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In This Issue...

Bacteria On Steroids: A New Way To Make Water At Tilapia Farms Safer

By Tiffany Woods

Wilfrido Contreras-Sánchez, director of the biological sciences division at the Autonomous Juarez University of Tabasco in Mexico, scoops young tilapias out of a treatment tank where they are fed MT-laced feed to turn them into males (Photo by Tiffany Woods).

VILLAHERMOSA, Mexico—It's no secret that baseball stars, bodybuilders and cyclists have used steroids. Now it turns out that even bacteria get juiced.

Researchers in Mexico have found that three common species of bacteria have voracious appetites for methyltestosterone (MT), a potentially harmful steroid that fish farmers use to change the sex of tilapia. The discovery may eventually result in a safer environment for farm workers and nearby residents and wildlife. It has global implications given that tilapia is raised in more than 100 countries, according to the U.N. Food and Agriculture Organization.

Tilapia producers add methyltestosterone to the powdered food they dish out to large tanks of tiny tilapias called fry every day for three to four weeks to turn them into males. They want males because they grow faster than females and because having only one gender prevents reproduction. (Breeding makes the farmers' operation less cost-efficient.) The young tilapias swallow the steroid but then excrete it back into the water through their feces and urine.

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Fish biologist Wilfrido Contreras-Sánchez worries that MT residue might endanger the health of workers who wade into the water to scoop up juvenile fish. Also, many tilapia producers discharge the hormone-laced water from the tanks into streams, rivers, and lagoons where it might harm other fish and amphibians, said Contreras, who heads the biological sciences division at the Autonomous Juarez University of Tabasco where the bacterial research was conducted. Additionally, the health of local residents who swim in or wash clothes in these bodies of water might be at risk, he said.

Lucero Vazquez Cruz, a graduate student at the Autonomous Juarez University of Tabasco in Mexico, studies how bacteria can degrade the steroid, methyltestosterone (Photo by Tiffany Woods)

Contreras said little is known about how the use of MT in aquaculture might affect humans or wildlife. MT is an androgen and is prescribed to stimulate puberty in slow-developing adolescent boys and to treat breast cancer. The U.S. Food and Drug Administration has said that prolonged use of high doses of androgens has been associated with the development of liver cancer and that androgens may increase elderly people's chances of developing prostate cancer. High doses in women can lead to deeper voices, facial hair, acne, and irregular menstrual cycles, the FDA said.

Contreras hopes that the bacteria he studied will eliminate potential hazards if added in sufficient amounts to the water filters in the tanks where the tiny tilapias dine on MT. They're naturally present in all fish culture systems (particularly in the filters) but not in large enough quantities to degrade the hormone, he said.

In lab tests, he and fellow researchers found that *Pseudomonas fluorescens*, which spoils milk, and *Bacillus ceresus*, the culprit of food poisonings, each removed 99 percent of the hormone after 20 days in flasks. Another species, *P. aeruginosa*, which can cause rashes, pneumonia, bladder infections, and swimmer's ear and can even break down crude oil, devoured 97 percent of the hormone after 16 days in flasks.

Because the single-celled *P. aeruginosa* had multiplied rapidly in the lab, researchers selected it for the next leg of the experiment. They added billions of the bacteria to filters that used gravel and special plastic balls to clean the water of three 8,000-liter concrete tanks. The filters were inside plastic drums that stood on the edge of the tanks. Each tank held 5,700 young tilapias that were fed MT daily (The fish ate the MT before it was pumped through the bacteria-smothered water filters on the other end of the tanks).

The trial showed a trend toward lower levels of MT over time in the tanks where bacteria had been added versus the control tanks without bacteria, Contreras said.

He and his team plan to conduct more experiments to fine tune how many bacteria to use, what species or combination of species to use, and how long to let them feast, Contreras said. If the kinks are worked out, the university hopes to grow mass quantities of whatever bacteria are finally selected and then sell the microorganisms to tilapia producers in the form of a concentrate, he said.

MT aside, the researchers uncovered something unexpected in their experiment. The fish in the tanks with *P. aeruginosa* weighed more than those in tanks without the bacteria. Some species of bacteria in aquaculture systems enhance growth, and *P. aeruginosa* may be one of them, Contreras said. Also, lab tests found no diseases in the kidneys, livers or spleens, of fish raised in tanks with the bacteria. Because the bacteria are already ubiquitous and may be eaten by tilapia, Contreras doubts that they would cause any health problems, like infections, in people or fish.

Host Country Investigators Meet For The Impact Assessment Project Meeting in Seattle, WA

By Steve Buccola

Fourteen Host Country AquaFish investigators—two each from the seven Aquafish CRSP Projects—assembled at Seattle's Best Western Executive Inn during the week of 4–7 October 2010 to work on next steps in Aquafish CRSP's research discoveries and impacts. This Technology Discovery and Impact Assessment Project Meeting was part of AquaFish CRSP's "eighth" project, "Impacts of CRSP Research: Human Capital, Research Discovery, and Technology Adoption," headed by Steve Buccola and John Antle of Oregon State University. AquaFish investigator Roberto Valdivia of Montana State University managed the project meeting.

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Le Xuah Sinh of Can Tho University in Vietnam describes his work on the University of Connecticut's multifaceted project dealing with fisheries management, processing and marketing of small fish products, and snakehead aquaculture development in the Mekong River Basin (Photo courtesy of Steve Buccola).

Goings-on in the Pond...

The Southeast Asian Development Center (SEAFDEC) in Tigbauan, Iloilo, Philippines conducted training workshops on "Post-harvest and Marketing of Milkfish" to enhance women's role and visibility in aquaculture. The Provice of Iloilo is the country's major milkfish producing area; however, women traditionally have limited participation in the industry. In seeking a solution to this disparity, Dr. Evelyn Grace de Jesus-Ayson, the Head of the Research Division of SEAFDEC, conducted two training workshops in April 2010 for all-women participants. The one-day training workshops included lectures on "Harvest and Post-Harvest Handling Techniques" and "Market Potential and Marketing Techniques of Economically Important Marine Fish". Participants in these two workshops included housewives, students, and unemployed single women. Learn more about SEAFDEC at: www.seafdec.org/cms/

AquaFish CRSP graduate students, Nhuong Van Tran (Vietnam) and Rafael Martinez-Garcia (México)—who recieved the Borlaug LEAP Fellowship—participated in the World Food Prize 2010 at the Fourth Annual Iowa Hunger Summit on 12 October. Nhuong is using his fellowship to conduct his PhD research at Auburn University on enhancing trade opportunities for global fisheries markets. He is collaborating with Lead PI Robert Pomeroy of the University of Connecticut to integrate his research with the AquaFish CRSP research in Cambodia and Vietnam. Rafael recieved his PhD, having worked with Lead PI Kevin Fitzsimmons at the University of Arizona. His research focused on the development of shrimp-tilapia polyculture to mitigate shrimp disease transmissions. He looks forward to returning to Mexico to apply developments in aquaculture science to improve the livelihoods of poor fish farmers. Learn more about the World Food Prize at: www.worldfoodprize.org

The AquaFish CRSP Technical Reports have been posted online. This two-volume document contains full text reports of the investigations carried out under the *Implementation Plan* 2007– 2009. View this document at: aquafishcrsp.oregonstate.edu/publications.php

Women in Science and Engineering: Q&A with Gertrude Atukunda

Gertrude Atukunda with two young female scientists recording data at the Kajjansi Aquaculture Research and Development Center (KARDC) in Uganda (Photo courtesy of Gertrude Atukunda)

Gertrude Atukunda is a project leader for the AquaFish CRSP in her native country, Uganda, and a Research Officer in socio-economics with the Kajjansi Aquaculture Research and Development Centre (KARDC). The mandate of KARDC is to develop technologies and generate information through aquaculture research for improved aquaculture fish production, and to guide stakeholders in the planning, investment, and development of aquaculture. Her responsibilities center on designing and carrying out aquaculture socioeconomic studies among fisher communities. These studies investigate the contribution of fisheries—both capture and aquaculture—on livelihoods, economic viability, adoption of aquaculture technologies, markets, and marketing.

Atukunda knows first hand that measures of inequality persist throughout the world. Women's roles in Uganda's aquaculture industry—although evident in its success —is largely invisible. "Women battle with demonstrating that they can perform as well or even better than men, despite domestic demands and obligations", says Atukunda. "This is because… men are still the majority in leadership positions. They tend to perceive women as not able to perform well in certain aspects, especially due to negative perceptions about their reproductive roles".

"Once a woman manages to complete education, there is no discrimination, per se, because employment opportunities are equal for both men and women", she remarks. She herself received a Bachelors of Science Degree in Sociology from Makerere University, in Kampala, Uganda, and went on to get her Masters of Arts in Development Studies at Uganda Martyrs University Nkozi. Still, she adds, women tend to get overworked because they are less assertive, and therefore readily agree to take on duties that put more demands on their time. "For example", she adds, "maternity leave is a big toll on office work, especially if the position of the individual is so specialized and not easily substitutable".

As a representative woman in her field who has experienced these challenges, Atukunda was invited as a special guest to Auburn University for a gathering sponsored by the WISE Institute (Women in Science and Engineering Institute) for female graduate students in STEM (science, technology, engineering, and mathematics). This assembly allowed for informal discussions about the opportunities and the challenges women face in these disciplines. The gathering was held on 12 October 2010, just days after she spoke at Auburn University's seminar for "Socioeconomic Aspects of Aquaculture Development in Uganda". *Aquanews* got in touch with Atukunda over email to gain her perspective on the role of women in her field of study, the challenges women still face in Uganda and worldwide, and where women can go from here.

Q You just left the US after having spent a week traveling between Seattle, Washington and Auburn, Alabama. Overall, how was your experience on this trip?

A The trip was very inspirational. I felt honored for having been identified to attend the CRSP project meeting, in addition to meeting my research collaborators at Auburn University. I liked the opportunities that were availed to me to speak on two occasions (the seminar where I presented a paper and discussion group of which I was the guest speaker). Both opportunities made me feel special not just as a research scientist who was representing the project I am working on but also as a woman. I was re-energized to continue seeking excellence in my career. I was also inspired to further my work in promoting the education of disadvantaged girls through charity work, which I am involved in outside my official duties.

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...Women in Science continued from page 4

Q What are some of the biggest challenges faced by women in your field in Uganda?

A The main challenges faced by women in the science field stem from their reproductive roles which sometimes demand time that officially is meant for office and related field work. Responsibilities in the laboratory and field often require working beyond office hours. Some of the work also includes overseeing experiments that require 24-hour monitoring, and writing proposals, reports, and papers for publication. In order to make personal career accomplishments, most colleagues have often used time after official working hours to succeed in writing.

"Our culture is still strongly embedded with gender stereotyping and misconceptions about the potential role of women in the professional sphere. Although the situation is changing, women are continually under-represented in the science field"

Women also tend to be reluctant to take up long-term training courses that keep them away from their homes. This is because once they have a family (husband and children) they are sensitive and careful about consequences that may arise when they are away from their families. In addition, society does not expect a woman to be away from her marital home, which, however, seems to be normal for a man.

Our culture is still strongly embedded with gender stereotyping and misconceptions about the potential role of women in the professional sphere. Although the situation is changing, women are continually under-represented in the science field. This situation sends the wrong signal that the field is not actually for women.

Q How might this compare to challenges faced on a global scale?

A Globally, women face the same challenges but the magnitude differs across continents. Gender stereotyping, which places women in disadvantaged positions, tend to be more prevalent in developing countries than in the developed ones. For example, women are largely responsible for the domestic work in their homes. Therefore, women in the professional sphere must resort to employing house helpers who are usually uneducated girls or school dropouts, a situation that further puts women at a disadvantage.

Q How have women's roles in science and engineering changed since you first got involved?

A Most of the few women in the science field have become very successful and acted as role models to other women and young girls. There have been efforts to recognize women scientists through rewards in appreciation of their achievements. These rewards have been in the form of grants to further their careers and leadership promotion roles that increase their visibility and self esteem.

Q What more do you feel needs to happen to help women succeed in these fields of study?

A First, we must continue to create awareness among households in order to promote education of girls, and increase professional training opportunities for women so that they can compete favorably with male counterparts. This can be achieved by increasing availability of funding opportunities that focus on empowering women scientists—post graduate, short course, and project proposal funding. Increasingly, these efforts have led to attitude change. For example, at the Aquaculture Research and Development Centre, the ratio of female to male employment at the level of scientist (minimum of Masters Degree) has over time shifted from 1: 2 in 1999 to 1:1 in 2010. Specific efforts to mentor young scientists can also greatly help women in their fields of study. Also, young scientists should have opportunities for interacting on a professional level. Competitive research and writing grants coupled with meetings where young scientists can share results and learn from each other should be made available. Women should be given opportunities and encouraged to take up long-term career development courses in their earlier lives, before they get too engrossed in the social demands of the marital home.

Graduate Student Profile: Gladys Kuria

Gladys Kuria sets up an integrated culture system to study feed recycling in tilapia ponds at the Mwea Aqua Fish Farm (MAFF) (Photo courtesy of Gladys Kuria)

While it was a fond taste of fish that initially got Gladys Kuria fired up about aquaculture, press further and she'll tell you there is much to love about the industry. In her native home of Kenya, for instance, aquaculture has been known to generate jobs, provide food security, and improve nutrition. Her interest in science propelled Gladys to earn her undergraduate degree in Fisheries and Aquatic Science at Moi University in 2009. She is continuing on to pursue a masters degree with a concentration in aquaculture at Moi University under the guidance of her major professor, Dr. Charles Ngugi. Not only is this university known for its competence in teaching, the Cheploilel Campus at Moi University is the only university in Kenya that offers a masters program in aquaculture.

Her thesis work investigates the effects of stocking density on growth, survival and yield performance of Nile tilapia (*Oreochromis niloticus*) in an integrated cage-cum-pond culture system. This system integrates cage culture with semi-intensive pond culture where an artificial diet is fed only in the cages. Any feed that passes through the cage mesh that would otherwise be deemed "wasted" in turn serves as a source of food for the fish in the open ponds. Feed waste contributes to economic loss and nutrient loading in aquaculture systems, greatly challenging the success of small-scale commercial fish farming. Feed "recycling" in this system effectively addresses this problem by increasing the efficiency of food utilization.
The study is being conducted at Mwea Aqua Fish Farm (MAFF) in nine 1m^2 cages within a 1300m^2 earthen pond and stocked with hand-sexed male tilapia fingerlings (approximately 65 g) from the MAFF hatchery. The pond is stocked with 4 fish per m^2, and the cages have been randomly allotted three treatments with three stocking densities of 50, 75, and 100 fish per m^3. The study is currently underway with daily water quality testing and monthly fish growth monitoring. The intended outcome of this research is to identify opportunities to improve fish yield in culture systems that are economically feasible for the farmers. Gladys has the unique opportunity of directly applying her research methods to improve current operations run by small-scale fish farmers in Kenya. Says Kuria, "They are expected to adopt the finding to increase fish yield, generate more income, and in the long run improve their livelihood".

Having worked with AquaFish CRSP for over a year, Kuria identifies working with and training local farmers who are participating in the on-farm trials as some of the most enjoyable experiences in her work with the CRSP. "I am interested in community development", Kuria adds, "giving back to the community through extension services and helping farmers to write proposals that could provide funding for various activities that would be of help to them". Kuria plans to continue her studies in a PhD program, which will prepare her for a career in researching and lecturing on topics in aquaculture. In addition to one day becoming a professor in aquaculture, she ultimately dreams of establishing a fish farm of her own.

"The poor perception of aquaculture in Kenya's recent past has made it difficult to promote its development, as most potential investors are not convinced that aquaculture can be a profitable enterprise", states Kuria. "However, the government is recognizing that the subsector can play a key role in poverty alleviation of rural populations". Kuria is particularly thankful to the CRSP for supporting aquaculture in Kenya through research and funding of various projects, and for providing many students with the opportunity to get involved in this burgeoning field. Say Kuria, "They have given many students from developing countries—including me—a remarkable chance to further their studies"

Hooking Up Snooks: Research Attempts to Bolster Stocks of Lucrative Snooks, No Easy Task

By Tiffany Woods

A fisherman casts out a net in hopes of catching snooks off the gulf coast near Jalapita, Mexico (Photo by Tiffany Woods).

JALAPITA, Mexico—The facility is part fertility clinic, part singles bar. It's tucked away on the beach in the sleepy village of Jalapita on Mexico's gulf coast amid coconut trees that stretch for miles. Under a blue sky, swimming pools bubble like hot tubs as palm fronds rustle in the warm breeze and tropical birds chatter. In one pool, four glistening, slender bodies eye each other across the water, their libidos artificially primed to put them in the mood.

This is where snooks come to hook up.

The fish are part of an experiment that aims to boost their population. Scientists at the Autonomous Juarez University of Tabasco in Mexico are trying to use these wild fish as a broodstock to crank out juveniles in captivity. The university aims to sell fingerlings to fishermen-turned-fish farmers as a way to relieve fishing pressure on wild stocks. It also hopes to sell them to the government to release into coastal lagoons and rivers.

"We need to increase the population in the wild. They're overfished. There has also been a lot of habitat degradation from cutting down mangroves and from oil refineries and wells," says Kevin Fitzsimmons, a professor at the University of Arizona and former president of the World Aquaculture Society.

He's one of the participants in the snook project, which also involves Texas Tech University. The work is partially funded by the U.S. Agency for International Development through its AquaFish Collaborative Research Support Program, which is headquartered at Oregon State University.

This funny-named fish, known as *robalo* in Spanish, is the most expensive fish sold in Mexico City, according to the country's National Commission on Aquaculture and Fishing. Fishermen in Mexico earned more than $25 million for landing about 8,000 metric tons of snooks in 2008, making it the country's eighth most important aquatic product in terms of value, the commission reported.

Various species of snooks inhabit coastal waters, estuaries and lagoons from Florida to Brazil. A widespread one is the aptly named common snook, a silvery, streamlined, snouted carnivore with a dark lateral pinstripe and a bulldoggish underbite. These acrobatic fighters, which can reach 4 feet and 50 pounds, are highly prized by sport anglers. Fishermen in Florida and Texas used to catch snooks until those states banned commercial captures in 1957 and 1987, respectively, to protect the population.

"In Texas there's anecdotal evidence that they're making a comeback. Sport fishermen are finding them more often and in places where they didn't find them before," says Reynaldo Patino, the leader of the Texas Cooperative Fish and Wildlife Research Unit at Texas Tech University and one of the researchers involved in the project.

Efforts to influence what snooks do when no one is looking is complicated by their sexual plasticity. They're protandric hermaphrodites, meaning they can change from males into females. So far, researchers have had some success in getting them to breed in captivity, but getting their kids to eat has been a real head-scratcher.

"It's a challenge," says Wilfrido Contreras-Sánchez, the lead investigator and the director of biological sciences at the university in Tabasco that's conducting the research. "Not much is known about snooks. There are still many questions."

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To help answer those questions, he began contracting fishermen in Jalapita in 2006 to catch two species of snooks: fat and common. Researchers later injected some and implanted others with different doses of a hormone to induce spawning. They wanted to know which treatment and which dosage produced the most mature eggs and resulted in the highest rates of fertilization, hatching and larval survival. None of the injected fish released its eggs, and only some of the fish with the implanted hormonal pellets did.

Maria de Jesus Contreras Garcia, a graduate student helping conduct the research, suspects that stress, which can adversely affect reproduction, may be to blame. Human contact may have frazzled the fish because researchers injected the hormone into each of them on three different occasions, she says. They handled the fish with implants only once.

Snooks for sale at the market in Villahermosa, Mexico (Photo by Tiffany Woods).

On one occasion, Contreras Garcia wanted to know how much time would pass between implantation and spawning so she and a colleague chaperoned three fish for 24 hours. They slept in a hammock and sofa bed in a makeshift house on the beach and set an alarm to sound every hour so they could alternate shifts. With flashlight in hand, she'd groggily lumber to the holding tank and scan the water for eggs. No luck.

Other snooks did spawn though. Almost all of the eggs hatched. But the tiny fish, still in their larval stage, lived for just eight days and were only about as long as the thickness of three stacked dimes. Autopsies revealed empty bellies. The food they were given, although microscopic, was too big for their small mouths, Contreras-Sánchez says.

He thinks they might survive if fed the same diet that recently hatched wild snooks around Jalapita feast on. He plans to hire local fishermen to collect microscopic animal and plant plankton as well as snook larvae from nearby spawning grounds. Researchers will dissect their wee stomachs to see if the grub inside is the same as the collected plankton. They then hope to customize a recipe for a locavore diet that they can duplicate in mass quantities in the lab.

They'll also inspect snooks' stomachs, intestines and pancreases to identify enzymes that help digest their food. Certain enzymes break down certain substances, so if they can indentify the enzymes, they'll know what to feed the fish, Contreras Sanchez said. Additionally, they're continuing to refine their work with hormonal injections and implants to see if they get better results. And they've added a third species to their research, the Mexican snook.

About a mile up the road from the research facility, fisherman Ramon Dominguez Sanchez is eager for results. He's eating a mango from a tree in his dirt yard as two women scrub clothes by hand. A few feet away, one of his sons sits under the hood of a truck and replaces the fuel filter. It smells of gas.

The broad-shouldered, thick-necked, flip-flop-wearing Dominguez is the president of a fishing cooperative in Jalapita that would like to buy young snooks from the university, rear them and sell them. The sooner the co-op can do this the better because harvests, at least for him, are declining, says Dominguez, 54, who has been hauling in nets for 40 years. During the previous week he pulled in about $10 worth of fish but there wasn't a snook in the bunch, he says. So Dominguez wants to see the research succeed.

Perhaps it's this pressure to perform that's causing some of the snooks not to cooperate. Back at the beachside research station, the two couples that were checking each other out in the pool have lost interest. Apparently, they're just not that into each other. Researchers vow to keep trying though. Sometimes love just needs time.

...Impact Assessment in Seattle continued from page 3

The first day of the workshop was devoted to examining progress in selected AquaFish CRSP investigations and to reviewing the latest methods of research discovery and impact assessment. To allow focus on individual projects and investigations, breakout sessions and software exercises—alternated by plenary meetings for discussing common problems—were held on the second and third days. Plans for the coming year and a meeting with AquaFish CRSP management staff wrapped up the event.

Sunny Seattle weather greeted attendees at the Impact Assessment Project Planning meeting as they posed for a group photo (Photo courtesy of Steve Buccola)

AquaFish CRSP impact assessments, which complement evaluation efforts by individual AquaFish CRSP projects, actually involve assessing the research discoveries themselves, as well as evaluating the impacts on the economy, community, and environment. US and Host Country personnel discussed discovery assessment methods reviewed in Seattle including input-output characterization and estimation, and statistical methods for inferring and updating forecasts of future research results. Attendees also discussed impact assessment methods including identification of impact indicators, data needed for implementing minimum-data approaches, and useful software.

The 14 Seattle project meeting attendees will serve in the front line of AquaFish CRSP's impact assessment efforts, collaborating with other Host Country investigators in their respective projects. Attendees were, by project university: Remedios Bolivar and Evelyn Grace Ayson (North Carolina State University), Gertrude Atukunda and Khalid Salie (Auburn University), Eladio Gaxiola and Erick Sandoval (University of Hawai'i at Hilo), Wilfrido Contreras-Sánchez and Pablo Gonzalez (University of Arizona), So Nam and Le Xuan Sinh (University of Connecticut – Avery Point), Gao Zexia and Vu Cam Luong (University of Michigan), and Steven Amisah and Sebastian Chenyambuga (Purdue University). Oregon State University PhD student Lin Qin assisted with research discovery activities. Kwamena Quagrainie (Purdue University) and Emmanuel Frimpong (Virginia Polytechnic Institute), and Laura Morrison and Lisa Reifke of the AquaFish CRSP Program staff, were helpful observers.

Follow-up will take place at an impact assessment workshop to be held in conjunction with the AquaFish CRSP 2011 annual meeting in Shanghai, China.

PONDERINGS…

By Lao-Tzu

Go to the people
Live among them
Learn from them
Love them
Start with what they know
Build on what they have:
But of the best leaders
When their task is accomplished
Their work is done
The people all remark
"We have done it ourselves."

Notices of Publication

Notices of Publication announce recently published work carried out under AquaFish CRSP sponsorship. To receive a full copy of a report, please contact the author(s) directly. All past and current Notices of Publication can be found at: aquafishcrsp.oregonstate.edu/publications.php

Development of testis and digestive tract in longnose gar (*Lepisosteus osseus*) at the onset of exogenous feeding of larvae and in juveniles (10-261)

Marta Jaroszewska[1], Konrad Dabrowski[1] & Gustavo Rodríguez[1]

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The aim of this study was to describe the ontogenetic development of the testis and the alimentary tract in longnose gar (*Lepisosteus osseus*) related to fish size and age at the onset of exogenous feeding and late ontogenesis. Using light microscopy, testes were first detected histologically by the appearance of primordial germ cells 9 days after the first exogenous feeding [31-31.5 mm total body length (TL)] and presumptive seminiferous tubules (maleness characteristic) in fish of 107 mm TL. The present histological studies indicated that the alimentary tract of lepisosteids is completely functional at the beginning of exogenous feeding, several days before the completion of yolk absorption. Based on these results, we have concluded that garfish larvae/juveniles can be effectively trained to consume formulated diets at early stages, after an initial feeding of live food for 2-3 days (23.5 mm TL). Our findings provide evidence of the first controlled rearing of longnose gar using live and formulated diets, providing the possibility of experimental work with this non-teleost fish.

This abstract was excerpted from the original paper, which was published online in Aquaculture Research 41(10):1486–1497, 2010.

Aquaculture Research and Development as an Entry-Point and Contributor to Natural Resources and Coastal Management (NOP10-262)

Maria Haws[1], Brian Crawford[2], Maria Celia Portella[3], Simon Ellis[4], Narriman Jiddawi[5], Avitti Mmochi[5], Eladio Gaxiola-Camacho[6], Guillermo Rodriguez-Dominiguez[6], Gustavo Rodriguez[6], Julius Francis[7], Carlos Rivas LeClair[8], Agnes Saborio Coze[8], Nelvia Hernandez[8], Erick Sandoval[8], Marta Jaroszewska[9], & Konrad Dabrowski[10]

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Recent, fervent international dialogue concerning the existence and magnitude of impacts associated with aquaculture has had both positive and negative outcomes. Aquaculture stakeholders have become sensitized to requirements for improved environmental management of aquaculture. On the other hand, in some cases aquaculture development has been negatively affected by some of the unwarranted and unproved allegations to the detriment of the stakeholders most in need of aquaculture development (i.e., resource users, particularly the poor, who are dependent on natural resources). These resource users are targeted by, and directly influence biodiversity and conservation agendas; hence the need to understand how to gain their active participation. This discussion focuses on examples of how aquaculture research and development can be a useful tool or strategy

for resource management initiatives and provide tangible positive including increased stakeholder participation and cooperation, offering alternatives to resource extraction and use in otherwise difficult or intransigent resource management conflicts

This abstract was excerpted from the original paper, which was published online in Coastal Management, 38:238–261, 2010

Market Channel and Trade of Fermented Small-Sized Fish Paste in Cambodia (NOP10-263)

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Fermented small-sized fish paste is considered to be one of the main food sources for Cambodians, especially for the poor. However, most small-sized fish are used as direct feed for aquaculture or dried for animal feed. This study was conducted in order to identify market channel and trade of fermented small-sized fish paste. The city of Phnom Penh, Kendal, Kampong Chhnang, Battambang, and Siem Reap Provinces were selected as the study areas. The study revealed that there were three main sources of product, which should be considered when analyzing total volume of annual production. The total production of the fermented fish paste in 2007-2008 was around 6,659 tons, of which 50.18% was domestically consumed and 49.82% exported to Thailand and Vietnam. Marketing and trading differed according to trading sites, stakeholder characteristics, and fish species containing in the fermented fish paste.

This abstract was excerpted from the original paper, which was published online in the International Journal of Environmental and Rural Development 1(1):145–151, 2010.

Upcoming Meetings and Events...

The AquaFish CRSP is proud to support workshops and meetings designed to facilitate increased knowledge and communication in aquaculture. Meetings and workshops coming up include...

Aquaculture America 2011
28 February – 3 March, 2011
New Orleans, Louisiana
www.was.org/WasMeetings/meetings/Default.aspx?code=AA2011

ISTA 9 (International Symposium on Tilapia in Aquaculture)
21– 24 April 2011
Shanghai Ocean University
Shanghai, China
ag.arizona.edu/azaqua/ista/ISTA9/ISTA9.htm

9AFAF (Asian Fisheries & Aquaculture Forum)
21– 25 April 2011
Shanghai Ocean University (SHOU)
Shanghai, China
www.9AFAF.org

World Aquaculture 2010
6 – 10 June 2011
Natal, Brazil
www.was.org/WasMeetings/meetings/Default.aspx?code=WA2011

Fifth International Symposium on GIS/Spatial Analyses in Fishery and Aquatic Sciences
22– 26 August, 2011
Wellington, New Zealand
www.esl.co.jp/Sympo/5th/first_announcement.pdf

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