AQUANEWS

Sustainable Aquaculture and Fisheries for a Secure Future

AquaFish Collaborative Research Support Program Newsletter

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In this Issue...

Kenya, July 2012. Photo by Hillary Egna

Development of More Sustainable Practices for the Culture of Gars and Other Air-Breathing Fish

By James Diana, Wilfrido Contreras-Sanchez, and Solomon David

*Juvenile Cuban gars (*Atractosteus tristoechus*) used in the AquaFish CRSP air-breathing fishes investigations at University of Michigan. Photo courtesy of Solomon David.*

As global climate change continues to take its toll on aquatic ecosystems by means of increased temperatures, water quality degradation, and habitat loss, the value of air breathing fishes to sustainable aquaculture is becoming more and more apparent. Air-breathing fishes are adapted for survival in low-oxygen and aquatic environments with poor water quality, presenting advantages for culture over many conventional aquatic species. Gars are a group of ancient air-breathing fishes (family Lepisosteidae) characterized by their elongate jaws, cylindrical bodies, and diamond-shaped ganoid scales. They are top-level predators in their native ecosystems, with 7 extant species ranging from southern Canada to Costa Rica. Although traditionally viewed as "trash" or "rough" fish in most of North America, gars are popular food fish in regions of Central America and the southern United States, and are increasing in popularity in the aquarium

"Air-breathing fishes present unique opportunities for sustainable aquaculture in the face of global climate change and limited natural resources."

Gars continued on page 2...

...Gars continued from page1.

trade. Sustainable aquaculture of gars has therefore become increasingly important for local food production, the aquarium trade, and conservation of biodiversity by maintaining wild populations. In April of 2011, AquaFish CRSP Director Dr. Hillary Egna organized a symposium in Shanghai, China focused on air breathing fishes as a way to initiate a suite of new investigations. This work on Gars is one of the three current investigations continuing this innovative work.

Gars are excellent candidates for aquaculture as they exhibit rapid growth to large sizes, are highly resistant to disease, can be maintained at high densities, readily adapt to artificial feed at early life stages, and are highly tolerant of low water quality conditions due to their air-breathing abilities. Their tolerance of low water quality and air breathing adaptations also allows for less expensive technological systems for aquaculture, as opposed to other fishes which may require considerable aeration and water turnover. Gars are therefore well-suited for culture in developing regions. The major exception to this is their carnivorous nature and usual demand for high protein fish meal in their feed.

Much progress has already been made in the aquaculture of Atractosteus gars (tropical gar *A. tropicus,* Cuban gar *A. tristoechus*, alligator gar *A. spatula*), primarily in their native regions of Mexico, Cuba, and the southern United States. Broodstock for all three species have been established and are currently maintained in their native regions, and juveniles have been released to help restock diminishing wild populations. Further efforts are being made in the southern US to protect alligator gar populations and manage them as a viable sport fishery, as well as increase its potential as a food fish.

Due to their unique appearance and predatory nature, gars are becoming increasingly popular in the ornamental fish trade; they have been a sought-after aquarium fish in Southeast Asia for many years, and are growing in popularity in the United States and other countries. Gar species cultured in Central America (tropical and Cuban gars) command a high price largely due to their rarity in the aquarium hobby. Prices in the United States can reach $200 USD for an individual tropical gar and over $300 USD for a Cuban gar. Tropical and Cuban gars are also highly valued overseas; in Singapore where 15 cm tropical gars average $150 USD and Cuban gars $400 USD.

In its efforts to successfully culture tropical gars for food and restock wild populations, Mexico has greatly increased the body of knowledge surrounding gar biology, ecology, and aquaculture. In contrast, little information is available on the culture of Cuban gars, and relatively few papers on either species have been published in the scientific literature. Even with the progress over the past two decades, there still remains much to be learned and developed for successful and sustainable gar culture. Continued research on various aspects of gar biology and ecology provides a better

Solomon David (University of Michigan) with a broodstock tropical gar (Atractosteus tropicus) at a local gar farm in Tabasco, Mexico. Photo courtesy of Solomon David.

understanding of their role in native ecosystems and can better inform conservation efforts.

Under the AquaFish CRSP Air-breathing Fishes investigations, University of Michigan (UM) and Universidad Juarez Autonoma de Tabasco (UJAT) researchers are further developing sustainable practices for gar culture. Drs. James Diana, Solomon David, and Wilfrido Contreras-Sanchez have collaborated on tropical and Cuban gar culture with 4 major experimental studies:

1. Utilize fish meal substitution using agricultural by-products to develop more sustainable feed (treatments 25, 50, 75 and 100% substitution).
2. Determine optimal densities for rearing tropical gars (treatments 25, 50 and 100 fish/m3).
3. Determine success of closed and recirculating filtration systems on water quality and growth (treatments closed and recirculating systems).
4. Determine the effect of salinity on growth (treatments salinity 0 ppt, 5 ppt).

The goal of this investigation is the development of more sustainable practices for gar culture and aquaculture for air-breathing fishes in general. Further, we hope to apply the results of our findings to current and new operations in developing countries. Culture of tropical and Cuban gars is directly beneficial to their respective regions as a local

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...Gars continued from page 2.

source of protein, additional revenue to farms from sales to the ornamental fish trade, and restocking local wild populations to help conserve biodiversity.

The use of fish meal in feed for farmed fishes is one of the major criticisms of aquaculture, therefore reduction of fish meal in feed is a major step toward improved sustainability. Because gars readily convert to non-live, pelletized feed, they are ideal candidates for fish meal substitution experiments. Researchers at UJAT developed experimental feeds substituting fish meal with beef by-products at different ratios to investigate more sustainable culture and growth of gars. Initial results for both tropical and Cuban gars indicate that growth did not significantly differ among treatments, suggesting that gars can maintain previously established growth rates even on low or zero-fish meal diets.

Because gars are air-breathers they should perform well in completely closed recirculating systems, potentially using less water for culture. Gars may also be cultured in systems with reduced or no additional aeration, further reducing energy consumption. Our experiments on recirculating and filtered systems begin to address the potential of reducing water and energy use in the culture of gars. Additionally, several gar species have been shown to have moderate to high salinity tolerances (compared to other freshwater fishes), and in some cases have shown improved growth under saline conditions. Furthermore, gars from different latitudes may exhibit different growth rates (latitudinal variation) therefore specific populations may be better than others as candidates for culture in certain locations. By comparing our growth models with those from other regions (specifically with the wide-ranging tropical gar) we can identify populations with the highest capacity for growth and production in culture. This could be incorporated into existing operations to increase efficiency, sustainability, and production, as well as making the technology for gar culture more accessible to developing regions.

Investigators from both UM and UJAT recently had the opportunity to meet and collaborate with gar researchers from several other countries at the 4th International Meeting on Lepisosteid Research and Management, which was hosted by UJAT in June 2012. Investigators from Mexico, Cuba, Costa Rica, and the United States were able to share current research and discuss ideas for gar culture and conservation. The AquaFish CRSP research was shown to be at the forefront of gar culture research, with methods and preliminary results from these experiments enthusiastically received at the conference.

Air-breathing fishes present unique opportunities for sustainable aquaculture in the face of global climate change and limited natural resources. The AquaFish CRSP's initial investigations into air-breathing fishes have led to results that will inform sustainable aquaculture practices in a changing environment.

To learn more about the AquaFish CRSP air breathing fishes work, please see the article on page 4 of the Spr 2012 Issue of Aquanews.

AquaFish CRSP investigators Solomon David (University of Michigan), Mar Contreras (UJAT), and Rafael Martinez (UJAT) discuss gar culture methodology at the 4th International Meeting on Lepisosteid Research and Management held at UJAT in June 2012.
Photo Courtesy of Solomon David.

AquaFish CRSP & IIFET Tanzania: An Outstanding Collaboration!

By Ann Shriver

The successful sixteenth biennial conference of the International Institute of Fisheries Economics & Trade (IIFET), held in Dar es Salaam, Tanzania on 16-20 July 2012, was heavily supported by the AquaFish CRSP in several important ways.

The conference title, IIFET 2012 Tanzania, Visible Possibilities: The Economics of Sustainable Fisheries, Aquaculture and Seafood Trade reflected the general theme of revealing the hidden possibilities of fisheries in all areas of the world, with particular emphasis on Africa and other developing regions. Participants reflected on the 'goods and services' that fisheries and aquaculture provide to human society – that the objectives of fishery management and aquaculture development are to provide contributions to human wellbeing – whether through macro-economic growth (resource rents, trade revenues), small-business profit, wage labor, or nutritious food.

Over 295 presentations were made during the 3½-day conference, in 17 pre-organized "Special" sessions and 20 regular parallel sessions, a poster session, and 4 plenary sessions. Topics included a wide variety of issues related to the economics and development of the fishing and aquaculture sectors, at all scales, and in all regions of the world.

Over 290 participants from 53 countries attended the conference, a higher diversity of represented countries than ever before! 37% of participants came from Africa, 15% from the Asia/Pacific region, 18% from North America, 28% from Europe, and 2% from South America and the Caribbean.

This increase in diversity of participation was due in part to the generous support of donors, including the AquaFish CRSP. Seventy four individuals received varying levels of support for their participation, including 5 prize winners. Of these, 8 awardees and one prize-winner received CRSP support.


FISHERIES Participants closely following discussions at the meet

Participants attending the 16th Bi-annual Conference on Fisheries Economy and Trade listen attentively to discussions in Dar es Salaam yesterday. PHOTO| VENANCE NESTORY

Two CRSP participants at IIFET, May Myat Noe Lwin and Wilfried Jamandre were featured on page 3 of The Citizen, the local newspaper as part of the article titled, "The paradox of Tanzania's fishing industry," which appeared on the front page on 18 July. Citation: Nestory, Venance. 2012. The Citizen, Dar es Salaam. 18 July. No. 2522: p.3.

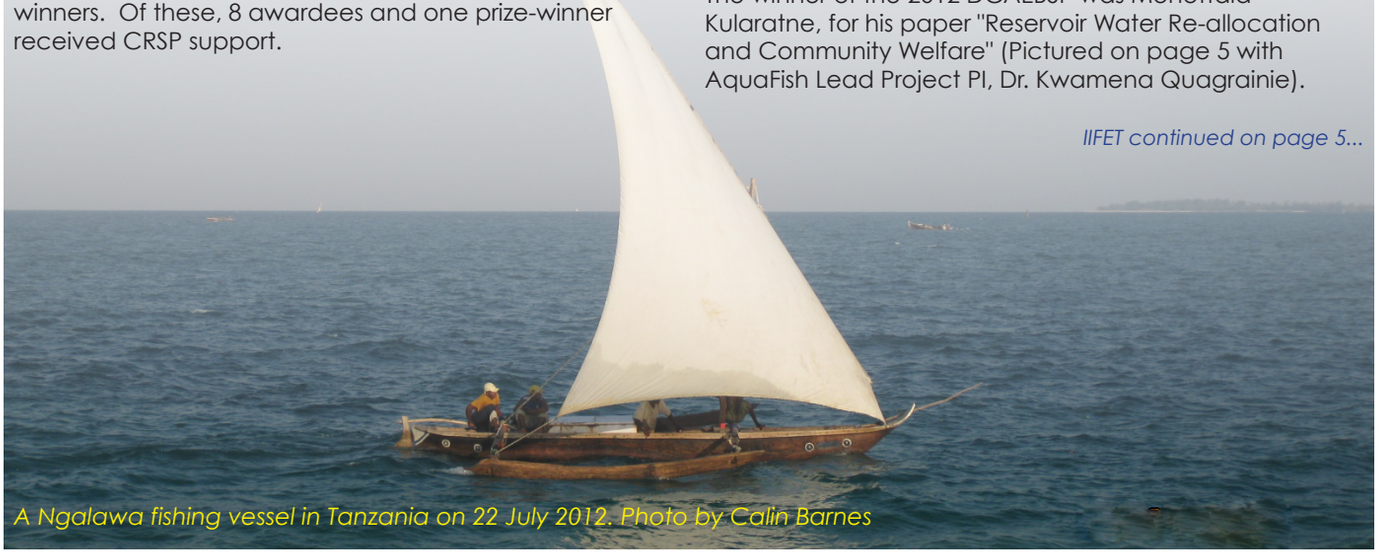
CRSP-Supported Participation:
The following individuals received support from CRSP that enabled their participation in the IIFET 2012 Tanzania Conference:

Dr. Ayanboye Abolupe Oluyemi, Nigeria
Dr. Mohan Chadag, Thailand
Ms. Trang Le Thi Huyen, Viet Nam
Dr. Didi Baticados Philippines
Dr. Daniel Adjei-Boateng, Ghana
Dr. Harrison Charo-Karisa, Kenya
Dr. Charles Gaspar Mahika, Tanzania
Ms. Ritha Maly, Tanzania

In addition, some 20 CRSP members from projects around the world attended as participants of IIFET 2012 as well as a pre-conference CRSP workshop on value-chain assessments held in Zanzibar (highlighted on page 7).

The Developing Country Aquaculture Economics Best Student Paper (DCAEBSP) Prize.
The winner of the 2012 DCAEBSP was Mohottala Kularatne, for his paper "Reservoir Water Re-allocation and Community Welfare" (Pictured on page 5 with AquaFish Lead Project PI, Dr. Kwamena Quagrainie).

IIFET continued on page 5...


A Ngalawa fishing vessel in Tanzania on 22 July 2012. Photo by Calin Barnes

...IIFET continued from page 4.

2012 DCEABSP award winner, Mohottala Kularatne with CRSP Lead Project PI, Kwamena Quagrainie.

This paper analyzed the development of culture fisheries in small scale irrigation systems in Sri Lanka, and whether the diversion of water to aquaculture activities from less efficient uses in rice farming would increase the total economic welfare of the farming community.

Participant Benefits

All funded participants expressed great pleasure and gratitude to the AquaFish CRSP, IIFET, and the University of Dar es Salaam for making their participation possible. Participants reported that the benefits they derived from the conference included:

- Receiving review comments and input by global experts in their fields on their research projects and methods,
- Exposure to the work of other researchers using similar techniques or analyzing similar policies or projects along with new or different techniques which could be used to perform similar analyses,
- Social interaction and networking, which will result in future, research collaborations,
- The opportunity to meet and interact with the established multi-disciplinary CRSP network of researchers,
- Participation in two value-chains special sessions, one organized by CRSP and the other by the FAO,
- Providing multiple exposure to a wide variety of perspectives, techniques, and countries, and
- The creation of networks within and among countries on specific topics of benefit to their future research.

Conference Proceedings

A completely new system has been developed for the collection and dissemination of conference proceedings for the IIFET 2012 Tanzania conference. This new system will make all conference materials instantly and freely accessible to anyone with an internet connection, anywhere in the world, at no charge.

The host of the conference proceedings will be the OSU Scholars' Archive. This permanent online archive hosts all kinds of scholarly materials. The system is ready to receive authors' papers, presentations, summaries, posters and report, and is available through the IIFET website at http://oregonstate.edu/dept/iifet/.

CRSP Sessions at IIFET

CRSP Director, Dr. Hillary Egna organized and co-moderated three special sessions with Dr. Meryl Williams in Tanzania at IIFET 2012 collectively focusing on fish value chains with an emphasis on gender integration.

The focus on markets and value chains was an attempt to better understand the intricate linkages between the chain elements, performance, and value added distribution to allow a determination of optimal institutional arrangements and policy approaches to smallholder participation.

The IIFET 2012 gender papers covered global studies and work in West and East Africa and Asia. The contributions came from government policy makers, academics and government researchers. They drew on many different streams of scholarship, focusing economic and social analysis of value chains on development in aquaculture and fisheries and on poverty in small scale fisheries. Gender differences in resource access rights, divisions of labor, access to capital and credit, measures of empowerment that affect power relations in the value chain and the concentration of power in the hands of certain actors and parts of the value chain were examined for fish products from tilapia and dagaa to groupers and tuna.

The three sessions involved participants from around the world and concluded with a panel discusssion involving 7 of the session's speakers. The three sessions were:

Session 01A: **Markets and Value Chains for Small Aquaculture Enterprises (in Fisheries, Aquaculture and Food Security)-** Organized and chaired by Hillary Egna.

Session 02A: **Looking at Fish Supply Chains with a Gender Lens**- Organized and co-chaired by Hillary Egna and Meryl Williams

Session 03A: **Overcoming Gender Inequalities in Fish Supply Chains to Inform Policy and Action-** Organized and co-chaired by Hillary Egna and Meryl Williams

The proceedings from the three sessions can be found at: http://aquafishcrsp.oregonstate.edu/Gender/

Session participants gather for a photo. Courtesy of Hillary Egna.

Aqua 2012 in Prague

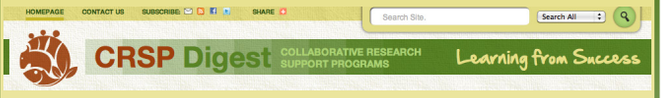
The World Aquaculture Society's Aqua 2012 conference was held 1-5 September in Prague, Czech Republic. AquaFish CRSP Research Projects Manager, Dr. Ford Evans represented the AquaFish Management Team in Prague this September. There he presented two posters from the Program Management Office, one on our capacity building efforts and one on our research into the domestication of indigenous species. To view or download these posters please visit our website at: aquafishcrsp.oregonstate.edu/posters.php.

Dr. Kevin Fitzsimmons, AquaFish CRSP Lead Project PI at the University of Arizona was also in attendance and presented three AquaFish CRSP Student Poster Awards.

Frist place went to **Paula Armesto** (Spain) for the poster titled: "Tissue Expression Analysis of The Renin-Angiotensin System Genes in the Flatfish *Solea Senegalensis* (Kaup): Differential Transcriptional Regulation by Salinity"
Second place went to **Li Kang** (China) for "Prevalence and Diversity of Fish-Born Zoonotic Trematodes in Tilapia *Oreochromis niloticus* Culture in Guangdong, China"
Second place went to **Ligianne Din Shirahigue** (Brazil) for "Fractions of Tilapia Oreochromis niloticus Acid Silage to Obtain By-Products"

Congratulations to all the winners!

The CRSP Digest Website



The new CRSP Digest website at www.crsps.net is your one-stop shop for updates, success stories, and resources for all of the various USAID-funded Collaborative Research Support Programs. Produced and maintained by Cultural Practice LLC and supported by individual CRSPs as a joint knowledge management program, the new CRSP Digest website is designed to be a searchable inventory of materials produced by the CRSPs. On the website, you will find research achievements, key facts, a searchable database of long-term training data, publications, and videos, an overview of both current and historical CRSPs, and announcements for CRSP-related news and events. Website contents can be searched by a number of different filters including topic, CRSP program, and location in order to enable CRSP participants and affiliates to find key documents and access relevant data.

Through the CRSP Digest webpage, visitors will also find links to the CRSP Digest Twitter feed, Facebook page, and the RSS feed where you can get up to date notifications of CRSP related news and events. This new website is slated to become a valuable source for new and archived CRSP material.

The website can be accessed at: http://crsps.net/

Goings-on in the Pond...

Expanding the reach of our efforts, AquaFish CRSP research has been featured in two recent USAID publications—the August 2012 Issue of the Feed the Future Monthly Newsletter and USAID's quarterly magazine "Global Waters." The two articles listed below are now available online and can also be accessed on the AquaFish CRSP website: aquafishcrsp.oregonstate.edu/news_events.php

From Best Practices to Best Outcomes in Ghana
feedthefuture.gov/article/best-practices-best-outcomes-ghana

On the Waterfront: Fishing for the Future
transition.usaid.gov/our_work/cross-cutting_programs/water/globalwaters/gw_ezine.html

As AquaFish's sixth year drew to a close, a no-cost extension was finalized with hopes of a long-awaited 5-year continuation. Over the spring of 2012, AquaFish CRSP underwent an external evaluation and received a positive review in June.

> ***"The AquaFish CRSP should be renewed based upon strong and demonstrated performance in research, outreach and development contributions, its alignment with FTF, and also because it is well managed."***
> --Excerpted from the AquaFish CRSP External Evaluation Report, June 2012

AquaFish, along with all the other CRSPs also were subjects of an intenseive BIFAD review, with a favorable report released in August 2012.

> ***"Frequently referred to as a "gem" embedded within the CRSP model, the capacity building element (HICD), particularly degree training, is one of the keys to the enduring legacy of the CRSPs and one that is not replicated by any other development model."***
> --Excerpted from the BIFAD Review of the CRSP Model, August 2012

Both reviews can be accesses on the CRSP Digest website at: www.crsps.net.

The AquaFish CRSP final technical reports for the 2009-2011 investigations is now availabe on the webiste at: http://aquafishcrsp.oregonstate.edu/publications.php. The two volumes of this report include the progress and accomplishments made by AquaFish CRSP particpants.

AquaFish CRSP Workshop on Value Chain Analysis for Aquatic Products

By Stephanie Ichien

On 13-15 September 2012, thirty-two CRSP participants gathered at the Zanzibar Grand Palace Hotel in Stonetown, Zanzibar for the AquaFish workshop on Value Chain Analysis for Aquatic Products. Organized by the University of Connecticut AquaFish Project under Dr. Bob Pomeroy, the workshop was sponsored by CRSP in cooperation with the Western Indian Ocean Marine Science Association (WIOMSA). The primary objectives of the workshop were to provide participants with an understanding of value chain analysis (VCA) and industrial organization analysis methods and to discuss the objectives, approaches, and methods being undertaken by the seven core AquaFish CRSP research projects. Workshop participants were able to take advantage of advice and guidance from the organizers and facilitators during breakout sessions and working groups as they applied the methods to develop report outlines using their own research and data.

On the third day of the workshop, the group took a field trip to Bweleo in west Zanazibar. After a greeting from the village head, workshop participants watched presentations on the various activities underway in Bweleo—women's projects, on pearl farming and shell jewelry making, implementation of no-take zones, seaweed farming and product marketing. Just before lunch, the group had the opportunity to see the pearl farms by small boat and many took the chance to get a closer look by diving right in.

Strategically held in the days leading up to IIFET 2012 Tanzania, the workshop convened in time for participants to stay in Tanzania for another few days and attend the conference on 17-20 July 2012. (For more information on IIFET 2012 Tanzania see the story on page 4).

Workshop attendees take advantage of the unique opportunity to interact with each other on value chain research from around the world and experience the many offerings of Zanzinbar, Tanzania. Photos by and courtesy of Hillary Egna.

AquaFish CRSP Student Corner...

Graduate Student Profiles: Cecilia Muthoni, Carolyne Musyoki, and Anthony Muthoni

By Stephanie Ichien

A true indication of the promising new generation of aquaculture and fisheries professionals in Kenya, Cecilia Muthoni, Carolyne Musyoki, Anthony Muthoni, Victor Motari, and Gladys Kuira are working on the AquaFish CRSP Associate Award project, Enhancing the Profitability of Small Aquaculture Operations in Ghana, Kenya, and Tanzania under the guidance of Dr. Charles Ngugi. In July 2012, the five students were part of a larger group of CRSP participants that met with Aquafish CRSP Director, Dr. Hillary Egna when she visited Kenya this summer. Dr. Egna was impressed by the students' enthusiasm and their clear potential. Here we feature Cecilia Muthoni, Carolyne Musyoki, and Anthony Muthoni in a three-part graduate student profile. (Victor Motari and Gladys Kuira were both featured in previous issues of AquaNews. To read more about Victor see the Winter 2011 issue of Aqunews and to read Gladys' student profile see the Fall 2010 issue.)

Cecilia Muthoni

Cecilia is currently working on an MSc in Aquaculture at Moi University in Edloret Kenya, having completed a BSc in Fisheries and Aquatic Sciences there in 2009. It was when she was in high school that Cecilia first gained an interest in aquaculture after hearing of the advances being made in China and Norway. Of particular interest to her was the opportunity to use fish farming and fishing as an economic activity, which is apparent in her thesis on "Consumer Preferences of Wild and Cultured Nile tilapia (*Oreochromis niloticus*) and African catfish (*Clarias gariepinus*) in Selected Urban Centers of Kenya" and in the CRSP work she is helping with to improve the productivity for fish farmers in Kenya with best management practices (BMPs). Under the guidance of her major professor, long-time CRSP HCPI Dr. Charles Ngugi, Cecilia is helping the AquaFish CRSP team to advance the adoption rate of BMPs in various regions in Kenya with the hope of improving the quality and quantity of local fish production. This work not only provides great benefit for the fish farmers involved, but also creates opportunities for students to understand the importance of well-tested BMPs and for them to play a role in disseminating proper techniques.

Grad students continued on page 7...

AquaFish CRSP Director, Dr. Hillary Egna (kneeling far left) gathers for a photo with CRSP participants in Kenya (July 2012). Among those gathered are students Carolyne Musyoki (standing second from left), Victor Motari (kneeling far right), and Cecilia Muthoni (standing second from right). Photo Courtesy of Hillary Egna.

...AquaFish CRSP Student Corner

...Grad students continued from page 8.

With recent boosts from the Government of Kenya's Economic Stimulus Program, the aquaculture and fisheries industries there are growing quickly and the demand for guidance and assistance has become increasingly apparent. The BMP project that Cecilia is a part of allows her to interact directly with farmers and to help them with the challenges they face on their farms. This has become one of Cecilia's most enjoyable experiences in working with AquaFish. "One interesting experience [was] when farmers were discussing a method of eradicating leeches in their fish pond. It was very interesting to hear one farmer give his solution— putting local brew in small tin containers (with holes made from outside on their sides) around the fish ponds, preferably on the dykes. The smell of the local brew attracts the leeches from the fish pond. The leeches enter the containers and once inside they cannot get outside (since holes are made from outside). They are then collected and thrown away/killed. The same process is repeated until the farmer realizes that there are no more leeches getting in to the container."

In addition to helping fish farmers deal with the challenges of sustainable aquaculture, Cecilia has a special interest in issues affecting families. She enjoys reading inspirational literature and counseling the youth of her community in responsible ways of living.

Once Cecilia completes her Master's she hopes to pursue a PhD in aquaculture.

Carolyne Musyoki

Carolyne Musyoki first got involved with the AquaFish CRSP best management practices investigation in Kenya in 2010, which has been funding a portion of her graduate studies in Hydrobiology (Fisheries Resource Management) at the University of Nairobi. Her CRSP work on BMPs integrates well with her MSc research, "Evaluation of the Impact of the Economic Stimulus Program (ESP) Aquaculture Development Intervention on Income Generation in Kiambu County," which she is carrying out under the mentorship of her major professor, Dr. Charles Ngugi. With a BSc in Agricultural Economics and Resource Management, Carolyne aims to complete her Master's research by June 2013 and hopes to continue working with small scale fish farmers for her PhD.

Realizing the importance of fish as a source of protein and the tragedy of dwindling wild fish resources, Carolyne's interest in aquaculture is rooted in the possibilities it provides for improving livelihoods. She states that "aquaculture, being one of the fastest growing sectors, has shown promising results and thus more people can access fish hence improving the society's nutritional status and at the same time it's a means of improving the livelihoods of the small scale fish farmers and [increasing] job creation." Simultaneously, Carloyne understands the challenges that aquaculture faces in Kenya including the lack of quality feeds and seeds, poor infrastructure, and pollution from pond effluents. Overcoming these challenges with techniques such as BMPs will increase the successes that Kenya is starting to see from the aquaculture industry—it is a source of alternative income, it has created new jobs for the youth and for women, and it has improved the nutritional health of local communities by making fish a more accesible food choice. Seeing some of these successes first hand, Carolyne considers her interactions with farmers during workshops as her most enjoyable experience in her work with AquaFish CRSP.

Anthony M. Muthoni

"...I wake up every morning looking forward to learn[ing] more about this diverse group of organisms."

--Anthony Muthoni

Currently working on his MSc in Fisheries Sciences at Kenyatta University with Dr. Charles Ngugi, Anthony Muthoni has always had a passion for fish. Completing his BSc in Fisheries and Aquatic Sciences in 2010, this passion has guided him through his studies in aquaculture and fisheries and has provided him with varied experiences that he can draw upon to help local fish farmers. Ultimately Anthony strives to become a leading fish expert in Kenya.

With support from the AquaFish CRSP Associate Award, Anthony is pursuing his goals and is working to overcome one of the major challenges to fish farmers—affordable feeds. His master's thesis evaluates the "Effects of dietary protein levels on growth performance and yield of all male Nile tilapia (*Oreochromis niloticus*, linn. 1858) in an integrated cage-cum-pond culture system" with the hopes of increasing profit margins for farmers by enhancing fish growth at a lower feed cost. The research aims to identify an optimum dietary protein level for maximum growth and yield for all male Nile tilapia in an intensive cage-cum-pond system. In addition to

Grad students continued on page 13...

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 present Notices of Publication can be found on the AquaFish CRSP website at: aquafishcrsp.oregonstate.edu/publications.php

Development impacts of long-term aquaculture training programs conducted in Kenya and Thailand (12-299)

John R. Bower[1], Charles Ngugi[2]

[1] Faculty of Fisheries Sciences, Hokkaido University
[2] Kenya Ministry of Fisheries Development

This paper reports the results of a survey conducted to assess the development impacts of USAID-supported aquaculture training programs conducted at three institutions of higher education in Kenya and Thailand. All program participants interviewed reported that they acquired specific knowledge, skills, and attitudes during the training and that it has had an important impact on their professional development. The programs have also had a marked effect on the institutions where the participants now work. Short-term training in the U.S. and short-term training in one's home country were rated as more effective training models than long-term training in the U.S.

This abstract is excerpted from the original paper, which was in the Journal of Higher Education and Lifelong Learning 19(2012):1-8.

Biological assessment of aquaculture effects on effluent-receiving streams in Ghana using structural and functional composition of fish and macroinvertebrate assemblages (12-300)

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Biological assessment of aquatic ecosystems is widely employed as an alternative or complement to chemical and toxicity testing due to numerous advantages of using biota to determine ecosystem condition. These advantages, especially to developing countries, include the relatively low cost and technical requirements. This study was conducted to determine the biological impacts of aquaculture operations on effluent-receiving streams in the Ashanti Region of Ghana. We collected water, fish and benthic macroinvertebrate samples from 12 aquaculture effluent-receiving streams upstream and downstream of fish farms and 12 reference streams between May and August of 2009, and then calculated structural and functional metrics for biotic assemblages. Fish species with non-guarding mode of reproduction were more abundant in reference streams than downstream ($P = 0.0214$) and upstream ($P = 0.0251$), and sand-detritus spawning fish were less predominant in reference stream than upstream ($P = 0.0222$) and marginally less in downstream locations ($P = 0.0539$). A possible subsidy-stress response of macroinvertebrate family richness and abundance was also observed, with nutrient (nitrogen) augmentation from aquaculture and other farming activities likely. Generally, there were no, or only marginal differences among locations downstream and upstream of fish farms and in reference streams in terms of several other biotic metrics considered. Therefore, the scale of impact in the future will depend not only on the management of nutrient augmentation from pond effluents, but also on the consideration of nutrient discharges from other industries like fruit and vegetable farming within the study area.

This abstract is excerpted from the original paper, which was published in Environmental Management 50(2012):166-180.

Improving Gender Equity in Aquaculture Education and Training: 30 years of Experiences in the Pond Dynamics/Aquaculture, Aquaculture, and AquaFish Collaborative Research Support Programs (12-301)

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The AquaFish Collaborative Research Support Program (CRSP) is dedicated to improving gender equality in the aquaculture and fisheries sectors and in the CRSP by creating equal opportunities for women and men in research, training and educational activities. Recognising the barriers and complex issues women face, the AquaFish CRSP has taken a mindful approach towards gender integration by focusing on women beneficiaries of its research and outreach, and on women in the Program. Gender must be included in projects in a cross cutting and an individual way. Despite these steps, gender-segregated statistics from AquaFish display characteristics of a "leaky pipeline" as seen in other fields of science. During the original Pond Dynamics/ Aquaculture CRSP (PD/A) and th subsequent Aquaculture CRSP (ACRSP) (1982-2008), 36.8% collectively, of degree students were women. In the AquaFish CRSP (2006-current), 55 women (55%) of degrees have been awarded to women. Although reaching a 50% target for women is a major accomplishment, the same proportion is not entering higher positions in science or research careers. Surprisingly, women still make up less than 50% of

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the CRSP short-term trainees. More research is needed to understand leaks in the pipeline and barriers to women's participation.

This abstract is excerpted from the original paper, which was in Asian Fisheries Science. vol. 255(2012): 119-128.

Hemolymph profiles of pond-reared and lake pen-cultured adult Chinese mitten crab, *Eriocheir sinensis* H. Milne Edwards, 1853 (12-302)

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Levels of seven hemolymph parameters (considered as indicators of physiological and immune status of organisms) in pond-reared (PR) and lake pen-cultured (PC) adult Chinese mitten crabs sampled from three experimental sites *viz*., a pond at Huangjin Lake area, a net-pen in the Huangjin Lake and a pond at Lu Lake area were analysed. Two sites in the Huangjin Lake area where the pond meets the lake, possessed good water quality whereas at Lu Lake area where the pond was not connected to the Lu Lake, the water quality was relatively poor. Hemocyanin content and total hemocytes count in PR crabs from Lu Lake area were significantly lower than those of PR and PC crabs from Huangjin Lake area, indicating PR crabs from Lu Lake area had relatively poor physiological and immune status. There were no significant differences in hemolymph profiles between PR and PC crabs from Huangjin Lake area. These results indicate that water quality had a significant effect on the physiological and immune status of cultured Chinese mitten crabs. The resuls indicate that pond-rearing is better for culture of Chinese mitten crabs, especially in ponds which are connected to natural water resources.

This abstract is excerpted from the original paper, which was published in Indian J. Fish., 59:1(2012):95-101.

The expression of prophenoloxidase mRNA in red swamp crayfish, *Procambarus clarkii*, when it was challenged (12-303)

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The expression of the prophenoloxidase (*proPO*) gene was investigated in nine tissues of red swamp crayfish *Procambarus clarkii*, by real-time PCR after challenges by CpG oligodeoxynucleotide (ODN), *Aeromonas hydrophila* and white spot syndrome virus (WSSV). The results can be summarized as follows: (i) the expression level of the proPO gene in haemocytes was highest among nine studied tissues before the challenge; (ii) the expression of *proPO* increased in all studied tissues after stimulation by CpG ODN and WSSV, and also increased in all tissues, except the ovary, after the *A. hydrophila* challenge; (iii) the whole expression profiles were different, suggesting that different immune mechanisms may exist for crayfish that are resistant to WSSV and *A. hydrophila*, although the expression in haemocytes was similar before and after the WSSV and *A. hydrophila*
challenges.

This abstract is excerpted from the original paper, which was published in Genomics 99 (2012): 355–360.

Cloning and characterization of leptin in a Perciform fish, the striped bass (*Morone saxatilis*): Control of feeding and regulation by nutritional state (12-304)

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In mammals, leptin is an anorexigenic peptide hormone that regulates energy homeostasis. It is produced predominantly by white adipose tissue and circulates as an endocrine indicator of energy reserves. Teleost leptin has been characterized in a few fish species, but its regulation is not well understood, particularly in response to nutritional status. In this study, we cloned a putative leptin in striped bass (*Morone saxatilis*) and report the first characterization of leptin in a Perciforme, the largest and most diverse order of fish. The striped bass leptin coding sequence was 65% homologous with pufferfish, 52% with Atlantic salmon, and 46% with human. PCR showed that leptin mRNA was exclusively expressed in the liver, and not adipose or other tissues. The leptin coding sequence of striped bass and the more widely cultured hybrid striped bass variety (HSB; *Morone chrysops*, white bass *M. saxatilis*) were identical. We then evaluated whether the metabolic status of HSB might alter leptin gene expression. Juvenile HSB were subjected to 3 weeks feed deprivation followed by 3 weeks of refeeding. Quantitative PCR showed that fasting for 3 weeks reduced hepatic leptin mRNA levels relative to fed controls. Leptin mRNA levels then increased upon refeeding, albeit levels were not completely restored to those seen in control fish fed throughout the experiment. Intraperitoneal injection of human leptin suppressed appetite in HSB. In as much as hepatic HSB leptin mRNA is regulated by nutritional state and has a corresponding anorexigenic effect, our results suggest that leptin may

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Upcoming Meetings and Events...

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

International Fisheries Symposium
6-8 December 2012
Can Tho University, Vietnam
http://www.ctu.edu.vn/colleges/aquaculture/ifs2012/

Aquaculture and Restoration: A Partnership Northeast Aquaculture Conference & Exposition (NACE), Milford Aquaculture Seminar (MAS), & International Conference on Shellfish Restoration (ICSR)
12-15 December 2012
Mystic Marriott Hotel & Spa
Groton, Connecticut
http://www.northeastaquaculture.org/

Aquaculture 2013
Triennial Meeting: Annual Meeting of the Aquaculture Sector of the American Fisheries Society, World Aquaculture Society, and National Shellfish Association
21-25 February 2013
Nashville, Tennessee
www.was.org/WasMeetings/meetings/Default.aspx?code=AQ2013

10th Asian Fisheries and Aquaculture Forum (10AFAF) and 4th Gender in Aquaculture and Fisheries Global Event (GAF4)
Sponsored by the Asican Fisheries Society
30 April - 4 May 2013
Yeosu, Korea
http://koference.cafe24.com/main.do?mode=mainView

North Amercan Association of Fisheries Economists (NAAFE) Forum 2013
21-24 May 2013
TradeWinds Island Grand Resort
St. Petersburg, Florida
http://www.conference.ifas.ufl.edu/naafe/index.html

The 10th International Symposium on Tilapia in Aquaculture (ISTA10)
6-10 October 2013
Ramada Hotel
Jerusalem, Israel
http://ag.arizona.edu/azaqua/ista/ISTA10/ISTA10.htm

For more meeting and employment opportunities visit our Education & Employment Opportunities network database online, EdOpNet, at aquafishcrsp.oregonstate.edu/edop.php

CONGRATULATIONS

Dr. Steve Amisah, CRSP HC-PI was recently named the Dean of Faculty in the College of Agriculture and Natural Resources at Kwame Nkrumah University of Sceince in Technology (KNUST) in Ghana. Dr. Nelson Agbo, CRSP HC Investigator was named the Head of the Department of Fisheries and Watershed Management also at KNUST. Admission to the newly formed BSc in Aquaculutre and Water Resources Management Program began this fall at KNUST; an applied program aimed at training people to practice aquaculture as a busiiness. The CRSP capacity building efforts in Ghana have played a role in the creation of this program and is an indication of the progress being made in the aquaculture and fisheries sectors of Ghana. Congratulations to Steve and Nelson on thier great successes!

Kudos to AquaFish CRSP AOR, Harry Rea and to recent OSU Fisheries & Wildlife graduate, Brian Gilooly on their respecitve USAID webinars. Both webinars included input from AquaFish, and focused on the importance of aquaculture and fisheries research in fighting poverty.

More information and screencasts can be found at:
Sustainable Aquaculture and Food Security- **Harry Rea**, Richard Grainger, and Randall Brummett
http://agrilinks.kdid.org/library/sustainable-aquaculture-and-food-security-event-resources
Fishing for the Future: The Why and How of Nature's Most Abundant Protein Source- **Bryan Gillooly** and Richard Volk
http://www.agrilinks.kdid.org/library/fishing-future-why-and-how-nature%E2%80%99s-most-abundant-protein-source-event-resources

PONDERINGS...

Excerpted from FAO's "The State of World Fisheries and Aquaculture 2012"

"Fisheries and aquaculture make crucial contributions to the world's wellbeing and prosperity. In the last five decades, world fish food supply has outpaced global population growth, and today fish constitutes an important source of nutritious food and animal protein for much of the world's population. In addition, the sector provides livelihoods and income, both directly and indirectly, for a significant share of the world's population.

Fish and fishery products are among the most traded food commodities worldwide, with trade volumes and values reaching new highs in 2011 and expected to carry on rising, with developing countries continuing to account for the bulk of world exports. While capture fisheries production remains stable, aquaculture production keeps on expanding. Aquaculture is set to remain one of the fastest-growing animal food-producing sectors and, in the next decade, total production from both capture and aquaculture will exceed that of beef, pork or poultry.

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play a role in energy homeostasis in these advanced Perciformes.

This abstract is excerpted from the original paper, which was published in General and Comparative Endocrinology 178 (2012): 98–107.

Prospects and Potential for Aquaculture of African Lungfish in Uganda (12-306)

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Shifting rainfall and temperature regimes are beinging new challenges to the management of water bodies and fish farms in sub-Saharan Africa (Dixon et al. 2003). Culturing species that are resilient to drought and stressful water quality conditions may be a major part of future African aquaculture. Air-breathig fishes, such as the African lungfish *Protpterus aethiopicus*, can use atmospheric oxygen to meet all or part of metabolic demands (Mlewa et al. 2007). Air-breathing fish have a role in managed fisheries and low-management culture systems where dissolved oxygen concentration is not a limiting factor. Among air-breathing fishes, the African catfish *Clarias gariepinus* can tolerate low levels of dissolved oxygen but its flesh is held in lower esteem by consumers as compared to lungfish. The quality of Pangasius_catfish is high but it is not a native species in Africa.

African lungfish is native to the natural waters of Uganda (Greewood 1958, 1985, Birt et al 2006) but populations are rapidly declining and the species is now endangered, mainly cased by oveexploitation, environmental degradation and large-scale conversion of wetlands to agricultural land (Goudsweaard et al. 2002, Balirwa et al. 2003). Therefore, it is essential to develop aquaculture to relieve pressure on natural stocks. This article explores the potential of African lungfish aquaculture to improve food security and livelihoods in Uganda; identifies indigenous production practices and approaches; consumer perspectives and markets; and an outlook for lungfish fisheries and aquaculture in Uganda and sub-Saharan Africa.

This abstract is excerpted from the original paper, which was published in World Aquaculture. 43:3(2012): 38-42.

All past and present Notices of Publication can be found on the AquaFish CRSP website at: aquafishcrsp.oregonstate.edu/publications.php

...Grad students continued from page 9.

providing the potential for increased profits, the results of Anthony's research will also be used to develop an enterprise budget as a financial guide for small-scale fish farmers.

Expecting to finish his Master's in June 2013, Anthony is immersing himself in a diversity of fish-related opportunities. One of his most enjoyable experiences has been "being [involved] at Mwea Aquafish Farm, one of the highly productive private fish farm in the republic. I have had an opportunity to interact closely with fish, understanding their ecology, physiology, biology and most interestingly their social behavior. In particular, I've enjoyed working with Nile tilapia (*Oreochromis niloticus*) and African catfish (*Clarias gariepinus*). I wake up every morning looking forward to learn[ing] more about this diverse group of organisms." In the future, Anthony hopes that he might open his own hatchery and fish restaurant, since cooking is another one of his passions. He says his best dish is the catfish fillet, and hopes that he can inspire others to cook fish as well. Anthony believes that if more people cook fish, the demand will increase, enabling the fish industry to grow and allow for the growth of a healthy nation.

As Kenya's aquaculture and fisheries industries quickly grow, the work that these students are involved with will become increasingly necessary for sustainability. The next generation of professionals will be key in improving the adoption rate of BMPs and in creating innovative practices. Each of the students featured in this issue has expressed their gratitude for the opportunity that CRSP has provided them.

Parting Shot

An indication that the AquaFish CRSP Mali Project is still having a positive impact, Seydou Toe (third from left in green), a former CRSP participant has his own fish farm and has become a sought after aquaculture consultant/trainer for local fish farmers. Photo courtesy of Héry Coulibaly.

To read more on the AquaFish CRSP Mali project, see the final report at: http://bit.ly/VaNk4d

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To subsrcibe to receive notifications for new issues of Aquanews please visit: http://lists.oregonstate.edu/mailman/listinfo/aquanews

Your comments, stories, student profiles, and photos are always welcome! Send information to aquafish@oregonstate.edu (please include "Aquanews" in the subject line).

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