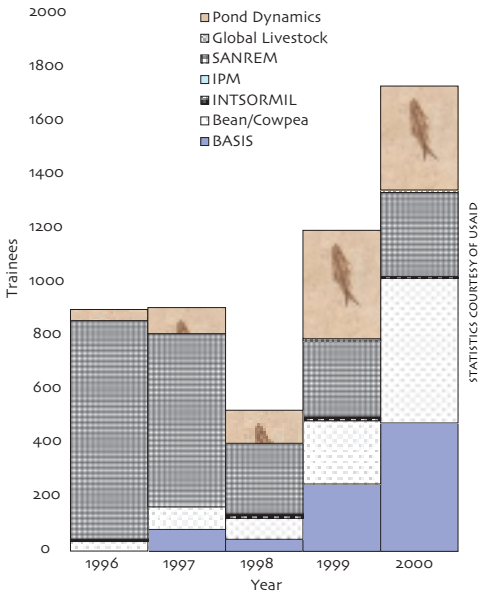
the PD/A CRSP assisted 35 US and 36 international students with funding, training, and research opportunities. Program researchers and students gave 39 presentations at scientific conferences in 10 countries.

Non-degree training takes place at many levels, from short courses and workshops conducted by CRSP researchers to laboratory and computer training of university and agency personnel to demonstration days, in which CRSP-developed technologies are shared with farmers, women's groups, and schoolchildren. The number of individuals receiving training from each of the reporting CRSPs is shown in the chart (right). During the past year, PD/A CRSP workshops to disseminate research results were held in five countries and provided training for more than 100 host country agency employees and 120 farmers.

In recognition of the importance of training activities to the success of the CRSPs, this issue of *Aquanews* celebrates the successful completion of degrees by nine individuals (see stories on pp. 6–8). In each issue we interview a current CRSP-sponsored graduate student. This month we spoke with Potjanee Nadtirom, who is studying at Thailand's Asian Institute of Technology (story on p. 3).



Training Impacts: The Big Picture

The Pond Dynamics/Aquaculture CRSP has conducted research in Mexico, Guatemala, Honduras, Panama, Peru, Egypt, Kenya, Malawi, Rwanda, Indonesia, the Philippines, and Thailand. Thousands of individuals have received training through CRSP-sponsored activities. These photographs just begin to tell the story.

THAILAND

PD/A CRSP trainees in Thailand conduct outreach in conjunction with estuarine water quality monitoring. While the field of aquaculture is still dominated by men, the Pond Dynamics/Aquaculture CRSP has been a strong advocate for increasing human capacity of women as well as men in developing countries. Over 30% of CRSP trainees since the program's inception in 1983 have been women.

KENYA

Charles Wariua and students Enos Were and Charles Achiudo (Moi University graduate students) learn fish management skills during internships with the PD/A CRSP Kenya Project. Sagana Fish Farm is an integral part of aquaculture education in Central Kenya. It serves as an important research base for graduate students. Students have come from numerous schools such as Moi University, the University of Nairobi, Kenyatta University, and Mombasa Polytechnic to utilize the farm's facilities. In addition, Sagana Fish Farm serves as a learning laboratory for primary and secondary students. Recently, the farm hosted 39 schools, educating over 900 students in just a six-month period. Adult extension work is also a focus for the farm, which hosts workshops in topics ranging from fish preparation to pond construction and management. Audiences include Sagana Women's Group, District Fisheries Officers, farmers, and local community members. Through educating important aquaculture stakeholders, Sagana can become an even more productive, efficient, and environmentally conscious player in the aquaculture field.

Graduate Student Profile: Potjanee Nadtirom

by Steve Sempier

Potjanee Nadtirom got hooked on fisheries science while fishing as a child. She grew up in Putthaisong, which is in the Buriram Province in northeastern Thailand. When she was old enough to attend college, a school in the same region as Putthaisong—Khon Kaen University—was just starting a degree program in fisheries science. Even though the fisheries science major was still in its infancy, Potjanee was undeterred and was one of the first to enroll in the program.

Aquaculture was emphasized in Nadtirom's fisheries science coursework. As she took more classes at Khon Kaen, her interest in aquaculture developed. After graduation she joined the Asian Institute of Technology (AIT)—a well-known and well-respected aquaculture institute and CRSP research site in Thailand. Nadtirom was first introduced to the CRSP in 1994 while working at AIT as a research assistant. During that time, she worked on the CRSP-funded high-input deep pond experiment in Thailand's Udornthani Province. Nadtirom gained valuable, practical experience as a research assistant but wanted to strengthen her academic knowledge in the field of aquaculture. In 1997 she decided to pursue a Master of Science degree at AIT. Currently, Nadtirom and her major professor CRSP principal investigator Yang Yi are concentrating on a new CRSP project that ties in with Nadtirom's requirements for her master's degree.

UNIVERSE PHOTOS, BANGKOK

AIT master's candidate Potjanee Nadtirom

Nadtirom began working on her master's project in September of 2000. Her research compares growth performance of different sex genotypes of Nile tilapia (*Oreochromis niloticus*) and the effects of androgen treatment. She is building on past findings that indicate that genotypic females do not grow as quickly as sex-reversed males. She notes that her experiment should shed more light on this issue by comparing growth performance between different phenotype/genotype combinations. (See the box at the end of this article for related publications by CRSP researchers.)

Nadtirom believes her work will enable farmers to obtain market-sized tilapia in less time and provide larger tilapia in the marketplace. She stresses, "If results show that existing production practices for Nile tilapia can be improved, it could mean that farmers adopting improved tech-

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The following list includes examples of previous PD/A CRSP research related to Nadtirom's master's project. You can access these abstracts and reports through the CRSP website at the addresses provided. Complete copies of these reports can be ordered through the website at: <pdacrsp.orst.edu/pubs/gen_order/gen_order.html>

Gale, W.L., M.S. Fitzpatrick, and C.B. Schreck, 1996. Masculinization of Nile tilapia (*Oreochromis niloticus*) through immersion in 17α-methyltestosterone or 17α-methyldihydrotestosterone. In: Egna, H.S., B. Goetze, D. Burke, M. McNamara, and D. Clair (Editors), Thirteenth Annual Technical Report. Pond Dynamics/Aquaculture CRSP, Oregon State University, Corvallis, Oregon, pp. 96-100. This paper can be viewed online at <pdacrsp.orst.edu/pubs/technical/13techhtml/2.c.1/2.c.1.html>

Green, B.W., E.H. Rizkalla, and A.R. El Gamal, 1995. Use of 17α-methyltestosterone for tilapia sex reversal. In: Egna, H.S., J. Bowman, B. Goetze, and N. Weidner (Editors), Twelfth Annual Technical Report. Pond Dynamics/Aquaculture CRSP, Oregon State University, Corvallis, Oregon, pp. 91–93. The abstract of this paper can be viewed online at: <pdacrsp.orst.edu/pubs/admin/admin_12/admin12.4/admin12.4.C.html#use>

Richman III, N.H. and E.G. Grau, 1995. Effect of 17α-methyltestosterone on the growth of two tilapia species, *Oreochromis aureus* and *Oreochromis mossambicus*, in fresh water. In: Egna, H.S., J. Bowman, B. Goetze, and N. Weidner (Editors), Twelfth Annual Technical Report. Pond Dynamics/Aquaculture CRSP, Oregon State University, Corvallis, Oregon, pp. 84–91. The abstract of this paper can be viewed online at <pdacrsp.orst.edu/pubs/admin/admin_12/admin12.4/admin12.4.C.html#effect>

Smith, E.S. and R.P. Phelps, 1996. Reproductive efficiency of Nile tilapia (*Oreochromis niloticus*) and "red" tilapia (*Oreochromis* spp.) and comparative growth and efficacy of sex reversal of Nile tilapia and "red" tilapia. In: Egna, H.S., B. Goetze, D. Burke, M. McNamara, and D. Clair (Editors), Thirteenth Annual Technical Report. Pond Dynamics/Aquaculture CRSP, Oregon State University, Corvallis, Oregon, pp. 105-107. This paper can be viewed online at <pdacrsp.orst.edu/pubs/technical/13techhtml/2.c.4/2.c.4.html>

Smith, E.S. and R.P. Phelps, 1997. Reproductive efficiency, fry growth, and response to sex reversal of Nile and red tilapia. In: Burke, D., B. Goetze, D. Clair, and H. Egna (Editors), Fourteenth Annual Technical Report. Pond Dynamics/Aquaculture CRSP, Oregon State University, Corvallis, Oregon, pp. 112-119. This paper can be downloaded in PDF format from <pdacrsp.orst.edu/pubs/technical/14tchpdf/2.c.5.pdf>

CRSP Makes a Splash at WAS Meeting

Aquaculture America 2001, the World Aquaculture Society (WAS) Annual Meeting was held in Orlando, Florida, 21 to 25 January. The PD/A CRSP sponsored a special session, chaired by CRSP researcher Claude Boyd, entitled "Best Management Practices (BMPs) for Pond Aquaculture." The session comprised the following 12 presentations, including 3 by CRSP participants.

Boyd, C.E. Role of BMPs in environmental management of aquaculture.
Chamberlain, G. The GAA code of conduct program.
Clay, J. Environmental and social BMPs for shrimp aquaculture.
Davis, D.A. Best management practices for feeds and feeding practices.
Egna, H.S. and **C. Craven**. The Pond Dynamics/Aquaculture CRSP and best management practices for small-scale warmwater aquaculture.
Hamper, L. Best management practices on shrimp farms in Texas.
Hargreaves, J. Research needs to evaluate best management practices for pond aquaculture.
Houston, D.E. and R.F. Hulcher. Development of NDPEs permitting program in Alabama: A state environmental agency perspective.
Knickerbocker, K. Florida's aquaculture best management practice program.
Tookwinas, S., P. Songsangjinda, K. Chankaew, M. Phillips, S.S. Yang. Implementation of the Thai code of conduct for shrimp farming: Preliminary results from demonstration studies in Thailand.
Tucker, C. Best management practices as a unifying principle for pond aquaculture research.
Wood, W. Perspectives on use of best management practices in agriculture.

WORLD AQUACULTURE Society

In addition, many CRSP researchers presented papers or posters on CRSP research in other sessions at the meeting:

Boyd, C.E., J. Clay, and J. Hargreaves. Codes of conduct for improving environmental and social performance in shrimp farming.
Craven, C. and **H.S. Egna**. The Pond Dynamics/Aquaculture CRSP: Strengthening linkages and developing technologies for sustainable aquaculture in the United States and worldwide. (poster)
Hatch, U. and **J. Falck**. Assessing economic risk in tilapia production in Honduras.
Kohler, C.C., M.J. DeJesus, S.T. Kohler, L.C. Baca, and **F. Alcántara Bocanegra**. Culture of *Colossoma macropomum* in Latin America.
Liti, D.M., O.E. Mac'were, and **K.L. Veverica**. Growth performance and economic benefits of *Oreochromis niloticus / Clarias gariepinus* polyculture in fertilized tropical ponds. (poster)
Molnar, J.J., Fernando Alcántara, and **S. Tello**. Small-scale aquaculture in the Peruvian Amazon: Marketing practices and strategies.
Neira, I. and **C. Engle**. The Honduran market for tilapia: Restaurant and supermarket surveys. (poster)
Sonnenholzner, S. and **C.E. Boyd**. Chemical and physical properties of shrimp pond bottom soils in Ecuador.
Thunjai, T., C.E. Boyd, and **W. Wood**. Vertical profiles of bulk density, total carbon, total nitrogen, and total phosphorus in pond soil cores.
Valderrama, D. and **C.R. Engle**. The effect of survival rates of white shrimp *Litopenaeus vannamei* on net farm income and optimal management strategies of Honduran shrimp farms.
Veverica, K.L., D. Mirera, and G.K. Matolla. Optimization of phosphorus fertilization rate in freshwater tilapia production ponds in Kenya.
Yi, Y., C.K. Lin, and **J.S. Diana**. Comparison of economic return, nutrient utilization efficiency and environmental impact among different culture systems of Nile tilapia *Oreochromis niloticus*.
Zelaya, O., C.E. Boyd, D. R. Teichert-Coddington, and D.B. Rouse. Effects of water circulation on water quality and bottom soil in shrimp ponds.

Among other CRSP participants who attended the meeting and spoke on non-CRSP research were Bart, Dabrowski, Fitzsimmons, Lochmann, Meyer, Phelps, and Popma.

In addition, the CRSP donated a copy of the book *Dynamics of Pond Aquaculture* to the National Aquaculture Association auction, held in conjunction with Aquaculture America 2001. The auction raised over $14,000.

Double Meetings in DC Highlight CRSP Accomplishments, Welcome SPARE

by Jeff Burright

The Pond Dynamics/Aquaculture recently linked with other CRSPs to participate in two organizational forums in Washington, DC. On March 6, CRSP directors attended the National Association of State Universities and Land Grant Colleges' (NASULGC) fourth annual forum, held on Capitol Hill. The forum's theme was "Agricultural Research and Education/Serving the Nation in Food and Health: A University Science Exhibition on Capitol Hill," and it hosted nearly 40 exhibits from various research organizations and universities, including a display provided by the CRSP Council entitled "CRSPs – Food and Health Promotion by US Universities and Developing Countries." The served as an opportunity for US Congress members and staff to learn about the positive returns from federal investments in agricultural research and education, and this exhibit which highlighted the activities and accomplishments of the nine CRSPs was a valuable addition to the program. Director Hillary Egna was one of the CRSP members who attended; she participated in the event on behalf of Oregon State University and the PD/A CRSP.

CRSP Council members were among those attending the 2001 Agricultural Sciences Exhibition in Washington, DC: (left to right) Gordon Tsuji (Deputy Director, Soil Management), John Yohe (Director, INTSORMIL), Carlos Perez (Director, SANREM), Hillary Egna (Director, PD/A), Irv Widders (Director, Bean/Cowpea), Tom Crawford (Associate Director, INTSORMIL), Brhane Gebrekidan (Director, IPM), and Goro Uehara (Director, Soil Management).

The second event occurred on March 29 and 30, when the Presidential Advisory Board for International Food and Agricultural Development (BIFAD) hosted its annual meeting, also held in Washington, DC. A significant portionof the first day's agenda was dedicated to the topic, "University Partnerships with the US Government in Global Agriculture," wherein many of the discussions centered around the CRSPs as a viable model for university participation in international agricultural research. John Yohe, CRSP Council chair, gave an introductory presentation entitled "Why CRSPs Work Well," and several individual and joint CRSPs presented various research topics for discussion. PD/A CRSP Director Hillary Egna attended the meeting, and she joined with representatives from the Soil and SANREM CRSPs to host a presentation and discussion called "CRSPs' Role in Natural Resource and Environmental Management." The meeting also highlighted a new subcommittee of BIFAD that has replaced the former Joint Committee on Agricultural Research and Development. The Strategic Partnership for Agricultural Research and Education, also known as SPARE, will exist as a reviewing body and an advising entity to BIFAD on subjects related to the CRSPs.

Potjanee Nadtirom

...from p. 3

niques in production could have the edge over their competitors." She believes that Nile tilapia has great potential for alleviating poverty since it is such a fast-growing species. If the growth performance is improved, she feels that Nile tilapia will gain even more importance in the aquaculture arena. Nadtirom emphasizes, "Of course the problem of early maturation and recruitment is still unresolved and as such is a management challenge when culturing [Nile tilapia]."

Nadtirom also identifies several challenges that face the aquaculture industry in Thailand. She believes the largest constraint is the decline of the environment due to lack of concern for water quality. This problem has impeded aquaculture development in Thailand. Potjanee also states a need to increase the quality and quantity of fish seed to farmers, especially in rural areas. Finally, the needs of the farmers are not being met due to lack of technological development.

When asked about men's and women's participation in aquaculture in Thailand, she noted, "Like anywhere else in the world, aquaculture and fishery work has always been male-dominated, but in Thailand today it seems that there is a greater degree of balance, with more and more women taking up aquaculture." She believes that the industry should recognize that there are many highly qualified women in the aquaculture field today.

Potjanee Nadtirom is a motivated individual who would like to get further involved with development work after graduation. Until then, you can find her working hard on her growth performance project, drawing, painting, or reading by day and stargazing by night.

Contreras Sánchez and Mwau Defend

Congratulations to recent graduates Wilfrido Contreras Sánchez and Patricia Nduku Mwau. Contreras Sánchez successfully completed the requirements for degree of Doctor of Philosophy in Fisheries Science at Oregon State University. A CRSP researcher on the Mexico Project, Contreras Sánchez defended his dissertation on 12 January 2001, and is now continuing his association with the CRSP from his faculty position at Universidad Juárez Autónoma de Tabasco. Patricia Mwau successfully defended her MS thesis in Zoology at the University of Nairobi, Kenya.

Sex determination in Nile tilapia, *Oreochromis niloticus*: Gene expression, masculinization methods, and environmental effects

(abstract of Wilfrido Contreras Sánchez's Ph.D. dissertation)

Sex differentiation in fish is a labile process that allows sex inversion in several species. The inherent capacity of fish germ cells to differentiate into oocytes or spermatocytes constitutes a key factor allowing for functional sex inversion. This thesis set out to determine the mechanism involved in steroid-induced sex differentiation of Nile tilapia, *Oreochromis niloticus*, by searching for differential expression of unique genes during the process. In addition, the studies documented the persistence of methyltestosterone (MT) in the environment after oral administration, and investigated the capabilities of short-term immersions in steroids for masculinizing tilapia fry as an alternative method. A significant leakage of MT to the rearing water and its subsequent accumulation in the sediments was detected after oral administration of the steroid. In addition, evidence was found for a significant effect of environmental conditions on the masculinizing efficacy of oral administration of steroids. Low levels of masculinization were obtained when MT was allowed to remain in the system. Results from short-term immersions in steroids indicated that the labile period for masculinization by immersion of Nile tilapia fry reared at 28°C occurs between 11 and 16 days post fertilization (dpf). Two three-hour immersions in trenbolone acetate at 11 and 13 dpf yielded the highest number of males. Time of immersion, length of the treatment, dosage, density, solvent vehicle, and number of immersions significantly affected the outcome of immersion trials. Heterogeneity of developmental stages, developmental rate, and sensitivity of progeny to steroids may play important roles in the efficacy of immersion treatments. The expression of unique mRNAs during the process of sex inversion was identified through the use of suppression subtractive hybridization. This technique allowed for the sequencing of 165 clones from which 61 proteins have been identified. A significant number of these genes seem related to the anabolic effects of trenbolone acetate. In addition, 12 genes were identified that are related to reproductive tissues; seven of which have unique or enriched expression in the testes. Some of the genes and protein products that have been identified are linked to gonadal development and testicular protein synthesis in other species.

Nutrient dynamics, with special reference to nitrogen and phosphorus in tilapia (*Oreochromis niloticus*)/catfish (*Clarias gariepinus*) polyculture ponds at Sagana Fish Farm, Central Kenya

(abstract of Patricia Nduku Mwau's M.S. thesis)

Budgets for nitrogen and phosphorus were estimated over a growing period from Oct. 1997 to March 1998 in 12 research fish ponds randomly assigned four treatments in triplicates to assess the efficiency of utilization in these nutrients. In treatment 1, urea and DAP were added to provide 16kg N/ha/week and 4kg P/ha/week, in treatment 2 Urea and DAP were added to give 8kg N and 2kg P/ha/week plus rice bran feed at 60kg/ha/day. Treatment 3 was rice bran only at 120kg/ha/day, and treatment 4 was rice bran as in 3 and inorganic fertilizer as in 2. Each pond was stocked with 1,600 tilapia *(Oreochromis niloticus)* fingerlings averaging 32g body weight and 160 African catfish *(Clarius gariepinus)* fingerlings of 4g body weight. All inputs and outputs to and from the ponds were sampled and analyzed for nitrogen and phosphorus. Water column samples were taken monthly to monitor the nitrogen and phosphorus forms in the water column. Soil samples were also taken monthly to monitor the variation of the nutrients content of the soil over the experimental period. Nitrogen and phosphorus content in the water supply canal were monitored within this period and the quality of the effluent water discharged assessed.

Results indicated that, in the water column total nitrogen and phosphorus concentrations increased with time while the dissolved inorganic nutrients (soluble reactive phosphorus, nitrates, nitrites and total ammonia nitrogen) remained at relatively low levels despite weekly fertilization and daily feed inputs, an indication that these nutrients were taken up by phytoplankton and incorporated into the organic forms in the water column. Nitrogen and phosphorus concentration in the soil increased with time indicating nitrogen and phosphorus retention by bottom sediments. Fish harvest accounted for 11.2 to 18.7% of the nitrogen inputs and 6.2 to 9.1% of the phosphorus inputs. Soil adsorption accounted for 61.5 to 69.2% of the nitrogen inputs and 81.7 to 90.8% of the phosphorus inputs. Drainage and outflow accounted for 9 to 16.1% of the nitrogen inputs and 1.8 to 4.2% of the phosphorus inputs while seepage accounted for 3.2 to 8.3% of the nitrogen inputs and 0.7 to 2.4% of the phosphorus inputs.

Rain and inflow water from the supply canal are not of great importance to semi-intensive fish farming as nutrient (N & P) input sources. Adsorption by soil was a major nutrient sink especially for phosphorus. Uptake of nitrogen and phosphorus by phytoplankton with their subsequent conversion to nitrogen and phosphorus in fish flesh was the second major loss of nitrogen and phosphorus added to the ponds. Concentrations of nitrogen and phosphorus in effluent discharged from ponds would have a very low fertilization potential in the receiving waters.

Recent Honduras Grads Address Tilapia Issues

Four students at Escuela Agrícola Panamericana (Zamorano), the host country institution for the CRSP Honduras Project, recently completed bachelor's theses related to CRSP research. We would like to offer our congratulations.

Martínez Ayala, Jose A. 2000. Socioeconomic characterization of farmers with and without tilapia production systems in Honduras. Special project of the Agronomy Engineering Program, Zamorano, Honduras. 52 pp.

The objective of this study was to identify the social and economic conditions that characterize those small-scale farmers who have incorporated tilapia production within their aquaculture production systems. The significant statistical ($P < 0.25$) variables found were the size of the farm, age and marital status of the producer, source of principal income, use of land, occupation of the producer, participation in projects, and the main product of the farm. All of these variables were found to have some influence on the adoption of a tilapia production system.

Mejía, Gloria M. 2000. Study of production costs of three tilapia culture systems on small- and medium-scale farms in five departments in Honduras. Special project of the Agronomy Engineering Program, Zamorano, Honduras. 44 pp.

The objective of this study was to define the technical characteristics of three production systems—commercial, semi-commercial, and subsistence; to compare costs in order to identify differences among systems; and to determine cost structures. This study found that the technical characteristics of subsistence systems were the most variable and deficient due to the low importance of aquaculture as an on-farm economic activity. Also, cost structures were significantly different among the three systems, which is a function of the differences in production practices and level of technology employed in each system. Lastly, the highest production costs were those of subsistence enterprises, while the lowest were those of enterprises with commercial goals.

Molina, Juan C. 2000. Studies on actual and potential demand for tilapia in five secondary cities in Honduras. Special project of the Agronomy Engineering Program, Zamorano, Honduras. 59 pp.

The objective of this study was to characterize institutional and non-institutional tilapia markets used by small- and medium-scale tilapia producers in five cities in Honduras. This study found that, in all of the cities, the red tilapia was preferred and the type of presentation in highest demand was whole. The preferred characteristic of tilapia was flavor, whereas spininess and problems with availability in markets were least preferred.

Quan Barcia, Vivian L. 2000. Evaluation of tilapia (*Oreochromis niloticus*) in ponds lined with concrete, plastic, and earth. Special project of the Agronomy Engineering Program, Zamorano, Honduras. 18 pp.

The objective of this study was to evaluate the effect of ponds lined with plastic, concrete, and earth on tilapia reproduction. This study found that, on average, the values of fingerlings per gram of female were 2.3, 2.2, and 1.8 for tanks lined with plastic, concrete, and earth, respectively, which did not demonstrate significant statistical differences. The cost of production per fingerling was L (lempira) 0.027, 0.021, and 0.021 for tanks lined with plastic, concrete, and earth, respectively.

Aquaculture Symposium at AAAS

A special symposium entitled "The Aquaculture Paradox: Does Fish Farming Supplement or Deplete World Fisheries?" was conducted at this year's American Association for the Advancement of Science (AAAS) Annual Meeting. Organizers included Roz Naylor, Stanford University; Rebecca Goldburg, Environmental Defense; and Meryl Williams, International Center for Living Aquatic Resources Management.

The symposium introduced controversial issues in the aquaculture arena. Topics included the use of wild fish as feed for the farming of carnivorous species, the impact of habitat modification for aquaculture applications, wild seed stock collection, effluents, exotic species, introductions, and pathogen invasions. The session analyzed marine and freshwater aquaculture throughout the world. Several of the focus questions included:

- What are the overall impacts of aquaculture activities on environmental systems worldwide?
- Does aquaculture enhance or diminish the available fish supply?
- What changes in current practices could ensure long-term sustainability?

The session presented scientific and policy issues and brought up solutions to challenges facing aquaculture production. Jason Clay's presentation titled "Shrimp aquaculture and the environment: Lessons learned about best and worst practices" incorporated findings of CRSP researcher Claude Boyd. This year's AAAS meeting took place February 15 to 20 in San Francisco, California.

New Additions to the Technical Committee

We want to welcome the newly elected Technical Committee members and show our appreciation for the continuing and past members for taking the time to serve as advisors to the program. New members were elected at the PD/A CRSP 2001 Annual Meeting, held 25–27 January 2001, in Orlando, Florida. The results of the election can be seen below.

PD/A CRSP Technical Committee

XENA CUMMINGS

Kevin Fitzsimmons, newly elected TC Co-Chair

Yang Yi, Materials & Methods Subcommittee

* newly elected

Name	Institutional Affiliation	Area of Representation
Co-Chairs		
Jim Diana	The University of Michigan	
*Kevin Fitzsimmons	University of Arizona	
Materials & Methods Subcommittee		
Claude Boyd	Auburn University	Production Optimization
Freddy Arias	Escuela Agrícola Panamericana	Social & Economic Aspects
*Yang Yi	Asian Institute of Technology	Environmental Effects
Technical Progress Subcommittee		
Joe Molnar	Auburn University	Social & Economic Aspects
Amrit Bart	Asian Institute of Technology	Environmental Effects
*Jim Bowman	Oregon State University	Production Optimization
Work Plan & Budget Subcommittee		
Tom Popma	Auburn University	Production Optimization
Carole Engle	University of Arkansas at Pine Bluff	Social & Economic Aspects
*Wilfrido Contreras-Sánchez	Oregon State University	Environmental Effects
External At-Large Members		
Damon Seawright	US Tilapia Industry	
Ex-Officio Members		
Hillary Egna	Oregon State University	
Cormac Craven	Oregon State University	
Harry Rea	US Agency for International Development	

KRIS MCELWEE

Jim Bowman, Technical Progress Subcommittee

Wilfrido Contreras, Work Plan & Budget Subcommittee

Comings and Goings in the Pond

The PD/A CRSP welcomes Stephanie Sanford as the newest member of the CRSP Board, representing Oregon State University. She replaces L.J. (Kelvin) Koong, who served the CRSP for three years. Currently, Stephanie serves as program coordinator of the Center for Water and Environmental Sustainability (CWESt) and as adjunct professor of sociology at OSU. She previously served as director of the Office of Affirmative Action and Equal Opportunity for thirteen years at OSU. Teaching and research about social psychology, civil rights, and environmental justice interest her. We look forward to Stephanie's leadership and experience.

Stephanie Sanford, new PD/A CRSP Board Member

Congratulations to recent graduates:

- A.R.S.B. Athauda, from Sri Lanka, completed an M.S. at the Asian Institute of Technology. His thesis was entitled "Ultra-sound immersion techniques to improve the efficiency of sex inversion of male tilapia population."
- Julie Ann Lanuza successfully completed an undergraduate thesis at Central Luzon State University. The title of her thesis, based on CRSP-supported research, is "Effect of stocking sizes on the growth and survival performance of Nile tilapia (*Oreochromis niloticus*) in ponds."
- Kris McElwee, Assistant Information Manager for the PD/A CRSP, successfully completed a masters in Marine Resource Management at Oregon State University. She defended a paper entitled "An assessment of water resource management in the Senegal River Valley."

Our congratulations also to Carl Schreck, a CRSP researcher and professor in the Department of Fisheries and Wildlife at Oregon State University (OSU). He recently received the Excellence in Fisheries Education Award from the American Fisheries Society. Schreck was cited for his "pioneering work in developing and teaching methods to understand the basic biology of fishes." The long-time OSU faculty member also was cited for his leadership and inspiration to students. Schreck has served as major professor for 43 master's and doctoral students including several students who have been funded by the PD/A CRSP.

Doug Ernst, Central Database Manager, was asked to serve as committee chair for Standards and Research Methods for the Aquacultural Engineering Society.

Notice of Publication

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Research Report 01-168

Effects of biomass of caged Nile tilapia (*Oreochromis niloticus*) and aeration on the growth and yields in an integrated cage-cum-pond system

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An experiment was conducted to determine the appropriate biomass of caged Nile tilapia (*Oreochromis niloticus*) supporting maximum production of small tilapia in open water and maintaining acceptable water quality, and to investigate effects of aeration on the growth of both caged and open-pond tilapia and water quality in an integrated cage-cum-pond system. One, two, three or four cages were suspended in unaerated ponds as experimental treatments with three replicates each. An additional treatment with four cages in aerated ponds was also tested. Large tilapia (91 ± 2.6–103 ± 2.8 g) were stocked in 4-m^3 net cages at 50 fish/m^3, while tilapia fingerlings (13 ± 0.2–16 ± 0.8 g) were stocked at 2 fish/m^3 in open water of all ponds. Caged tilapia were fed with floating pelleted feed twice daily at 3%, 2.5%, and 2% body weight/day during the first, second and third month, respectively. Important water quality parameters, such as dissolved oxygen, unionized ammonia nitrogen and chlorophyll *a*, were analyzed biweekly. The biomass of caged tilapia had significant ($P < 0.05$) effects on the growth of both caged and open-pond tilapia. Survival of caged tilapia decreased with increasing biomass of caged tilapia per pond, while survival of open-pond tilapia in the treatment with one cage was significantly ($P < 0.05$) lower than that in treatments with more cages. Final mean weight of caged tilapia decreased significantly ($P < 0.05$) from 478 ± 20.0 g in the treatment with one cage to 261 ± 10.0 g in the treatment with four cages. However, the growth of open-pond tilapia (0.74 ± 0.02–1.57 ± 0.10 g/fish/day) increased significantly ($P < 0.05$) with the increased biomass of caged tilapia per pond, in response to the increased feed inputs to cages. Total extrapolated net yield, including both caged and open-pond tilapia, was highest (6.20 ± 0.36 t/ha/crop) in the treatment with four cages; however, the treatments with one or two cages gave significantly ($P < 0.05$) better overall feed conversion ratio (0.82 ± 0.02 –0.98 ± 0.02). Nighttime aeration for 5 h enhanced the growth of tilapia in the treatment with 4 cages/pond, and increased the carrying capacity in the integrated cage-cum-pond system. Net yield of caged tilapia in aerated ponds averaged 6.92 ± 0.60 t/ha/crop, which was significantly ($P < 0.05$) higher than that (3.65 ± 0.22 t/ha/crop) in unaerated ponds with four cages each. However, the growth of open-pond tilapia in aerated ponds was significantly ($P < 0.05$) lower than that in unaerated ponds. Further study should focus on determining the appropriate stocking density of open-pond tilapia to optimize the harvested tilapia size both from cages and open ponds in order to develop an integrated cage-cum-pond system for tilapia rotation culture.

This abstract was based on the original paper, which was published in *Aquaculture*, 195 (2001):253–267.

Boyd Begins Water Quality Series in *GA Advocate*

The magazine *Global Aquaculture Advocate* is featuring a series of articles written by CRSP researcher Claude Boyd. These articles are part of the Responsible Aquaculture Program that was formed by the Global Aquaculture Alliance and has established recommendations for water quality standards for shrimp farm effluents. Standards were set for the following variables: pH, total suspended solids, total phosphorus, total ammonia nitrogen, five-day biochemical oxygen demand, and dissolved oxygen. In the next few issues of the *Advocate*, Boyd will discuss general information on a particular variable, how to measure the variable, and why it was selected as one of the standards. The first of Boyd's articles addresses pH and is featured in the February 2001 issue of the *Advocate*. The pH article begins with basics such as what pH is and the pH scale and then launches into factors that influence the pH level in ponds. The article concludes with practical aspects of pH such as how to measure and manage pH in aquaculture applications. The articles will serve as a useful guide for people starting in the shrimp aquaculture field and an appropriate supplement to those who are already well-informed on the subjects.

Upcoming Conferences and Expositions

Date	Topic/Title	Event Location	Contact Information
April 26–28, 2001	Acquacoltural International 2001	Verona, Italy	Sue Hill, Heighway Events, Haines House, 21 John St., London WC1N 2BP UK; Phone: 44-20-7505-3608; Fax: 44-20-7831-2509; Email: sue.hill@informa.com; Website: <www.veronafiere.it>
April 28–May 2, 2001	32nd Annual Conference for the International Association for Aquatic Animal Medicine	Tampa, Florida, USA	Ilze K. Berzins, The Florida Aquarium, 701 Channelside Dr., Tampa, FL 33602; Phone: 813-273-0917; Fax: 813-209-2067; Email: IBerzins@FLAquarium.org; Website: <www.iaaam.org>
May 6–9, 2001	Aquaculture Canada 2001	Halifax, Nova Scotia, Canada	Linda Hiemstra, Aquaculture Association of Canada, 16 Lobster Ln., St. Andrews, NB, E5B 3T6, Canada; Phone: 506-529-4766; Email: hiemstra@mala.bc.ca
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/infofish/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	3rd International Fair for Aquaculture and Fisheries	Izmir, Turkey	Ali Civ, FGS Fuarlçilik AS, Çelîktepe, Inönü cad No 11/3, 4 Levent, Istanbul, Turkey; Fax: 02-12-281-27-13; Email: fgsfair@fgsfair.com.tr; Website: <www.fgsfair.com.tr/english/bilgi.html>
June 26–28, 2001	AFS/FHS/Western Fish Disease	Victoria, British Columbia, Canada	Garth Traxler; Phone: 250-756-7069; Email: traxlerg@pac.dfo-mpo.gc.ca; Website: <www.fisheries.org/fhs/meeting.htm>
July 22–24, 2001	Aquacultural Waste Management Conference	Roanoke, Virginia, USA	Greg Boardman; Phone: 540-231-2013; Email: gboard@vt.edu
August 4–7, 2001	Aquaculture Europe 2001	Trondheim, Norway	P. Ferlin; Email: ae2001@aquaculture.cc
August 19–23, 2001	131st American Fisheries Society Annual Meeting	Phoenix, Arizona, USA	Betsy Fritz; Phone: 301-897-8616 ext. 212; Email: bfritz@fisheries.org
August 22–24, 2001	6th Central American Symposium on Aquaculture	Tegucigalpa, Honduras	Susan Chamberlain; Office Manager, Global Aquaculture Alliance, 5661 Telegraph Rd., Suite 3A, St. Louis, MO 63129; Phone: 314-293-5500; Fax: 314-293-5525; Email: gaa@mo.net; Website: <www.gaalliance.org/symp.html>
September 3–6, 2001	Larvi 2001	Ghent University, Belgium	Conference Secretariat, Laboratory of Aquaculture and Artemia Reference Center, Ghent University, Rozier 44 B-9000, Ghent, Belgium; Phone: 32-9-2643754; Fax: 32-9-2644193; Email: larvi@rug.ac.be
October 24–26, 2001	4th World Fish Inspection and Quality Control Congress	Vancouver, British Columbia, Canada	International Association of Fish Inspectors, 1568 Merivale Road, Box 225, Ottawa, ON, K2G 5Y7, Canada; Fax: 613-228-6654; Email: congress@iafi.net or conference@iafi.net (for conference information)
November 7–12, 2001	ASEAN-SEAFDEC Conference on Sustainable Fisheries in the New Millennium	Bangkok, Thailand	Conference Secretariat, PO Box 1046, Kasetsart Post Office, Bangkok 10903, Thailand; Phone: 66-2-940-6326-9; Fax: 66-2-940-6336; Email: conference@seafdec.org; Website: <www.seafdec.org/millennium/second.htm>

Workshops and Short Courses

Date	Title/Topic/Site	Contacts
April 23– May 18, 2001	Hatchery Management for Finfish/ Pathumthani, Thailand	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>
May 2–4, 2001	Shrimp Health Management/Ft. Pierce, Florida, USA	Aquaculture Center for Training, Education, and Demonstration (ACTED), Harbor Branch Oceanographic Institution, 5600 US Hwy 1 North, Ft. Pierce, FL 34946; Phone: 800-333-4264 or 561-465-2400 ext. 416; Fax: 561-466-6590; Email: acted@hboi.edu; Website:<www.aquaculture-online.org>
May 9–June 14, 2001	Management of Sustainable Aquafarming Systems/Tigbauan, Iloilo, Philippines	Aquaculture Department Training Courses; Training and Information Division, SEAFDEC Aquaculture Department, Tigbauan, Iloilo 5021, Philippines; Phone: 63-33-336-2891; Fax: 63-33-335-1008; Email: training@aqd.seafdec.org.ph
May 10–11, 2001	Live Feeds Culture/Ft. Pierce, Florida, USA	ACTED (see above)
May 14–25, 2001	Diagnosis and Treatment of Warmwater Fish Diseases/Gainesville, Florida, USA	Ruth Francis-Floyd, Institute of Food and Agricultural Sciences, 7922 NW 71st Street, Gainesville, FL 32653-3071; Phone: 352-392-9617; Fax: 352-846-1088
May 14–25, 2001	Shrimp Hatchery Operations/Ft. Pierce, Florida, USA	ACTED (see above)
June 4–13, 2001	Marine Finfish Culture/Ft. Pierce, Florida, USA	ACTED (see above)
June 5– July 13, 2001	Marine Fish Hatchery/Tigbauan, Iloilo, Philippines	SEAFDEC Aquaculture Department (see above)
June 7–16, 2001	Inland Aquaculture Study Tour/ Pathumthani, Thailand	TCU (see above)
June 24–30, 2001	Aquaponics and Tilapia Aquaculture Short Course/Kingshill, US Virgin Islands	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/Pathumthani, Thailand	TCU (see above)
June 25–30, 2001	Shrimp Health Management Training Workshop/Bangkok, Thailand	Network of Aquaculture Centres in Asia-Pacific, PO Box 1040, Kasetsart Post Office, Bangkok 10903, Thailand; Phone: 66-2-561-1728; Fax: 66-2-561-1727; Email: naca@mozart.inet.co.th; Website: <ag.ansc.purdue.edu/aquanic/calendar/shrimpthai.htm>
June 27–29, 2001	Opportunities in Aquaculture/Ft. Pierce, Florida, USA	ACTED (see above)
June 28, 2001	Tilapia Farming/Ft. Pierce, Florida, USA	ACTED (see above)
June 29, 2001	Shrimp Farming/Ft. Pierce, Florida, USA	ACTED (see above)
June–July, 2001 (Two weeks)	Planning and Management for Sustainable Coastal Aquaculture Development/ Pathumthani, Thailand	TCU (see above)
July 9–27, 2001	Practical Aquaculture Techniques/Ft. Pierce, Florida, USA	ACTED (see above)
July 25–27, 2001	Design and Operation of Aquaculture Facilities/Roanoke, Virginia, USA	Greg Boardman; Phone: 540-231-2013; Email: gboard@vt.edu
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

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