

# AQUANEWS



Sustainable Aquaculture  
for a Secure Future

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## Production of Monosex Tilapia for Aquaculture

by William L. Shelton, Ronald P. Phelps, and Martin Fitzpatrick

Tilapias are one of the most important groups of cultured finfishes in the world, currently second only to the carps in total production. As sustainability becomes more important in aquaculture, fish farmers and scientists hope to depend

reproductive capacity can result in the production of too many young and/or undersize fish for market. Various management practices have been used to control unwanted excessive recruitment, including cage culture, predator stocking, interspecific hybridization, hand sexing, steroid-induced sex reversal, and chromosome manipulation. Each practice has varying degrees of effectiveness under different applications; however, sex reversal (or sex inversion) has emerged as the most widely accepted means of controlling reproduction in commercial aquaculture, largely replacing hybridization as the primary means of monosexing (the production of populations of only one sex) throughout the world. The practice is not limited to industrialized countries, but has been extended to developing countries as well. The protocol is relatively uncomplicated and can be effectively practiced by following generally proven procedures.

From the outset of the development of sex-reversal treatment procedures, concern was expressed for health and environmental issues. Eating fish that have been exposed to steroids was recognized as a potential problem related to the controversy over the use of steroids and steroid-like compounds commonly used in the cattle industry. Steroids are used in the cattle industry in a fattening procedure that immediately precedes slaughter. The practice was approved by the FDA, but has been subject to considerable

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## Tilapia Do the Darnedest Things!

by Deb Burke

It was a year and a half ago that Oregon State University CRSP researcher Wilfrido Contreras Sánchez discovered that he had a jumping male tilapia in his midst. "The tilapia was four months old when he started his jumping behavior . . . it was like his first walk," said Contreras, who discovered the jumping fish while spawning tilapia in his lab.

Contreras had two spawning tanks for tilapia placed side-by-side—the tank on the left contained Don Juan (the jumping male) and three females, and the tank on the right was empty. After Don Juan had performed beautifully for a number of spawns, Contreras moved Don Juan to the empty tank on the right. The next day when Contreras returned to the lab he found Don Juan back in the tank on

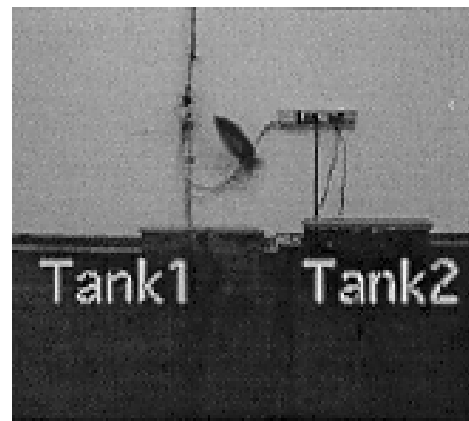
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BRIGITTE GOETZ

Martin Fitzpatrick, PD/A CRSP Principal Investigator, examines squashes of tilapia fry gonads

less on energetically inefficient carnivorous species; thus, even greater importance can be expected to be placed on tilapia culture. However, one of the major constraints of production has been the inherently high reproductive capacity resulting from early maturity, highly developed parental care, and multiple spawning cycles. In some cases, this high



Don Juan, the jumping tilapia, en route to a tank full of females. The video from which this still was taken can be viewed on the web at [www.orst.edu/Dept/crsp/fishmov.html](http://www.orst.edu/Dept/crsp/fishmov.html)

## Best Wishes to Tony Circa

by Deb Burke

Recently the PD/A CRSP learned that Tony Circa, Philippines Principal Investigator, would be leaving the program to work with USAquafarm in California. We thought that this event provided an excellent opportunity to write about Tony Circa's experiences in the field of aquaculture and wish him success on his new path.

Tony Circa received his Bachelor of Science in Inland Fisheries from Central Luzon State University (CLSU), Philippines, and his Master's Degree in Aquaculture from the Asian Institute of Technology (AIT) in Bangkok, Thailand. In June of 1980 Circa began working at CLSU as a research assistant on a United States Agency for International Development (USAID) freshwater aquaculture project. In 1996 Circa began his work with the PD/A CRSP, which has included research on the timing of supplemental feeding and the formulation of practical feed diets using non-fishmeal sources. With the International Foundation for Science (IFS), Circa worked on a waste recycling project that involved aquaculture; he also participated in genotype x environment studies with the Genetically Improved Farmed Tilapia (GIFT) Project, a collaboration among organizations based in the Philippines—Freshwater Aquaculture Center (FAC), CLSU, Bureau of Fisheries and Aquatic Resources / Department of Agriculture (BFAR/DA), University of the Philippines, Marine Science Institute (UP/MSI), and the International Center for Living Aquatic Resources Management (ICLARM)—and Akvaforsk Institute of Aquaculture Research, located in Norway.

Circa is now working for USAquafarm, a company that was recently acquired by Combined Resources Corporation (CRC). Initially, Circa did consulting work with CRC, a firm he had made contact with in February of 1998 at the World Aquaculture Society (WAS) Meeting. After the WAS meeting, Circa provided



SAYEA JENABZADEH

Former CRSP Principal Investigator Tony Circa

informal consultation via telephone to CRC, which led to a short-term consulting trip for Circa to California, where the corporation is based, in June 1998. Recently, CRC bought Solar Aquafarm, now called USAquafarm, and requested that Circa remain with the corporation and work on USAquafarm's upcoming aquaculture ventures.

"At present," Circa says, "USAquafarm's operational plans are still on the drawing board." Additionally, USAquafarm was damaged during the storms of El Niño last year, so the farm is not yet operating at full capacity. Currently, Circa's work is related to repairs, routine fish-related activities, planning, and providing technical

advice, and he anticipates increased participation in USAquafarm activities.

Circa notes that his previous education and training in the CRSP were instrumental to his work with USAquafarm. He feels his experiences fit well with USAquafarm's present and future work. At this time USAquafarm is solely engaged in tilapia production; however, the farm plans to expand its production to include aquarium species.

Circa discussed the PD/A CRSP's research and its impacts on aquaculture in the Philippines and South-east Asia. He stated that PD/A CRSP research results may be useful not only for semi-intensive tilapia production but also for some stages of intensive production systems.

"Because feeds are an expensive input item, farmers, whether they are involved with semi-intensive or intensive aquaculture production, will look for ways to reduce feed costs." Circa thinks that pond fertilization, an area of emphasis for CRSP research, was one area of aquaculture production that farmers were turning to in an attempt to reduce their expenses. Circa explained that pond fertilization may be most important during the nursing of fingerlings or the early stages of grow-out.

Regarding the future of aquaculture, Circa sees it as a food-producing

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## Tilapia in Space!

John Glenn's return trip to space wasn't the only first for the NASA shuttle program on October 29, 1998. The 77-year-old astronaut, who made history in 1962 as the first American to orbit the Earth, may have been the oldest person ever to blast off into orbit, but he shared the limelight with tilapia eggs that were part of the first aquaculture experiments to be conducted in orbit.

The project was designed by Hillsborough Community College (HCC) in Tampa, Florida, as part of

AMIGO, the Aquaculture MicroGravitational Orbit project. The ongoing study will attempt to identify the effect of a 10% gravitational environment on the development of the eggs, as compared to a control group of eggs maintained back on earth at HCC.

Aquaculture is thought to be an attractive food source for space stations and other space exploration in the future, and tilapia in particular were chosen for this experiment because of their favorable space culture potential.

## CRSP Profile: Kris McElwee

by Matt Niles

She has biked through central Europe and trekked through Turkey. She has managed a used music store, run the Oregon State University (OSU) radio station, and tended bar at a local Corvallis drinking establishment. She has played bass with fellow recording artist and CRSP researcher Grant Feist in the infamous Corvallis band Lupo and has learned the art of bassoon reed making from one of the finest in the nation. She has worked in Africa twice, first with the Peace Corps in Kenya and then to study the water quality of the Senegal River. Now, Kris McElwee is the CRSP's new Assistant Information Manager, in the Information Management and Networking Component of the CRSP based at OSU.

"Choosing the doors that are open" is the reason Kris is probably the only person in the world that could give a treatise on the finer points of bassoon reed making while making our CRSP publications the flawless works of art they are. Kris was hired in her new position in November of 1998, after completing her graduate work. She had worked as a Graduate Research Assistant for the CRSP as a technical editor since December of 1997.

While it's clear that she is perfectly suited to her new position, the road she has taken to arrive here has been a meandering one. With a B.A. in Geology from Case Western Reserve University in Cleveland, Ohio, in

hand, she immediately went to work on a Marine Geology Ph.D. in the School of Oceanography here at OSU.

Kris took a break from the Ph.D. grind in 1984, when her focus shifted from rocks to records. She managed a used music store for two years, managed OSU's KBVR radio station, and worked at a local bar, all the while tearing up Corvallis' local music scene with her classic Rickenbacker electric bass.



SAYEA JENABZADEH

CRSP Assistant Information Manager  
Kris McElwee

In 1993, Kris began a two-year trip to Kenya with the Peace Corps, where she worked on agroforestry issues. She returned to Oregon after traveling through Turkey in 1994, and worked at the Multnomah County Public Library in Portland for two years, which was the beginning of a shift

away from hard science toward pursuits challenging both her knowledge of the liberal arts and her extensive science background.

Kris returned to Africa in the summer of 1997, this time to Senegal, where she interned at the National Oceanographic Research Center for three months. Here she worked with water quality issues in the Senegal River, an area of study in which her interest was rekindled three years before while in Kenya with the Peace Corps.

This experience formed the basis of the project required for the completion of her Master's program in Marine Resource Management, which she began nine months before back at OSU.

Upon entering the Marine Resource Management program, Kris immediately began a two-year stint as the editor of *Streamlines*, the newsletter of the College of Oceanic and Atmospheric Sciences at OSU. This position kicked off Kris' career as an editor and publisher, and added to the already impressive wealth of experience she brought to the CRSP.

Serving as the Assistant Information Manager of the CRSP is clearly just the latest in a long list of Kris' adventures, and we hope her new position proves to be as exciting as the rest. We are confident that the passion and dedication Kris brings to the CRSP will ensure that she is as successful here as she has been in her previous endeavors. 📺

## Tony Circa

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activity that will receive increased attention worldwide due to the pressures of population growth, trends in health consciousness, and declines in catches of wild fish. He suggests that aquaculture will be considered as a possibility for stocking natural bodies of water including the seas and as an alternative food production system on lands, particularly in swamps or saline soils of developing countries, which are not

suitable for agricultural crops. Circa thinks that aquaculture could be tapped to produce feed ingredients such as fishmeal, so that supplies of wild fish utilized for fishmeal could be supplemented. Finally, Circa discussed the possibility of aquaculture being a part of the experiments of space shuttle missions. For example, he said a study might ask the following: "How would tilapia and algae survive and grow in a space aquarium?" 📺

## CRSP Website

Be sure to visit the PD/A CRSP website at <[www.orst.edu/dept/crsp/homepage.html](http://www.orst.edu/dept/crsp/homepage.html)>. From the homepage follow links to CRSP publications, including *Aquanews*. And don't miss *EdOp Net's* new look. *EdOp Net* is a monthly newsletter of educational and employment opportunities. Another link is to the PD/A CRSP Central Database, which can also be reached directly at <[biosys.bre.orst.edu/crspDB/default.htm](http://biosys.bre.orst.edu/crspDB/default.htm)>. Happy surfing! 📺

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## Monosex Tilapia

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criticism. There are important differences between steroid use practices of the fish and cattle industries. For fish production, steroids are used to create monosex populations for reproduction control, and the treatment is limited to a relatively brief period early in the nursery phase of culture. Additionally, the time between steroid treatment and consumption is quite different for fish production versus cattle production. Fish receive treatment early on and then are cultured an entire growing season without steroid treatment, whereas cattle receive continual steroid treatment to the time of processing. Furthermore, the drugs used in the respective treatments are different. Tissue analysis has demonstrated that edible portions of the fish carcass have nearly undetectable levels of steroid even during treatment and that residuals clear from organs months before marketing. Since the early part of this decade, the use of methyltestosterone (MT) for monosexing tilapia in the US has been increasingly scrutinized; not only do the drugs have to be proven safe for fish and not to endanger public health, they must be shown to be environmentally benign. These concerns cannot be taken lightly. Fish treatment in aquaculture is now operating under the conditions of an Investigational New Animal Drug Exemption (INAD). The threat of losing the important tool of sex reversal is serious, as the growing importance of tilapia in our future food production depends on the effective control of unwanted recruitment.

Management of fish reproduction for aquaculture is considered to be of primary importance throughout the sphere of the PD/A CRSP. Broodstock and seed supply have been identified as major constraints to aquaculture and thus one of our major research priorities. Tilapia reproduction must be controlled under most currently practiced culture conditions. Where large fish are wanted, monosex seed is preferred. Monosex seed production techniques should be technologically

and financially accessible to a range of producers—small-scale farmers to commercial operations—and constantly yield high quality monosex populations, while not requiring an inappropriate level of sophistication or carrying unwanted risks. PD/A CRSP-sponsored investigations have helped refine the current practice of direct steroid induction of all-male Nile tilapia (*Oreochromis niloticus*). Alternative protocols based on other techniques also are being examined.

Direct induction of sex reversal with hormone-treated feed is effective, and the technology is readily transferable. However, the total quantity of hormone used is related to MT concentration in the feed, rate of feeding, and feed conversion efficiency, which all affect the levels of hormone that reach open aquatic systems through discharge in hatchery effluents. The fate of steroids in the environment is not well known. Current PD/A CRSP studies at Oregon State University (OSU) in collaboration with Universidad Juárez Autónoma de Tabasco (UJAT) in Mexico and at Auburn University (AU) in the US are examining the pathways and levels of steroid contamination. Techniques have been developed that will allow the detection of as little as one part per billion of hormone in pond soils. Preliminary results from aquarium studies suggest that methyltestosterone leaks from the food into the

surrounding environment, tending to disappear quickly from the water but to remain in the soil for at least several weeks after treatment ends. Other research at OSU and UJAT has focused on development of an alternative masculinization treatment for tilapia based on short-term immersion in steroid solutions at critical stages of development—a technique successfully used with salmonids. Some progress has been made in applying similar methods to tilapias. If this approach can be used to create monosex populations of tilapia, then lower total amounts of steroid will be needed and greater control over the release of steroids can be exercised.

Direct induction of sex reversal with steroids is an alteration of the phenotype; the genotype remains unchanged. Breeding sex-reversed fish has been used to identify sex-reversed individuals, since the progeny sex ratio is a function of the parental genotypic sex. Breeding for monosex populations by using sex-reversed broodstock can be practiced with current technology. This approach would reduce the amount of hormone potentially reaching the environment, as only broodstock would be treated. The concern regarding eating steroid-treated fish also would be avoided since only the progeny of fish exposed to steroids

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### For Further Reading

The following CRSP Research Reports have been published on reproduction control research. Abstracts of the reports (in English, French, or Spanish) can be viewed at the PD/A CRSP website at <[www.orst.edu/dept/crsp/pubs/nops/noporderpage.html](http://www.orst.edu/dept/crsp/pubs/nops/noporderpage.html)> or copies can be ordered at the postal or email address on p. 7.

- 88-10 Sikoki, F.D., R.A. Tubb, and L.R. Curtis. Elevation of sex steroids and inhibition of UDP-glucuronyltransferase are out of phase during gonadal maturation in the common carp. (12/88)
- 90-27 Green, B.W. and L.A. Lopez. Implementing the large-scale production of young males of *Tilapia nilotica* using hormonal sex inversion in Honduras. (5/90)
- 94-63 Green, B.W. and D.R. Teichert-Coddington. Production of *Oreochromis niloticus* fry for hormonal sex reversal in relation to water temperature. (2/94)
- 94-75 Green, B. and D. Teichert-Coddington. Growth of control and androgen-treated Nile tilapia, *Oreochromis niloticus* (L.), during treatment, nursery and growout phases in tropical fish ponds. (12/94)
- 98-121 Contreras Sánchez, W.M., M.S. Fitzpatrick, R.H. Milston, and C.B. Schreck. Masculinization of Nile tilapia (*Oreochromis niloticus*) by single immersion in 17 $\alpha$ -methylidihydrotestosterone and trenbolone acetate. (4/98)

## Darnedest Things

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the left with all the females.

Contreras figured that someone had returned Don Juan to the tank, so he again caught Don Juan and returned him to the tank on the left. The following day when Contreras returned to the lab he again found Don Juan in the tank on the left with all the females. Contreras still thought that someone from the lab was returning Don Juan to the other tank, so once again he caught Don Juan and returned him to the empty tank. He began to suspect that Don Juan was jumping to the tank with

the females when one day he left the lab to do some fieldwork and on his return, only two hours later, found Don Juan yet again in the tank with the females. Contreras then decided to set up video cameras at two angles, one in front of the tanks and one to the right of the tanks, to see what Don Juan was up to when he wasn't there. Don Juan was captured on film jumping into the tank with the females at least three times; however, Contreras is sure Don Juan has jumped at least ten times. Of Don Juan's jumps Contreras said, "[Don Juan] didn't do just short jumps . . . he jumped about a foot

and a half into the air . . . he wasn't just flopping around."

Shortly after the discovery of Don Juan's feat he was the focus of an OSU student's senior project; Rik Hornick ran an experiment on jumping behavior in tilapia (see related story below). Today, Don Juan still lives in Contreras' lab. For reasons unknown Don Juan has lost his sight (maybe too much sperm loss) but, according to Contreras, is still growing and one fantastic spawner and living the life of an ex-jumper champion at OSU.

View the video of Don Juan on the web at <[www.orst.edu/Dept/crsp/fishmov.html](http://www.orst.edu/Dept/crsp/fishmov.html)>. 

## Jumping Tilapia Research

by Deb Burke

**D**on Juan, "the jumping guy," inspired Rik Hornick, a student at Oregon State University (OSU) to conduct a study entitled "A comparison of the jumping behavior of Nile tilapia (*Oreochromis niloticus*) between fish in isolation and fish in small groups in an aquarium setting." The following is a summary of Hornick's research.

It has been observed that Nile tilapia (*Oreochromis niloticus*) will occasionally jump from aquaria when raised in captivity for aquacultural production or research. This behavior is often fatal.

Jumping behavior has been observed on numerous occasions in one particular fish (designated "the jumping guy") in a lab at OSU, who, when separated from a "breeding group" consisting of himself and three females, would repeatedly jump back into the aquarium containing the other fish. The hypothesis tested in this experiment is that Nile tilapia will exhibit an increase in jumping behavior when isolated from other fish in an aquarium setting. The experimental objectives were to determine if isolation elicits increased jumping behavior in comparison with fish contained in aquaria with other fish and if isolated males exhibit a higher frequency of jumping behavior than females in isolation and group settings. Jumping


arenas were constructed at two different locations—Smith Farm and Nash Hall at OSU.



CRSP Student Researcher Rik Hornick

Each arena consisted of five aquaria arranged with a single aquarium placed in the center and the four remaining aquaria located on each side. Twelve trials were conducted at the two sites, and 40 fish were tested for the following variables: location of the site, the sex of the fish, the social status of the aquarium (whether fish are in a group or alone), and the length of the acclimation period before the observation for jumping behavior began. Four fish were placed into one of the outside aquaria for an acclimation period, and then one fish was selected and placed into the center aquarium. The fish were then observed every two hours for a total of six hours to monitor for jumping.

Seventeen jumping events were observed during the 12 trials. Of the approximately 40 fish tested for jumping in group and isolation, eight fish jumped in seven trials, with six of these fish jumping more than one time. Female fish represented a slightly higher proportion of fish jumping, with female jumpers representing 4.88% of the females tested compared with male jumpers representing 3.57% of the males tested. There were no significant differences in jumping behavior based upon the sex of the fish, social status of the aquarium, length of the acclimation period, or location of the arena.

Although the results of the experiment do not support the hypothesis that isolation would lead to an increase in jumping behavior, the question of utility of this behavior and its application in fish ecology is still an open question. One of the conditions that existed in the "jumping guy" phenomenon was the state of reproductive readiness of the fish. Since "jumping guy" was originally separated from the females to prevent spawning, it can be assumed that he was in a state of reproductive readiness, and that this might have influenced his jumping response. Reproductive readiness was not examined in this experiment; however, it is conceivable that during this physiological state, a fish may experience a heightened sense of agitation and that this might influence his or her jumping response. 

## Pond Bottom Soil Research

by Claude E. Boyd and C. Wesley Wood

**A**quaculture ponds are constructed from soil, which affects pond water quality, and the basic characteristics of pond water quality depend upon the exchange of nutrients between soil and water. Organic matter added to ponds or produced in ponds by photosynthesis accumulates on pond bottoms and decomposes. Organic matter decomposition in sediment influences both the quality of the bottom soil and the quality of pond water. Therefore, the nutrient and organic matter composition of pond sediment and the interactions between pond sediment and pond water quality can have far-reaching effects on fish and crustacean production in ponds.

In the early days of aquaculture, little attention was given to soils aside from their suitability for pond construction. Today, aquaculturists realize that soils have a considerable impact on fish and crustacean culture. Still, our knowledge of pond soils lags far behind our understanding of many other factors that influence production. The PD/A CRSP soils project was initiated by Auburn University researchers to obtain basic information on pond soil characteristics at CRSP research sites, measuring decomposition and nutrient mineralization rates from sediment, and developing a system of pond soil classification based on sediment cores taken from pond bottoms.

A series of soil cores have been collected from ponds in Honduras, Thailand, Kenya, and Peru, and cores are soon to be collected from ponds in the Philippines. Study findings reveal that the system of separating pond sediment profiles into layers (horizons) as suggested by earlier research at Auburn University is widely applicable. This system recognizes six layers: a flocculent layer of recently deposited sediment (F horizon), a layer of highly fluid and mixed sediment of 2 to 10 cm in depth (S horizon), a layer of less fluid and unmixed mature sediment of variable depth (M horizon), a transition layer

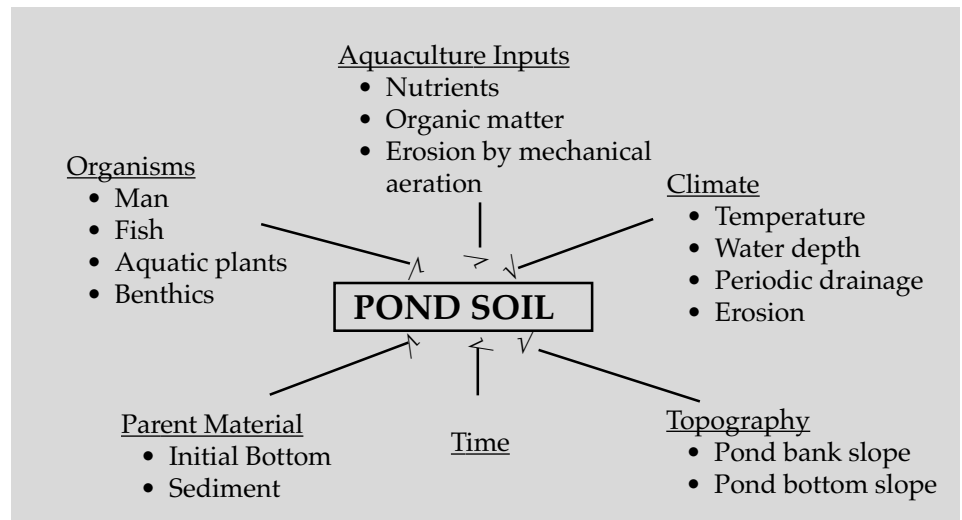
(T horizon), and the original undisturbed soil (P horizon). We were able to identify all the horizons in cores from the CRSP sites. We also found similar trends pertaining to change with depth in profiles for most soil characteristics. For example, bulk density increases and organic matter and nitrogen concentrations decrease progressing from upper to lower horizons.

Ponds at all CRSP sites visited have soils that are well suited for aquaculture, but soil properties differ greatly among sites. For example, the water-extractable phosphorus concentration in the 0-2 cm layer of sediment ranged from 0.041 ppm in ponds at



CRSP Researchers (from left to right) Claude Boyd, Wesley Wood, and Prasert Munsiri take pond soil cores in research pond at Asian Institute of Technology, Thailand

among sites will allow greater flexibility in developing a system of pond soil classification based on horizons in pond bottom cores. Initial attempts to develop this system will begin in 1999 after a series of core samples is taken from the Philippine CRSP site. We plan to collaborate with



External factors influencing pond soil development

Sagana, Kenya, to 0.305 ppm in ponds at the Asian Institute of Technology (AIT) in Thailand. Such large differences in water-soluble phosphorus no doubt influence the fertilizer requirements for maintaining phytoplankton blooms. The background data on pond soils will be helpful to those conducting experiments at the CRSP sites. We also plan to continue annual sampling at selected CRSP sites to determine how soil properties change over time in response to aquacultural activities.

The wide variation in soil properties

other CRSP researchers in determining the best soil properties to include in the classification system. The classification system should be quite valuable in allowing management procedures to be adjusted for differences in soil properties.

As a result of examining pond sediment and cores during this research, the factors influencing pond soil development have been identified. Of course, the major factors are the same ones that influence terrestrial soil

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## New Fertilization Guide Available Now

### POND FERTILIZATION: ECOLOGICAL APPROACH AND PRACTICAL APPLICATION

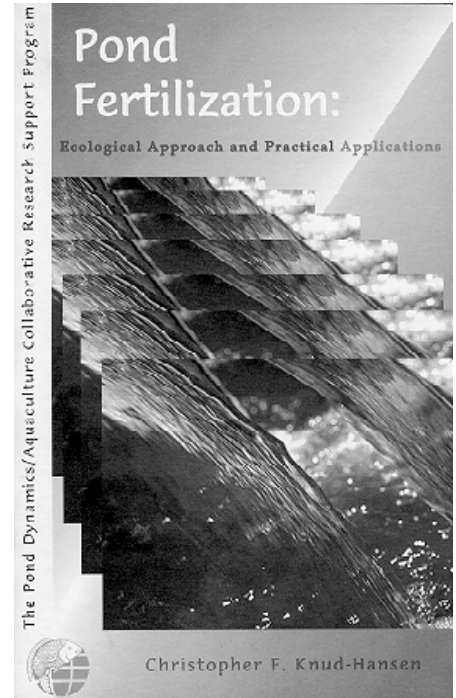
by Christopher F. Knud-Hansen

This 137-page report provides an approach to pond fertilization that takes into account the efficiencies, ecological impacts, and economics of various fertilizers as well as the dynamic chemical and biological processes that take place in pond ecosystems. The book incorporates years of PD/A CRSP pond dynamics and fertilization research in a form designed to be understood by regional extension workers, educated farmers, aquaculture students, and scientists.

Copies can be requested from:

Publications  
Pond Dynamics / Aquaculture CRSP  
Oregon State University  
400 Snell Hall  
Corvallis, OR 97331-1641

Email: [crsp.mail@orst.edu](mailto:crsp.mail@orst.edu)



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### Pond Soils

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development, i.e., parent material, climate, activity of organisms, topography, and time (see diagram). Ponds are built in existing soils, but the upper horizons usually are removed during construction. Once fish or crustacean culture is initiated, a distinct soil profile begins to develop. This profile develops within a few years in ponds as compared to many years in terrestrial soils.

CRSP soils research results are useful to small-scale as well as commercial aquaculturists. We have been contacted by producers in several countries regarding management techniques that can be applied between crops to enhance soil properties. Recently, when we took samples from the station in Iquitos, Peru, we were invited to Tumbes, Peru, to present our findings from the CRSP project to a group of aquaculturists. A continued research focus on the role of pond soils in aquaculture systems can result in large benefits to a wide range of producers. 

### For Further Reading

The following CRSP Research Reports have been published on pond bottom soils research. Abstracts of the reports (in English, French, or Spanish) can be viewed at the PD/A CRSP website at [www.orst.edu/dept/crsp/pubs/nops/noporderpage.html](http://www.orst.edu/dept/crsp/pubs/nops/noporderpage.html) or copies can be ordered from the postal or email address above.

- 88-4 Lin, C.K. Acidification and reclamation of acid sulfate soil fishponds in Thailand. (1/88)
- 94-69 Ayub, M., C.E. Boyd, and D. Teichert-Coddington. Effects of urea application, aeration, and drying on total carbon concentrations in pond bottom soils. (12/94)
- 94-70 Boyd, C.E. and D. Teichert-Coddington. Pond bottom soil respiration during fallow and culture periods in heavily-fertilized tropical fish ponds. (12/94)
- 95-86 Bowman, J.R. and J.E. Lannan. Evaluation of soil pH-percent base saturation relationships for use in estimating the lime requirements of earthen aquaculture ponds. (7/95)
- 96-96 Boyd, C.E. and P. Munsiri. Phosphorus adsorption capacity and availability of added phosphorus in soils from aquaculture areas in Thailand. (6/96)
- 96-98 Munsiri, P. and B.F. Hajek. Texture and chemical composition of soils from shrimp ponds near Choluteca, Honduras. (11/96)
- 97-101 Shrestha, M.K. and C.K. Lin. Phosphorus fertilization strategy in fish ponds based on sediment phosphorus saturation level. (1/97)
- 97-112 Boyd, C. and P. Munsiri. Water quality in laboratory soil-water microcosms with soils from different areas of Thailand. (1/98)
- 97-113 Shrestha, M.K. and C.K. Lin. Determination of phosphorus saturation level in relation to clay content in formulated pond muds. (1/98)
- 97-116 Munsiri, P., C.E. Boyd, B.W. Green, and B.F. Hajek. Chemical and physical characteristics of bottom soil profiles in ponds on haplaquents in an arid climate at Abbassa, Egypt. (1/98)

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## Deputy Director to Leave PD/A CRSP for Small Ruminants

A few months ago Deputy Director Brigitte Goetze surprised the CRSP with the news that she would be leaving the program for greener pastures—Green Peak Farm, to be specific, and its herd of 15 goats.

Brigitte and husband Corwin Willard have lived at Green Peak Farm, located on 50 acres about 30 miles southwest of Corvallis, since 1988. Brigitte's interest in hand-spinning, dyeing, and knitting influenced the couple's decision to begin raising goats in 1993. Now in 1999 the goat herd numbers 15, with more expected to be born in the coming months. The goal over time is to improve and increase the bloodlines, with a focus on two breeding lines of angora goats—colored (grey, silver, and black) and registered (white). Natural silver wool is of particular interest to Brigitte because of the difficulty of achieving lustrous silver with dyes. Also residing at Green Peak Farm are two sheep, four hens, two dogs, and one cat.



Brigitte Goetze

Brigitte joined the CRSP in 1993 upon returning to the US from her native Germany. When she did, she brought to the program a background in science journalism and adult education, as well as masters and doctoral degrees in fisheries biology. Brigitte's first CRSP responsibility was as coordinator of the Egypt Project, a USAID mission buy-in grant. When the Egypt Project ended in 1995, the duties of deputy director shifted to oversight of the CRSP's internal operation and program administration. In addition, she served as manager of the Information Management and Networking Component during the first year of the 1996-2001 *Continuation Plan*, the program's current USAID grant.

Her keen insights on animal (most certainly including the human animal) behavior, philosophical bent of mind, and generous good humor will be heartily missed by everyone in the CRSP. Still, is this turn of events really any wonder? It so happens that when the name Goetze is run through a computer spell-check program, the suggested replacement is "goats." 🐐

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## Monosex Tilapia

... from p. 4

would be grown for the market. However, to produce broodstock that would sire only all-male offspring would require an initial feminization of Nile tilapia by treatment with estrogen. Subsequent breeding of these fish with untreated fish would then be necessary for the purpose of progeny testing in order to identify those individual fish that produce only all-male offspring. This method is less desirable than the direct androgen treatment in most circumstances because estrogen treatment is less efficient at producing sex-reversed fish than is androgen treatment and because of the time and resource commitment required by progeny testing. Nevertheless, this method may warrant further development in the future.

Another direction being taken in PD/A CRSP studies at the University of Oklahoma (UO) involves chromosome manipulation. Induction of chromosome recombinations is somewhat analogous to direct induction of sex reversal in that both require careful attention to the timing of treatment, the magnitude of that treatment, and the way in which it is applied. Once the optimal protocol is developed, adherence to established details by producers determines the likelihood of repeating the demonstrated experimental success. Furthermore, most sex reversal techniques are less than 100% effective. The androgen treatment of developing fry usually produces 95% male populations. While this is acceptable in most production systems, any deviation below 95% can result in excessive recruitment. Many chromosome set manipulation techniques also have limitations: gynogenesis has low yields and produces all females; triploid induction produces mostly sterile fish, but some remain diploid and fertile; and tetraploid induction is still a highly undeveloped technique.

Whereas gynogenesis, triploid, and tetraploid induction usually manipulate the maternal genome, androgenesis attempts to manage the paternal genome. At UO, PD/A CRSP researchers are trying to develop androgenesis techniques for Nile tilapia that will allow for the practical production of fish that will sire only all-male offspring. Thus, all males produced with this induction protocol would have the unusual sex-determining genotype of YY and would produce only male offspring (XY) when bred with normal females (XX). This broodstock production would be a direct induction technique that does not require steroid treatment, yet can mass-produce monosex male progeny for grow-out.

An additional component being examined by PD/A CRSP researchers, and the basis for such a breeding program, is the stability and fidelity of the sex-determining mechanism in Nile tilapia. Testing the sex-determining mechanism through pair spawning of various stocks at AU, UO, and OSU is an integral component of PD/A CRSP studies. Earlier investigations demonstrated significant departures from the expected 1:1 progeny sex ratio in offspring of pair-spawned Nile tilapia. Approximately 20% of the broodstock produced progeny that were outside the range to be considered a population with an expected sex ratio of 50% males and 50% females. If non-sex-chromosome sex-determining factors are present in some stocks, other stocks would need to be identified. Nile tilapia stocks with predictable sex-determining genotypes will be as important to the success of monosex breeding programs as the empirically developed treatment protocols. Finally, if unique broodstock are developed for the anticipated breeding programs, the investigation of cryopreservation techniques will be needed so that gene banks can be used to facilitate the dissemination of the technology. 🐟



## Fishellaneous Items

### Sex, Drugs and . . . Shellfish

Prozac, the mood-altering drug used to control depression in human beings, can apparently play a role in the lives of clams and mussels by getting them in the mood to spawn, *The San Diego Union-Tribune* reports.

Research at a university in the USA shows that the widely prescribed anti-depressant stimulates spawning in freshwater fingernail clams and zebra mussels. Rarely has either animal been observed to spawn in the wild or in the laboratory without the use of an artificial chemical aid, the newspaper says.

Research suggests Prozac acts on molluscs in the same way as it affects people. The drug allows both subjects to secrete more serotonin, a neurotransmitter that exists in all organisms and regulates moods in people.

Biologists have known for some time that serotonin induces clams and mussels to spawn. But the new research shows Prozac to be far more effective and cheaper to use for aquatic farmers.

Serotonin costs about \$22 per gram. Prozac is 190 times more expensive but is effective at less than 0.002 the quality of serotonin, the report concludes.

Source: *Seafood International* 13, no. 10, October 1998.

### News from the US Dept. of Agriculture

The Fall Issue of Small Farms Digest is now available at <http://www.reeusda.gov/smallfarm>. This issue features interviews with women from Zambia, Mongolia, Barbados, Australia, El Salvador, the Chippewa Indian Nation, Illinois, and Wisconsin - all participants in the USDA-sponsored Second Annual International Conference on Women in Agriculture.

To receive a direct electronic copy of this free quarterly newsletter, send your request to [bhodes@reeusda.gov](mailto:bhodes@reeusda.gov).

### Eat One Live Fish and...

Hundreds of thousands of people gathered in southern India recently to swallow a herbal medicine stuffed inside live fish—a treatment believed to cure asthma and other respiratory ailments.

The medicine is free, but patients must buy their own fish, called murrel, which normally costs Rs10 (\$0.25). Prices shot up to Rs60 (\$1.50) per fish for the event.

Between 350-400,000 people endured temperatures of more than 40 deg C to receive the herbal helping hand.

The government deployed anti-riot troopers to control the crowds. Police used batons to restrain restless people and barely managed to avert a stampede, witnesses said.

Source: *Seafood International* 13, no. 10, October 1998.

### What's Next? *Penaeus* in the Pokey?

The Illinois Department of Corrections, in the USA, the organization responsible for running the state of Illinois' prison system, is about to expand its fish operations, according to *American Seafood Institute Report*.

A new facility is being designed "to spur new industry." It will include an extensive fish processing centre to complement its new aquaculture operation, as well as a breeding line that operates at another prison.

"Local fish farmers will also be able to bring their product to the joint (sic) for processing," the report concludes.

Source: *Seafood International* 13, no. 10, October 1998.

### Fish Farming Saves Villagers

Haiti - January 2, 1999

The fortunes of 2,000 villagers in Pandiassou have changed since a Roman Catholic monk inspired the farmers to build fish ponds.

Drought had made their land arid and many people faced unemployment and hunger. Now, irrigation from the ponds allows three harvests a year, and farmers can make US\$800 on every acre from each harvest.

Brother Franklin Armand and the Little Brothers and Sisters of the Incarnation persuaded the farmers to build ponds and the European Union has now given US\$800,000 towards the project and the UN Development Programme has helped with a US\$1 million grant.

In November, the village co-operative inaugurated a new freezer facility to store fish, which the members hope to sell.

Source: *Fish Info Service*, [www.sea-world.com](http://www.sea-world.com). Reprinted with permission.

### 210,000 Young Tilapias Seeded

Mexico - November 9, 1998

Some 210,000 young tilapia - mainly black tilapia - have been seeded in the El Novillo dam this year, in a bid to protect the species and restore the fishery, as 1,560 people in San Pedro de la Cueva, Sonora, depend on this activity.

The mayor of the municipality, Francisco Silva Castillo, said that this year's target of 650,000 tilapias could not be reached because the dam was at a very low level.

The El Novillo (or Plutarco Elias Calles) dam is located in San Pedro de la Cueva, 140 km east of Hermosillo, and is one of the most important in the area, with a capacity of 3,020 million cubic metres.

At present, catches have fallen by 30% due to the low level of the dam following a lack of rains.

Source: *Fish Info Service*, [www.sea-world.com](http://www.sea-world.com). Reprinted with permission.

## Workshops and Short Courses

Date	Title/Topic/Site	Contacts
Year-round	Work Experience in Hatcheries Techniques/ Asian Institute of Technology, Thailand	Training and Consultancy Unit, Aquaculture and Aquatic Resources Management Program, School of Environment, Resources and Development, Asian Institute of Technology, PO Box 4, Klong Luang, Pathumthani 12120, Thailand; Phone: 66-2-524-5445; Fax: 66-2-524-5484; Email: tcuaasp@ait.ac.th
Year-round	Training & Research in Fisheries & Stock Mgmt/Wageningen Agricultural University, the Netherlands	G. van Eck, Dept of Fish Culture & Fisheries, PO Box 338, 6700 AH Wageningen, The Netherlands; Phone: 31-8370-8330; Fax: 31-8370-83937; Email: gerrie.van.eck@alg.venv.wau.nl
Year-round	Tropical Aquaculture Advanced Training in a Third Country/ Escuela Agricola Panamericana (EAP), Honduras, and Asian Institute for Technology, Thailand	Zentralstelle fuer Ernährung und Landwirtschaft (ZEL) Feldafing/ Zschortau, Deutsche Stiftung fuer Internationale Entwicklung (DSE), D-82336 Feldafing, Germany; Phone: ++49-8157-38-0; Fax: ++49-81-57-38-227
February 20-March 12	Sustainable Rural Aquaculture for Small-Scale Farmers/Dhaka, Bangladesh	Aquaculture Course Coordinator, Education and Training Department, IIRR, 4118 Cavite, Silang, Philippines; Phone: 63-46-414-2417; Fax: 63-46-414-2420; Email: etd-iirr@cav.pworld.net.ph
May 9-June 11	HDNR Smithsonian Conservation Short Course: "Biodiversity Monitoring and Assessment for Adaptive Management"/Washington, D.C.	Christopher Ros c/o SI/MAB Program, Smithsonian Institution, S. Dillon Ripley Center, 1100 Jefferson Drive SW, Suite 3123, Washington, D.C. 20560-0705; Phone: 202-357-4793; Fax: 202-786-2557; Email: cjr@ic.si.edu; For more information refer to: <a href="http://www.si.edu/organiza/museums/ripley/simab/start.htm">http://www.si.edu/organiza/museums/ripley/simab/start.htm</a>
May 17-28	Diagnosis and Treatment of Warmwater Fish Diseases/University of Florida, Gainesville, Florida	Dr. Ruth Francis-Floyd, Dept. of Fisheries and Aquatic Sciences, University of Florida, 7922 NW 71st St., Gainesville, FL 32653; Phone: 352-392-9617; Fax: 352-846-1088; Email: rff@gnv.ifas.ufl.edu; For more information refer to: <a href="http://www.ifas.ufl.edu/~conferweb">www.ifas.ufl.edu/~conferweb</a>
June 23-26	The 5th International Interdisciplinary Conference on the Environment/Baltimore, Maryland	Demetri Kantarelis or Kevin L. Hickey, IEA/Kantarelis-Hickey Assumption College, 500 Salisbury Street Worcester, MA 01615; Phone: 508-767-7557 (Kantarelis), 508-767-7296 (Hickey); Fax: 508-767-7382; Email: dkantar@assumption.edu, khickey@assumption.edu; For more information refer to: <a href="http://champion.iupui.edu/~mreiter/iea.htm">http://champion.iupui.edu/~mreiter/iea.htm</a>
September 19-October 22	HDNR Smithsonian Conservation Short Courses: "Economic and Policy Solutions for Ecosystem Conservation"/Washington, D.C.	Christopher Ros c/o SI/MAB Program, Smithsonian Institution, S. Dillon Ripley Center, 1100 Jefferson Drive SW, Suite 3123, Washington, D.C. 20560-0705; Phone: 202-357-4793; Fax: 202-786-2557; Email: cjr@ic.si.edu; For more information refer to: <a href="http://www.si.edu/organiza/museums/ripley/simab/start.htm">http://www.si.edu/organiza/museums/ripley/simab/start.htm</a>
September 22-25	Aquaculture Marketing Seminar 1999	Aquaculture Magazine, PO Box 2329, Asheville, NC 28802, USA; Phone: 828-254-7334; Fax: 828-253-0677; Email: aquamag@ioa.com; <a href="http://www.aquaculturemag.com">www.aquaculturemag.com</a> .
October 31-November 12	HDNR Smithsonian Conservation Short Course: "Smithsonian Environmental Leadership & Communication Course"/Washington, D.C.	Christopher Ros c/o SI/MAB Program, Smithsonian Institution, S. Dillon Ripley Center, 1100 Jefferson Drive SW, Suite 3123, Washington, D.C. 20560-0705; Phone: 202-357-4793; Fax: 202-786-2557; Email: cjr@ic.si.edu; For more information refer to: <a href="http://www.si.edu/organiza/museums/ripley/simab/start.htm">http://www.si.edu/organiza/museums/ripley/simab/start.htm</a>

## Upcoming Conferences and Expositions

Date	Topic/Title	Event Location	Contact Information
January 27-30	Aquaculture America	Tampa, Florida, USA	Florida Aquaculture Association, PO Box 1519, Winter Haven, Florida 32882; Tel: 941-293-5710; Fax: 941-299-5154.
January 29-31	25th Annual East Coast Commercial Fisherman's and Aquaculture Trade Exposition	Ocean City, Maryland, USA	Betty Duty; Tel: 800-421-9176
February 1-5	International Conference on Integrated Fisheries Monitoring	Sydney, Australia	Conference Secretariat, GPO Box 2179, Brisbane, Qld 4001 Australia; Tel: 07-3832-8894; Int: 61-7-3832-8894; Fax: 61-7-3832-8254; Email: mail@enterprisingevents.com.au
February 3-5	Fish Farming Trade Show	Greenville, Mississippi, USA	Tel: 601-981-0807; Fax: 601-981-0506
February 11-12	Aquacultura 1999: 9th International Biennial Exhibition of Fish Farming Technologies, Equipment, and Products	Verona, Italy	The Consultants International Group, 1616 H Street NW, Washington, DC 20006; Tel: 202-783-7000; Fax: 202-393-4655; Email: cigroup@aol.com
February 15-17	8th Iranian National Fisheries Conference on Responsible Aquaculture Development	Tehran, Iran	Aquaculture Department, No. 45 Mahan Al, Vesal Shiraz St., Tehran, Iran 14168; Phone: 98-21-6417181; Fax: 98-21-6417261
March 18-20	VIV Aquaculture '99	Bangkok, Thailand	Ms. A. van Rooijen, Royal Dutch Jaarbeurs, PO Box 8500, NL -3503 RM Utrecht; Phone: 31-30-29-55-662; Fax: 31-30-29-55-585
April 7-9	Farmed Fish Quality	Bristol, England	Langford Continuing Education Unit; Phone 44-117-928-9502; Fax: 44-193-485-2170
April 26-May 2	World Aquaculture '99	Sydney, Australia	John Cooksey; Phone: 1-425-485-6682; Fax: 1-425-483-6319
August 11-14	Aqua Nor '99	Trondheim, Norway	Stiftelsen Nor-Fishing, Nidarhallene, N-7030 Trondheim, Norway; Phone: 47-73-92-93-40; Fax: 47-73-51-61-35

### Bolivar Joins CRSP as New Philippines PI


We are pleased to welcome a newcomer to the PD/A CRSP, Dr. Remedios Bolivar, who joined the PD/A CRSP in September 1998 as the new Philippines Principal Investigator, replacing Tony Circa (please see story on p. 2). Currently an Associate Professor at Central Luzon State University (CLSU), Philippines, Bolivar has been teaching since 1979. In addition to her professorship at CLSU's Freshwater Aquaculture Center (FAC), Bolivar has served as Project Leader of the Fish Genetics Project funded through the International Development Research Center and Research Leader of the GIFT (Genetic Improvement of Farmed Tilapia)

project, a collaboration involving ICLARM (International Center for Living Aquatic Resources Management), Akvaforsk Institute of Aquaculture Research in Norway, the Philippine Bureau of Fisheries and Aquatic Resources, and FAC at CLSU.

Bolivar has extensive education and training in the discipline of aquaculture. In 1987 she received her Master of Aquaculture at the University of the Philippines in the Visayas and in 1998 completed her Ph.D. in aquaculture genetics from the Biology Department at Dalhousie University, Halifax, Canada. Additionally, she

participated in a year-long training for Senior Aquaculturists in Asia and the Pacific and an eight-month training in Ecology and Fish Productivity at the Southeast Asian Regional Center for Tropical Biology (BIOTROP) in Bogor, Indonesia.

With a research interest in fish genetics, Bolivar's doctoral dissertation was on the estimation of response to within-family selection for growth in Nile tilapia. She has attended a number of conferences and workshops related to fish genetics.

The PD/A CRSP looks forward to working with Dr. Bolivar and extends its welcome. 

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### Humble beginnings . . .

It was Fall of 1983, and the first issue of *Aquanews* was hot off the copy machine. A full six pages long, issue No. 1 was produced by Michele Leslie, *Aquanews*' first editor, and Jim Lannan, the CRSP's first director. The debut issue, published at OSU's Marine Science Center in Newport, Oregon, introduced the new newsletter to CRSP participants and the PD/A CRSP to the world.



### A new look . . .

Hillary Egna took the helm of *Aquanews* as its third editor in the Fall of 1986, and gave the newsletter its first facelift since its inception three years before. This was also the first issue to be published at the Program Management Office's current location at Oregon State University in Corvallis. In 1990, Egna took over the directorship of the CRSP.

### Aquanews today . . .

Danielle Clair has been the editor of *Aquanews* since the Spring of 1996. Alert readers may have noticed the loss of *Aquanews*' familiar blue coloring in the most recent Fall 1998 issue. Recent funding cuts have necessitated some new economies—thus the return to black and white. We will strive to keep our newsletter as good as it's ever been, and our readers needn't worry about our content going the way of our color. We hope you enjoy reading . . .

# AQUANEWS

Director: Hillary S. Egna  
*Aquanews* Editor: Danielle Z. Clair  
Staff: Kris McElwee, Matt Niles, and Deb Burke

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