



## IN THIS ISSUE...

- Africa Day Conference in Uganda Focuses on Empowering Women, Boosting Nutrition 1
- Goings-On In the Pond 2
- PONDerings 3
- Research into Alternative Snakehead Feed Holds Promise for Relaxing Ban in Cambodia 4
- AquaFish Student Corner: Graduate Student Profile 6
- Collaborative Research Project in Bangladesh 7
- Notices of Publication 8
- Upcoming Meetings and Events 10



Polyculture ponds in Bangladesh  
(photo courtesy of Russell Borski)

## AFRICA DAY CONFERENCE IN UGANDA FOCUSES ON EMPOWERING WOMEN, BOOSTING NUTRITION

By Morgan Chow, AquaFish Innovation Lab



Makerere University PhD student E. Mastula shares her research experience at Makerere with conference attendees (photo courtesy of John Walakira).

Moving from business as usual to sustained and effective action to end hunger and malnutrition on the African continent is no easy feat. That's why the 2015 Africa Day for Food and Nutrition Security Conference brought together more than 400 participants from a wide range of organizations (national, regional, and continental) to focus on empowering women, securing food, and improving nutrition. Like AquaFish, the conference tries to overcome challenges associated with

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AquaFish Host Country Co-PI Dr. John Walakira at the Africa Day Conference (photo courtesy of John Walakira).

multisectoral work meant to improve nutrition and livelihoods of vulnerable communities.

Discussions at the meeting — held 28-30 October 2015 in Kampala, Uganda — aimed to stimulate stronger political and financial commitments that address regional challenges in food and nutrition insecurity.

AquaFish researchers played a valuable role at the conference this year. AquaFish HC Lead Project PI Dr. Theodora Hyuha of Makerere University in Uganda presented an overview on AquaFish research, while students Gidongo Halasi of Makerere University, Ben Kiddu of Auburn University, and Moureen Matuha of Auburn University presented posters on their research.

AquaFish Host Country Co-PI Dr. John Walakira of the National Fisheries Resources Research Institute (NaFIRRI) in Uganda said that, for him, the most interesting ideas shared at the conference pertained to the importance of placing women in leadership roles and decision-making positions and supporting innovations in “agricultural enterprises that improve household nutrition and income.” More specifically, Dr. Walakira said he was

*Africa continued on page 3...*

## Goings-On In the Pond...



AquaFish Host Country Lead PI and Associate Professor at Makerere University Dr. Theodora Hyuha and AquaFish Host Country Co-PI Dr. John Walakira, of Uganda’s National Fisheries Resource Research Institute, were both quoted in a story featuring their research on markets and marketing strategies for fish farmers in the Daily Monitor, an independent daily newspaper in Uganda. To read the story, go to <http://bit.ly/1Unex5x>

AquaFish researchers from the University of Connecticut recently published a policy brief article in Catch and Culture — the Mekong River Commission’s monthly newsletter on Fisheries Research and Development in the Mekong Region — Volume 21 (3) in December 2015. The article is titled, “Fish consumption among women and pre-school children in Cambodia”, by Drs. Touch Bunthang, So Nam, Chheng Phen, Pos Chhantana, En Net, and Robert Pomeroy. To read the story, go to <http://bit.ly/1Wu5ZIR>

AquaFish Host Country Lead Project PI Dr. Steve Amisah, has been promoted from associate professor to professor in the Department of Fisheries and Watershed Management at Kwame Nkrumah University of Science and Technology in Kumasi, Ghana.

With support from AquaFish projects, Bangladesh Agricultural University Research Office has developed a mechanism to provide contracts to other Bangladesh universities, signifying the growth of multi-institutional collaborations within Bangladesh.

...Africa continued from page 2.

drawn to discussions of diet diversification through bio-fortification and nutrient-dense diets.

Other major topics addressed at the meeting also closely aligned with AquaFish goals and current research investigations, including "Harnessing opportunities for production, access, and consumption of nutritious, safe, and diverse diets" and "Strengthening institutional capacities and systems, partnerships, and knowledge sharing for enhanced delivery of food and nutrition security interventions," said Dr. Walakira.

Matuha said she had a positive experience sharing her research on mobile phone use for aquaculture development in Uganda and that conference-goers "welcomed the innovative aspect of using mobile phones to enhance aquaculture development in Uganda," and that many asked when the app would be available so they could start using it.

According to Matuha, the app will focus on enhancing market access for users as farmers have indicated challenges with accessing markets for their harvested fish. Matuha said she believes that mobile phones will help to bridge a gap between the availability and delivery of both aquaculture inputs and outputs.

Overall, the meeting produced many action items for participating organizations: investing in and advocating for improved nutrition programs, creating partnerships with mutual accountability, building capacity and empowering women, and adopting climate-resilient agriculture. These items fall closely in line with goals of the 2014 Malabo declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods, an outcome of the 2014 African Union Summit in Malabo, Equatorial Guinea and a critical policy initiative for African economic growth and poverty reduction.



## PONDERINGS...

### OREGON STATE UNIVERSITY RESEARCHERS DISCOVER BACON- FLAVORED SEAWEED



*A close up of dulse seaweed at Hatfield Marine Science Center in Newport, OR. Photo by Stephen Ward, OSU Extension and Experiment Station Communication*

Oregon State University (OSU) researchers recently patented a new strain of red marine algae, known as dulse that grows quickly and is full of protein. It also tastes like bacon.

Dulse (*Palmaria* sp.) exists in the wild along both the Pacific and Atlantic coastlines, but OSU researcher Dr. Chris Langdon and colleagues have created and patented a new strain with the original goal of creating a super-food for abalone. This strain of dulse is an excellent source of minerals, vitamins, and antioxidants.

Not only did feeding dulse to the abalone result in tremendous growth rates, but dulse's potential for human food consumption has caught the attention of many. OSU faculty in the College of Business, OSU's Food Innovation Center in Portland, and many Portland-area chefs are currently working on developing new food products with dulse as the main ingredient.

According to these OSU researchers, dulse has twice the nutritional value of kale, it tastes like bacon when it is fried, and holds great potential for a new industry in Oregon.

To read more about dulse and OSU's involvement, go to <http://bit.ly/1HtllAQ>.

## RESEARCH INTO ALTERNATIVE SNAKEHEAD FEED HOLDS PROMISE FOR RELAXING BAN IN CAMBODIA

By So Nam, Chheng Phen, Nen Phanna, and Peter Starr, Inland Fisheries Research and Development Institute

The results of recent research in Cambodia and Vietnam on formulated feed for wild snakeheads show promise for reducing the demand for small fish for feed. Under a study funded by AquaFish, the Inland Fisheries Research and Development Institute (IFReDI) at Cambodia's Fisheries Administration has been developing indigenous broodstock for domesticated breeding of striped snakehead (*Channa striata*) and then weaning the fry with formulated feed developed by Can Tho University in Vietnam. The best results were seen with feeding 30-day-old fry at a rate that increased by 10 percent every three days, which resulted in lower cannibalism and higher survival of the fish at 60 days.

Although Cambodia has identified aquaculture as one of three pillars of the fisheries development in the country and has increased the national budget to boost production, aquaculture development remains constrained by a 10-year government ban on farming two snakehead species native to the Lower Mekong Basin. Cambodian and Vietnamese farmers typically feed these highly carnivorous fishes with catches of small, low-value freshwater fish that are otherwise consumed by the rural poor, hence the reason for the ban. The development of formulated feed as a substitute for these low-value fish is one of the conditions for lifting the ban on farming snakeheads, which are high-value species popular among Cambodians, especially on festive occasions.

IFReDI has now taken the formulated feed research a step further by extending feeding with the formulated feed until the snakeheads reach maturity, usually around six months. The experiment has involved about 400 individuals that are the first generation of 100 wild



AquaFish researcher Nen Phanna with formulated feed at the Freshwater Aquaculture Research and Development Centre in Prey Veng Province, Cambodia (photo by Lem Chamnap).

broodstock from Cambodia and 50 domesticated broodstock from Can Tho University. While the wild broodstock were unable to consume the formulated feed, their offspring had no problems. And as of June 2015, some of the females from both the domesticated and wild broodstock were already producing eggs, underlining the pressing need for pilot experimental farms for grow-out using the formulated feed.

The need to extend government research to commercial farms in Cambodia is highlighted by a new study on formulated snakehead feed by Can Tho University Vice Rector and AquaFish Host Country Co-PI Tran Thi Thanh Hien and her colleagues from the university's College of Aquaculture and Fisheries and the University of Rhode Island, U.S.

Published in *Aquaculture* in June of this year, the study involved a series of experiments

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over eight weeks to test formulated diets that replaced fish meal with soybean meal. Fish meal accounts for 33 percent of the formulated feed developed by Can Tho University and faced significant spikes in price last year, following a sharp decline in catches of anchoveta (*Engraulis ringens*), a major component of Peruvian fish meal for which Vietnam is the world's fourth-largest importer.

In the first experiment with striped snakehead, soybean meal substituted 0, 20, 30, 40, and 50 percent of the fish meal with or without the addition of phytase as a supplement (phytase is an enzyme that accounts for 0.02 percent of the university's formulated feed). The second experiment conducted the same tests with or without the addition of taurine, an amino acid important in the metabolism of fats. The two experiments showed that soybean meal could replace 30 percent of the fish meal without phytase or taurine and 40 percent if the enzyme or an amino acid supplemented it. A third experiment with Indonesian snakehead (*Channa micropeltes*) showed that soybean meal also could replace 40 percent of the fish meal when supplemented by phytase. When compared with fish fed on fish meal alone, the study indicated that diets using soybean meal as a replacement could reduce the cost of feed by almost 12 percent in terms of 1 kilogram of weight gain.



An AquaFish snakehead research pond at the Freshwater Aquaculture Research and Development Centre in Prey Veng Province, Cambodia (shown left) and snakehead weaning (above) (photos by Lem Chamnap).

Dr. Hien and her colleagues also have carried out research using locally available rice bran and cassava meal to replace both fish and soybean meal in the diets of striped snakehead. In the first experiment, a mixture of rice bran and cassava meal replaced 0, 10, 20, and 30 percent of the fish and soybean meal. No differences in survival or growth were found, except that fish fed with the replacement diet of 10 percent had faster growth than the control group. In the second experiment, rice bran and cassava meal supplemented with the enzyme alpha-galactosidase were used as a substitute for 0, 50, 60, and 70 percent of the fish and soybean meal. The third experiment used the same rates of substitution with a feeding attractant solution. In both cases, the optimal replacement rates were 70 percent for growth, 60 percent for food conversion ratio, and 50 percent for protein efficiency and economic benefits.

These research findings suggest that using alternative feeds rather than threatened, low-value freshwater fish is a viable option for snakehead aquaculture. Using soybean, rice bran, and cassava meal for snakehead culture not only contributes to lifting the Cambodian ban on snakehead farming but also may provide significant cost savings to farmers throughout the region.



## AQUAFISH STUDENT CORNER

### GRADUATE STUDENT PROFILE: PUTHEARATH TITH

By Susannah L. Bodman,  
AquaFish Innovation Lab

Declining annual fish catches in capture fisheries drew Puthearath Tith, a graduate student at Royal University of Phnom Penh, Cambodia, to the world of aquaculture, which she sees as playing a key role in addressing gaps in food and nutrition security in the future.

Puthearath Tith, who hails from Takeo Province in Cambodia, is working toward a Master's degree in biodiversity conservation with support from AquaFish Innovation Lab. Her thesis is titled: "Assessment of Fish Species Diversity in Tonle Sap Great Lake in Cambodia."

"Tonle Sap Great Lake is one of the largest lakes in Southeast Asian countries containing over 500 fish species," she said. "Cambodia's geography is dominated by the Mekong River, which is more than 500 kilometers in length, and the Tonle Sap Great Lake is its heart. The country is rich in natural resources of all kinds, especially fisheries."

So far, her research activities have included assessments of food-fish preferences in 120 households in three communes (one each) in Cambodia's Kratie, Pursat, and Battambang provinces.

The assessments found that carp (*Gymnostomus* sp.) is the most-consumed species of captured fish in Kratie and Pursat, while three spot gourami (*Trichopodus trichopterus*) and catfish (*Mystus* sp.) are consumed in Battambang. Farmed fish species also are on the menu, with mostly the African sharptooth catfish (*Clarias gariepinus*) consumed in Kratie, shark catfish (*Pangasius djambal*) in Pursat and striped snakehead (*Channa striata*) in Battambang.

The huge variety of fish and aquatic organisms in Cambodia gives local consumers a chance



Puthearath Tith at her Bachelor's graduation ceremony (photo courtesy of Puthearath Tith).

to develop favorites and avoid eating species they don't like, Puthearath Tith said. Many people also favor farmed fish, "so it can help to increase the number of fish and aquatic organisms ... to suit the current needs of the society."

As for her research on Tonle Sap Great Lake, Puthearath Tith is aiming to be finished around December 2017.

"This study will look at something quite different from my previous work," she said. "It will come up with fish species richness and catch composition — that information will help in the selecting of species for aquaculture development in Cambodia."

Currently, Cambodian aquaculture uses mainly exotic species that can harm natural fish stock, she said.

And exploration of Cambodia's diverse aquatic species is an area of critical focus.

"Biodiversity plays a key role in maintaining the natural cycles and ecological balance," she said. "At present, multiple factors, including population growth, climate change, overfishing, hydropower dam development in mainstream Mekong, etc., are likely to have potential impacts on biodiversity in Mekong River and Tonle Sap area, especially on fisheries resources."

As for her involvement with AquaFish, Puthearath Tith has been supported since June 2013 and

*Graduate continued on page 7...*

## AQUAFISH STUDENT CORNER

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Puthearath Tith analyzes samples in her lab (photo courtesy of Puthearath Tith).

earned a Bachelor's degree in fisheries science from Cambodia's Royal University of Agriculture in September of that year. She also received a general English program degree from the Australian Centre for Education in 2014.

The most enjoyable part of her AquaFish connection has been in achieving a "better outcome and experiences from my previous research," she said.

However, challenges do lie ahead for aquaculture in Cambodia, including the high costs of artificial fish feed and electricity, Puthearath Tith said.

Relating to her thesis research, Puthearath Tith is interested in developing scientific capacity in Cambodia — an effort she said is "crucial to the long-term sustainability of essential ecosystems services and broader development goals for" the nation. She is also drawn to the "study of the impacts of Mekong hydrology dams development on fishery resources; fish habitats; and food and nutrition security in poor rural areas..."

As for the future, Puthearath Tith plans to stick with fisheries and aquaculture.

"I am planning to do more research in fisheries (fish genetics, fish population dynamics, fish habitats) and aquaculture (indigenous fish species [which are] commonly consumed) after graduation of my Master's degree," she said.



## COLLABORATIVE RESEARCH PROJECT IN BANGLADESH

By Morgan Chow, AquaFish Innovation Lab



Farmers harvest fish in a Bangladesh pond (photo courtesy of the AquaFish Innovation Lab).

USAID is supporting a range of innovative intervention models that combine investments in aquaculture or horticulture to address chronic undernutrition, a major constraint to development in many countries. Involving the Nutrition Innovation Lab, the Horticulture Innovation Lab, the USAID mission, USAID international partners, and other program partners, the project aims to generate lessons of integrated aquaculture and horticulture for improved income and dietary improvements.

AquaFish Innovation Lab has been asked to play an advisory role on the project, which was launched in nine rural communities in Bangladesh in November 2014. AquaFish Director Dr. Hillary Egna gave two presentations on aquaculture in Bangladesh and the surrounding Asia-Pacific region at the project's launch in Dhaka and has continued to serve on the technical advisory panel reviewing the proposals and technical plans for the project.

Dr. Egna has promoted the development of low-tech cold storage products as well as innovative methods for drying small fish for preservation. However, Dr. Egna recommended against the development of floating gardens on ponds for biosecurity, profitability, and environmental reasons. AquaFish hopes that collaborative research efforts across innovation labs will continue in the future to address overlapping concerns for global food security.



## Notices of Publication

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### **Assessment of farmed tilapia value chain in Ghana (15-351).**

Gifty Anane-Taabeah<sup>1</sup>, Kwamena Quagraine<sup>2</sup>, and Steve Amisah<sup>1</sup>.

1. Department of Fisheries and Watershed Management, Faculty of Renewable Natural Resources, Kwame Nkrumah University of Science and Technology, PMB KNUST, Kumasi, Ghana, West Africa.

2. Department of Agricultural Economics, Purdue University, 403 W. State Street, West Lafayette, IN 47907-2056, USA.

The study assessed the value chain of farmed tilapia in Ghana. A survey conducted in 2012 provided data on key actors, flow of products and information, costs and margins, and relationship among actors. The study showed that all key actors in the value chain: input suppliers; fish farmers; traders; and food services had positive margins except fish farmers. Input suppliers accrued most of the margins generated along the chain. The performance of chain actors was assessed using a factor evaluation matrix, which showed that product offering may be the strength at each stage of the value chain. The efficiency and profitability of tilapia value chain in Ghana can be improved by having well-defined payment transaction with customers, persistent relationships with customers, and good information management such as keeping good records on costs and revenues. Fish farming could be more profitable if farmers reduced their variable costs, priced their fish using a cost plus or percentage markup approach, and adopted target marketing.

This abstract was excerpted from the original paper, which was published in *Aquaculture International* (2015), DOI 10.1007/s10499-015-9960-1.

### **Does climate change matter for freshwater aquaculture in Bangladesh? (15-352).**

Nesar Ahmed and James S. Diana.

School of Natural Resources and Environment, University of Michigan, Ann Arbor, MI 48109, USA.

Freshwater aquaculture plays an important role in the economy of Bangladesh, providing food, income, livelihoods and export earnings. However, freshwater aquaculture in the Mymensingh area of north-central Bangladesh has been accompanied by recent concerns over climate change. Field survey revealed that different climatic variables including flood, drought, rainfall variation and temperature fluctuation have had adverse effects on pond-fish culture. These climatic variables have detrimental effects on the ecosystem of ponds and thus affect survival, growth and production of fish. Changes in climatic variables have adverse effects on fish reproduction, grow-out operation, parasite infestation and disease occurrence. Considering vulnerability to the effects of climate change on pond-fish culture, we propose adaptation strategies that need to be introduced to cope with the challenges.

This abstract was excerpted from the original paper, which was published in *Regional Environmental Change* (2015), 1-11.

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### **A study of using crude bromelain enzyme in producing salty fermented fish product from commercial snakehead fish (15-353).**

Truong Thi Mong Thu, Nguyen Thi Nhu Ha, and Tran Thi Thanh Hien.

College of Aquaculture and Fisheries, Can Tho University, Vietnam.

The study of using crude bromelain enzyme in producing of salty fermented fish product from commercial snakehead fish was conducted from March to November 2014 at college of Aquaculture and Fisheries of Can Tho University with two main experiments (i) the effect of mechanical handle on proximate composition and texture property of product (ii) effect of supplementing crude bromelain enzyme at different rates and different fermentation times on product quality. In the first experiment, snakehead was applied [by] mechanical handle for 10 minutes and soaked with salt for 5, 10, 15, 20, 25 and 30 days.

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In the control group, fish were not applied [by] mechanical handle and soaked with salt for 30 days. In the second experiment, salty snakehead fish was supplemented with 2, 3, 4 and 5% of crude bromelain and fermented for 2, 4, 6, and 8 weeks. The control group was done without crude bromelain addition and fermented for 8 weeks. The results in the first experiment indicated that the group with mechanical handle snakehead fish and soaked with salt for 20 days gained the highest proximate composition (salt content 20.62%, moisture content 55.53%, protein content 18.94%) and hardness (20091 g force). In the second experiment, salty snakehead fish of 20 days was fermented with 3% crude bromelain and fermented for 6 weeks provided high proximate composition (20.67% of salt, 56.45% of moisture, 19.79% of protein, 8.02 mg total amino acids, 10-2 g fermented fish) and hardness (16607 g force) and had higher sensory score (color: 6.13, aroma: 6.07, taste: 6.00, and overall: 6.20) (1: extremely undesirable and 7: extremely desirable) in comparison with control group. Therefore, applying of crude bromelain enzyme can shorten the processing period of the salty fermented snakehead fish product and still ensures quality on nutrition and sensory quality compared with traditional methods.

This abstract was excerpted from the original paper, which was published in *Science and Technology Journal of Agriculture and Rural Development* (2015), ISSN 1859-4581.

#### **Quality Enhancement of Dried Snakehead Fish (*Channa striata*) by Supplementing Wine and Glycerol (16-354).**

Ha Thi Nhu Nguyen, Truong Thi Mong Thu, and Tran Thi Thanh Hien.

College of Aquaculture and Fisheries, Can Tho University, Vietnam.

The quality and safety of dried snakehead fish (*Channa striata*) on the local markets in Vietnam could not be controlled recently. Therefore improvement of this former processing is necessary concerned and conducted in order to obtain high quality of dried fish products as well as long-term storage to meet the diversified consumer taste. The study aims not only to assess the properties of dried snakehead fish (with sucrose addition) based on supplementing wine (30%) and glycerol into fish muscle but also to enhance the quality of dried fish products. Total plate count, chemical indices, and organoleptic evaluation were recorded to exam

the changes of dried snakehead fish corresponding to 1, 2 and 3% (w/w) of wine (30%) addition. Then, the effects of adding glycerol (0, 1, 2, 3%, w/w) on dried snakehead fish with 2% of wine (w/w) were surveyed over a period of four weeks. As compared to the other treatments, addition of 2% (w/w) of glycerol and 2% (w/w) of wine (30%) to dried fish illustrated the highest sensory properties and the lowest parameters of total plate count, moisture content, water activity, peroxide value, total volatile base nitrogen in four weeks. In addition, these analyzed parameters were within acceptable limits. Therefore, the quality and safety of dried snakehead fish were obtained during storage time. The proximate composition of raw snakehead fish and dried products were also studied. The results showed that moisture, protein, lipid, ash and sodium chloride content of raw snakehead fish were 78.1, 18, 2.5, 1.14, 0.73% respectively, whereas those of dried products with wine and glycerol addition were 29.4, 58.9, 5.54, 5.49, 4.56%.

This abstract was excerpted from the original paper, which was published in the *Journal of Agriculture and Rural Development* ISSN 1859-4581 (2016), 1:74-84.

#### **Leptin stimulates hepatic growth hormone receptor and insulin-like growth factor gene expression in a teleost fish, the hybrid striped bass (16-355).**

Eugene T. Won, Jonathan D. Douros, David A. Hurt, and Russell J. Borski.

Department of Biological Sciences, North Carolina State University, Raleigh, NC, USA.

Leptin is an anorexigenic peptide hormone that circulates as an indicator of adiposity in mammals, and functions to maintain energy homeostasis by balancing feeding and energy expenditure. In fish, leptin tends to be predominantly expressed in the liver, another important energy storing tissue, rather than in fat depots as it is in mammals. The liver also produces the majority of circulating insulin-like growth factors (IGFs), which comprise the mitogenic component of the growth hormone (GH)-IGF endocrine growth axis. Based on similar regulatory patterns of leptin and IGFs that we have documented in previous studies on hybrid striped bass (HSB: *Morone saxatilis* × *M. chrysops*), and considering the co-localization of these peptides in the liver, we hypothesized that leptin might regulate the endocrine growth axis in a manner that helps coordinate somatic growth with energy availability. Using a HSB hepatocyte culture system

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to simulate autocrine or paracrine exposure that might occur within the liver, this study examines the potential for leptin to modulate metabolism and growth through regulation of IGF gene expression directly, or indirectly through the regulation of GH receptors (GHR), which mediate GH-induced IGF expression. First, we verified that GH (50 nM) has a classical stimulatory effect on IGF-1 and additionally show it stimulates IGF-2 transcription in hepatocytes. Leptin (5 and/or 50 nM) directly stimulated in vitro GHR2 gene expression within 8 hrs of exposure, and both GHR1 and GHR2 as well as IGF-1 and IGF-2 gene expression after 24 hrs. Cells were then co-incubated with submaximal concentrations of leptin and GH (25 nM each) to test if they had a synergistic effect on IGF gene expression, possibly through increased GH sensitivity following GHR upregulation by leptin. In combination, however, the treatments only had an additive effect on stimulating IGF-1 mRNA despite their capacity to increase GHR mRNA abundance. This suggests that leptin's stimulatory effect on GHRs may be limited to enhancing transcription or mRNA stability rather than inducing full translation of functional receptors, at least within a 24-h time frame. Finally, leptin was injected IP (100 ng/g and 1 µg/g BW) to test the in vivo regulation of hepatic IGF-1 and GHR1 gene expression. The 100 ng/g BW leptin dose significantly upregulated in vivo IGF-1 mRNA levels relative to controls after 24 hrs of fasting, but neither dosage was effective at regulating GHR1 gene expression. These studies suggest that stimulation of growth axis component transcripts by leptin may be an important mechanism for coordinating somatic growth with nutritional state in these and perhaps other fish or vertebrates, and represent the first evidence of leptin regulating GHRs in vertebrates.

This abstract was excerpted from the original paper, which was published in *General and Comparative Endocrinology* (2016), doi: <http://dx.doi.org/10.1016/j.ygcen.2016.02.003>.

## Parting shot



AquaFish research pond in Tanzania (photo by Dr. Hillary Egna).



## Upcoming Meetings and Events...

### International Symposium on Tilapia in Aquaculture

26-29 April 2016

Surabaya, Indonesia

[www.ag.arizona.edu/azaqua/ista/ISTA11/ISTA11.htm](http://www.ag.arizona.edu/azaqua/ista/ISTA11/ISTA11.htm)

### Asian-Pacific Aquaculture 2016

26-29 April 2016

Surabaya, Indonesia

[www.marevent.com/APA2016\\_INDONESIA/APA16%20Reg%20Bro%206-22.pdf](http://www.marevent.com/APA2016_INDONESIA/APA16%20Reg%20Bro%206-22.pdf)

### International Institute of Fisheries, Economics, and Trade Conference 2016

12-15 July 2016

Aberdeen, Scotland

[www.iifet-2016.org/](http://www.iifet-2016.org/)

### 11th Asian Fisheries and Aquaculture Forum, Asian Fisheries Society

3-7 August 2016

Bangkok, Thailand

[www.asianfisheriessociety.org/events.php](http://www.asianfisheriessociety.org/events.php)

### 6th Global Symposium on Gender in Aquaculture and Fisheries

3-7 August 2016

Bangkok, Thailand

[www.genderaquafish.org/](http://www.genderaquafish.org/)

### LACQUA16

28 November — 1 December 2016

Lima, Peru

[www.marevent.com/LACQUAA2016\\_PERU.html](http://www.marevent.com/LACQUAA2016_PERU.html)

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