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The Ohio Aquaculture Research and Development Integration Program Newsletter is published biannually to share the program's highlights and successes.

For more information on OARDIP, contact Dr. Han-Ping Wang at wang900@osu.edu.

Ohio Aquaculture Research and Development Integration Program (OARDIP) Newsletter

The Ohio State University

OCARD Receives Award to Host Aquaculture Boot Camp (ABC)

The Ohio Center for Aquaculture Research and Development (OCARD) at the OSU South Centers has received an award of $550,000 from the USDA National Institute of Food and Agriculture to develop and operate Aquaculture Boot Camp (ABC).

ABC is a program for training new and beginning aquaculture farmers in production techniques and business development skills in Ohio and adjacent states. This is a joint effort between the aquaculture, business development and marketing programs at OSU South Centers. OCARD is the first aquaculture unit to receive this type of project funding from the USDA.

Operators of small farms play an important role in agricultural production in Ohio and adjacent states. One-third of U.S. and Ohio farm sales originate from small farms.

Many small farm owners and beginning farmers in traditional agriculture are seeking new enterprises and opportunities to increase revenues and maintain the family farm. Aquaculture presents a great opportunity for both rural and urban small and beginning farmers in Ohio. It has diversified and supplemented farm income for many small farm operations.

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Indoor Perch Larvae Nursery

Recently, researchers have successfully nursed perch larvae and fry in an indoor aquaculture system at the OSU South Centers Aquaculture Research Center. Experimenting with an indoor culture and production system for marine rotifers, and using algal paste to supply the rotifers, and then intermixing rotifers with artemia and microdiets, approximately 50% of the perch fry were successfully reared and transferred to a complete artificial diet.

Perch fry successfully nursed in an indoor aquaculture system at OSU South Centers

Researchers have been able to successfully hatch, maintain, and grow multiple tanks of yellow perch fry using this approach. This breakthrough will allow more control in perch rearing and eliminate variables such as weather and temperature. Future experiments with this process will follow.

Yellow perch is the most popular aquaculture species in Ohio. One roadblock hindering expansion has been low survival and availability of fry and fingerlings. The survival rate of traditionally pond-nursed fry is dependent on weather and late winter storms killing the fry in ponds overnight.

Yellow perch can reach market size in one year with a constant temperature and photoperiod in an indoor system, which limits sexual maturation. Therefore, developing the indoor culture of yellow perch has significant advantages over pond culture. Limiting this possibility has been the poor indoor survival of newly-hatched fry to the stage where they are completely feed-trained. Developing techniques to increase indoor survival of larvae and fry using live feed will have a significant impact on the yellow perch industry development.

OCARD Receives Award to Host Aquaculture Boot Camp

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Aquaculture can have a significant impact on Ohio's family farms, and can allow more farmers to maintain their current operations. The growing aquaculture industry has also allowed for the conversion of small, unprofitable veal, swine, and poultry operations to become profitable aquaculture operations.

Approximately 40% of aquaculture producers in Ohio reported being in business less than five years, and another 39% reported less than ten years in operation. Therefore, 79% of all Ohio aquaculture farms are considered new or beginning.

These new and small aquaculture operations are in urgent need of training in production techniques and business management strategies that will aid in their current operations and achieve their long-term goals of farming success. Unfortunately, there are very limited opportunities to access aquaculture classroom training and hands-on practice for those new and beginning farmers.

We will address this need by developing and delivering an Aquaculture Boot Camp. The ABC will offer integrated training in aquaculture production and business management strategies with "3-I" levels:

Introductory: a general level where sharing of information is the goal

***Intermediate*:** a mid-level involving participation in a variety of learning activities;

Intensive: an in-depth level involving immersion in a year-long hands-on training and mentoring program.

The ABC project will serve the following target audience:

- Beginning and new aquaculture farmers with less than 10 years of any farming experience.
- Other new farmers attempting to diversify their existing farming enterprise.
- Potential future aquaculture farmers: students and those without a family farming history.
- Educators and others who influence the farming decisions made by potential fish farmers.

The ultimate goal of this program is to utilize a multi-faceted approach, including classroom and hands-on training, paired with industry mentoring, to improve the success rate of new and beginning aquaculture farmers in the State of Ohio and adjacent states.

To achieve the long-term goal, the ABC 3-I training and partnership model will be utilized to pursue the following specific goals:

- Provide tools for new and beginning farmers to enhance their aquaculture production success by developing and delivering production curriculum and hands-on practices.
- Enhance the financial viability and business success of beginning aquaculture farmers by delivering business management and marketing strategies.
- Strengthen the success of new and beginning aquaculture farmers through the ABC mentorship and partnership with the industry via the Ohio Aquaculture Association and other partners.

For more information, please contact Dr. Hanping Wang at wang.900@osu.edu or Dr. Laura Tiu at tiu.2@osu.edu.

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- USDA National Institute of food and Agriculture (NIFA)
- North Central Region Aquaculture Center (NCRAC)
- Ohio Sea Grant
- Ohio Soybean Council
- Ohio Agriculture Research and Development Center (OARDC)
- The Ohio State University Extension

Get on the Fish Bus!

By Dr. Laura Tiu

I love to learn new things about the aquaculture industry in Ohio. I typically learn the most when I spend some time with the fish farmers themselves. I had that opportunity June 24, 2012 when the Fish Farmers of Ohio Association (FFOA) sponsored a bus tour of farms in northern Ohio. Thirty-five people boarded the bus to visit a variety of operations.

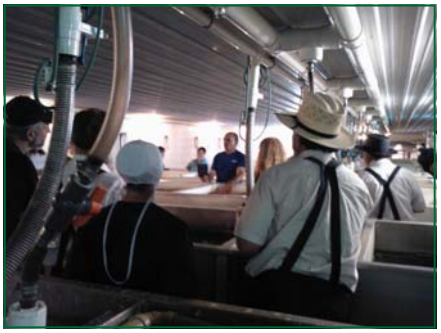
Originally, we were to visit the Castalia State Fish Hatchery. However due to some bus issues, we ended up touring John Yoder's farm in Fredericksburg, Ohio. And what a delight that was! I got to see my first spring-powered aeration system. John raises largemouth bass and bluegill for the food market. His largemouth bass put on quite a show feeding aggressively for the group.

Spring-powered aeration system

Next, we visited Woodside Farms in Bellevue, Ohio. Woodside Farms is one of Ohio's largest indoor aquaculture facilities. They use recirculating aquaculture systems (RAS) to raise tilapia for the Asian markets and spotfin shiners for the baitfish market on Lake Erie. They are on the cutting edge of aquaculture technology and have plans to expand their operation greatly in the near future, particularly in the arena of live food production for larval fish.

Above: Woodside Farm systems

Right: Tom Yingling with group



Our next stop was Calala's Water Haven in New London, Ohio. Bob Calala and his two brothers are second generation fish famers with a large diversified operation. While they focus on the production of crayfish for bait, the farm also produces a variety of fish including large and small mouth bass, bluegill, and yellow perch. Calala's is also home to Ohio's only freshwater prawn nursery. Bob shared his aquaculture experience with the group, as well as showing off some equipment he has designed and built. He and his brother also gave a demonstration of how they harvest crayfish from their ponds.

The tour ended back in Wooster Ohio on the banks of a pond managed by Tom Machamer, the FFOA President, for spotfin shiner production. Tom shared his technique for spawning and collecting spotfin shiner eggs as well as a demonstration of how aggressive this particular species feeds.

Above: Crayfish harvest at Calala's Water Haven

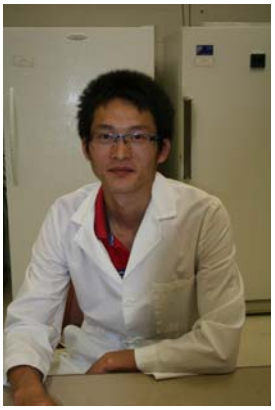
Right: Calala's crayfish

Visiting an aquaculture facility is a great way to learn more about the industry and the people growing your food. We plan to organize another bus tour in the fall to continue this valuable tradition.

Machamer spotfin pond

Meet Our Visiting PhD Students

The Ohio Center for Aquaculture Research and Development (OCARD) has conducted an international training program for visiting scholars since 2005. The program has attracted about twenty international scholars and PhD students to work under Dr. Hanping Wang's guidance in the Aquaculture Research Center and Genetics Lab at Piketon. The two new visiting PhD students are from China and Egypt.



Zhigang Shen is a PhD student of the College of Fishery, Huazhong Agricultural University in China. Before he joined the OCARD training program at OSU South Centers, he had been working on sex-control technology in fish. Shen has published two papers in peer-reviewed international journals. For part of his dissertation, Shen will be doing research for two years in sex control in yellow perch and bluegill at the OSU South Centers Aquaculture Research Center and Aquaculture Breeding and Genetic Laboratory.

Nour Eissa is a visiting PhD student from Egypt. He graduated from Veterinary Medicine and received his Master's degree in fish diseases and aquaculture, and then received a scholarship from his government for two years to complete his PhD research under Dr. Wang's supervision at OSU South Centers.

Nour's research is directed toward improving fish health through screening the effect of repeated handling stress under different temperatures to determine the best temperature to handle the fish with minimal stress. Also, he is working to improve aquatic animal health through probiotic application, which is considered as a new eco-friendly alternative measure for sustainable aquaculture to avoid drawbacks of chemical treatments

First Friday Aquaculture Tours

Researching an aquaculture enterprise takes a lot of time. Aquaculture is a complex industry and the learning curve is long and steep. As part of the learning process, aquaculture entrepreneurs are encouraged to visit existing aquaculture farms to get a better understanding of the facilities and techniques involved in growing fish.

Unfortunately, given increasing biosecurity concerns on private fish farms, it is becoming increasingly difficult to visit an operating fish farm. In order to give interested individuals that opportunity, we are opening up the Ohio State University Aquaculture Research Facility to group tours the first Friday of every month from March through October.

These informative, yet informal First Friday Aquaculture Tours are scheduled from 10:00 am until 12:00 noon. They include an overview of the OSU Aquaculture Program, updates on the latest research projects, and a tour of our laboratories and fish farm facilities. Picture taking is encouraged and welcomed. Participants are encouraged to dress for the weather as the majority of the tour takes place outdoors.

The event is hosted by OSU's Center for Aquaculture Research and Development, Ohio Agricultural Research and Development Center and Ohio State University Extension. For more information, or to register (free, but required), contact Julie Moose at (740) 289-2071, ext. 223 or e-mail moose.14@osu.edu.

Aquaculture Specialist Dr. Laura Tiu (right) explains the various tanks available during First Friday tours

New Scientific Publications

Evaluation of 1-stage and 2-stage selection in yellow perch I: Genetic and phenotypic parameters for body weight of F 1 fish reared in ponds using microsatellite parentage assignment

X. J. Cao, H. P. Wang, H. Yao, P. O'Bryant, D. Rapp, W. M. Wang and R. MacDonald

ABSTRACT: Two selection methods, 1-stage selection (OSS) and 2-stage selection (TSS), for improving efficiency and profitability of selective breeding of yellow perch were evaluated, through examining the genetic and phenotypic parameters for BW of F1 fish using microsatellite parentage assignment in this study. Approximately 94% of the sampled yellow perch progeny were assigned to single parental pairs using 8 microsatellite markers, which confirmed the applicability of the communal rearing technique in yellow perch breeding.

Within OSS, the genetic correlation between 1-yr-BW and 2-yr-BW was high (0.98), indicating that the growth of yellow perch recorded at yr 1 could predict their growth for yr 2. Also mean family BW and family EBV for BW between yr 1 and 2 were found to be significantly correlated, suggesting yr 1 fast-growing yellow perch families continued to be the fast growing families in yr 2. Two-year random fish undergoing

TSS were significantly heavier ($P < 0.01$) than those undergoing OSS. In addition, top males and females with TSS were heavier ($P < 0.01$) than those with OSS. Based on these results we concluded that the TSS was more desirable and effective for yellow perch breeding compared with OSS in terms of improving selection efficiency and reducing costs.

Journal of Animal Science
2012.90:27–36

From markers to markets: Genetic improvement of yellow perch through commercial-scale marker-aided cohort selection for growth

Han-Ping Wang, Hong Yao, Paul O'Bryant, Jacob Rapp, Laura Tiu and Geoff Wallat

Abstract Yellow perch *Perca flavescens* is a particularly important aquacultural and ecological species in the Great Lakes Region (GLR) and the Midwest USA. The demand for this species has remained very high in the GLR. Due to the relatively slow growth of currently cultured populations of yellow perch, the development of the yellow perch aquaculture industry has been hindered. The goal of this project was to use a marker-aided cohort selection to improve the growth rate of the species and reduce their grow-out time to market.

To achieve this goal, approximately 800 broodfish from eight stocks representing major populations were obtained from eight states (NC, NY, PA, ME, OH, MI, WI and NE). Those fish served as a base population for the breeding program. By performing cross-breeding of the base population, approximately 1500 fast-growing broodfish candidates were selected as a base generation from more than 100 families that were reared in communal ponds, based on both phenotypic and genetic data in two overlapping generations.

More than 100 microsatellite markers were developed for the breeding program. Parentage analysis techniques using eight molecular makers in yellow perch have been developed. Five improved lines have been developed through three rounds of selections. For each generation, approximately five hundred fish were selected and genotyped using microsatellites to construct a pedigree. Among the 500 fish, at least 100 pairs of the least related, with highest breeding value were selected and divided into five cohorts based on their pedigree. If the constraint on the rate of inbreeding could not be achieved, another batch of fish was genotyped and included in the total number of candidates.

The selection lines were created by pair-mating 20 pairs within each cohort to found the next generation of improved lines. The individuals of average weight were chosen for the control line. This cohort selection has the advantage of preventing the top fish only from limited families.

On-farm tests of the improved lines of the third generation are being performed. Current research data shows that the improved lines grew 32.2% faster than unimproved fish in Year 1 in commercial farms. This improvement would make it feasible for yellow perch to reach market size within 14 months in pond culture conditions and in 9 months in recirculating aquaculture systems. In addition, two mapping families have been established and reared to maturation in tanks for future QTL mapping.

The International Symposium on Genetics in Aquaculture XI, Auburn University, June 24-30, 2012.

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New Scientific Publications

(continued

Developing genetically fast-growing monosex male populations in bluegill sunfish

Han-Ping Wang, Zexia Gao, Hong Yao, Jacob Rapp and Paul O'Bryant

Bluegill *Lepomis macrochirus* is an important and high-value species for both food and recreational aquaculture, and has unique niche market in the Midwest and some other states. Much interest has been generated concerning the development of monosex male populations of bluegill due to their more rapid growth capacity relative to females. The methods involved to develop monosex population require a comprehensive understanding of the underlying basis of sex determination and gonadal function with development of monosex male populations.

In this study, through histological observation, the bluegill is classified as a differentiated gonochorist and its critical period of sex differentiation occurs between 13.2 and 16.0 mm total length. Based on this result, 100% monosex female populations without intersex gonad were produced. By crossing the largest sex-reversed females (most of them should be XY-females) with regular males, 70% - 100% males were produced, and 25% of them should be YY-males.

Developing superior all-male bluegill populations via crossing super sex-revised fish with genetically improved lines is underway. Effects of genotype by temperatures on sex ratio were tested also on two batches of fry with different parents.

In the first batch, sex ratios did not deviate significantly from 1:1 in 23 °C group ($P > 0.05$); however, sex ratios significantly deviated from 1:1 in 29 °C and 34 °C groups, in which a significantly higher proportion of males (66.67–70.64%) was yielded. The percents of males in 34 °C and 29 °C groups were significantly higher than that in 23 °C and 17 °C groups ($P < 0.05$).

In Batch 2, sex ratios were significantly different from 1:1 in groups of 34 °C and 17-to-29 °C, in which a significantly higher proportion of males (58.79%) and females (63.9) was produced, respectively, while no significant deviations from 1:1 were detected in groups of 23°C and 29°C ($P > 0.05$).

In both batches, the proportion of females decreased in low temperature treatment of 17 °C or 17-to-29 °C. We also tested 12835 AFLP loci and screened a considerable proportion of the bluegill sunfish genome, not a single sex-specific marker was found. These results suggest that sex chromosomes may be absent in the bluegill and a sex determining system based on polygenic effects will need to be considered.

The International Symposium on Genetics in Aquaculture XI, Auburn University, June 24-30, 2012.

Molecular Cloning and Differential Expression of Three GnRH Genes during Ovarian Maturation of Spotted Halibut, Verasper variegatus

Yong-Jiang Xu, Xue-Zhou Liu, Mei-Jie Liao, Han-Ping Wang, and Qing-Yin Wang

In this study, the gonadotropin-releasing hormone (GnRH) genes in spotted halibut were cloned and sequenced by isolating their cDNAs. The species expressed three molecular forms of GnRH in the brain: chicken-type GnRH-II (cGnRH-II), seabream-type GnRH (sbGnRH), and salmon-type GnRH (sGnRH). Phylogenetic analysis divided the molecular forms of GnRHs into three branches: cGnRH-II branch, sGnRH branch, and fish-specific GnRH branch. The spatial expression showed that they had the highest expression levels in the brain. cGnRH-II was exclusively detected in the brain, while sbGnRH had a global expression pattern in all examined organs. sGnRH was detected in the brain, pituitary, and ovary.

The temporal changes of brain GnRH mRNA expression levels were examined during ovarian maturation and post spawning, and the serum steroid hormones and gonadosomatic index (GSI) were recorded. Amounts of sbGnRH mRNA substantially elevated ($P < 0.05$) during ovarian maturation, which concomitant with considerable elevation of GSI and serum steroids levels. On the contrary, neither sGnRH nor cGnRH-II mRNA levels showed significant changes during ovarian maturation in this study.

These results suggested that these three GnRH genes are the important regulators for the differential expression of GnRH in spotted halibut, and would help us better understand the reproductive endocrine mechanism of spotted halibut.

Journal of Experimental Zoology Part A: Ecological Genetics and Physiology 317:434-446, 2012.