



Ohio Aquaculture Research and Development Integration Program (OARDIP) Newsletter

The Ohio State University

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The Ohio Aquaculture Research and Development Integration Program Newsletter is published biannually to share the Program highlights

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OSU Aquaculture Program Receives Funds to Establish Ohio Soy-Aqua Research and Development Initiative

OSU Aquaculture Program in Piketon has recently been awarded \$100,000 by the Ohio Soybean Council and OARDC to establish Ohio Soy-Aqua Research and Development Initiative. The overall goal of this initiative is to support the growth and sustainability of the rapidly growing aquaculture industry in Ohio, and in turn, develop new and local markets for Ohio soybeans through evaluation, development and sales of soy-based fish diets by collaboration with the Ohio Soybean Council.

Aquaculture is the fastest-growing animal-food-producing sector, and currently demands 25% of global fish meal and 36% of the global fish oil supplies. As fish meal production declines, aquaculture represents great potential for the use of soybean meal as a protein replacement in fish feeds.

Aquaculture sales in Ohio have tripled in recent years. To achieve the goal, in this research period, the initiative will:

1. Determine whether genetically improved yellow perch produced by the current breeding program and reared with fish meal-based diets (FMD) perform well when they are reared with soybean meal-based diets (SMD);
2. Assess whether sufficient genetic variation exists to improve growth, feed intake and feed efficiency through selection under both FMD and SMD by rearing genetically improved fish using both diets for industry-based breeding program;
3. Evaluate the effect of SMD and FMD on the growth performance and feed efficiency of spotfin shiners for development of baitfish culture techniques for Ohio's temperate climate;
4. Develop and provide educational and promotional materials designed to promote the growth of aquaculture in Ohio and activities of the Soy-Aqua Initiative in collaboration with OSC.

Ohio has a New Aquaculture Coordinator at the Ohio Department of Agriculture



Gary Stansberry

The coming decade promises to be one of intense growth of the aquaculture industry in Ohio. The directive from Director Boggs of the Ohio Department of Agriculture (ODA) to "make no small plans" has inspired a renewed

commitment to addressing challenges in the industry.

Two barriers identified by the industry were financing and marketing. To address these

issues and more, the ODA has hired an Aquaculture Coordinator, Gary Stansberry, to work directly with farmers.

Gary started in his position the beginning of December and has already visited several farms around the state. Gary is looking to help farmers connect with programs, agencies or other people that can help them with their issues.

Gary will serve as a liaison between the industry and the DOA and enable farmers to access existing programs as well as develop new ones. Ohio Aquaculture welcomes Gary to the team.

OARDIP Achievements and Impacts 2009

O'GIFT (Ohio Genetic Improvement of Farmed-fish Traits) Program

Multiple improved lines of yellow perch have been developed. The testing data show that the improved lines grew 28% - 54% faster than unimproved fish. ~60,000 improved perch fry and fingerlings were distributed to fish farmers. The additional 2nd generation of improved fish has been created in 2009. Four F₂ mapping families have been produced for quantity maps identifying genes important to increasing production. Two projects on genotype by environment interactions on growth performance of cross-bred yellow perch families were completed and two papers on these have been published by prestigious scientific journals (2009).

For bluegill, success of creating females with male genotype was published in *Aquaculture*, the best journal in the aquaculture area. About 15,000 all-male and 5,000 super male populations, which would grow 40-50% faster than a mixed-gender population, have been generated by crossing those females with regular males. In addition, eight strains of largemouth bass have been obtained for its selective breeding.

The O'GIFT program is expected to increase aquaculture production of perch, bluegill and bass by 35-50% by developing genetically improved broodstocks.

Bowling Green Aquaculture Program/Center (BGAC)

BGAC has established indoor spawning protocols for spotfin shiner culture, a new baitfish species for Ohio, and is making progress with live first feed types and transitions to prepared diets for the fully indoor culture of spotfin shiner juveniles and market size adults. Successful first feeding and the use of our newly-developed techniques for multiple spawns (early, normal and late season) per year will allow farmers to meet the huge demand for high quality bait in our region and increase their profitability. BGAC organized a Baitfish Grower's Alliance and has provided a Baitfish Culture manual and training session to 10 new baitfish producers.

BGAC directly supports over 30 aquaculture operations in northern Ohio through technical consultations, demonstrations, and dissemination of research results.

Fish Production Improvement Program

A practical strategy for establishing mostly-male bluegill groups that can gain 61.0% more weight than the mixed-sex control was published in *North American Journal of Aquaculture*. Bluegill and perch in communal rearing grew 62.5% and 33.1% faster than in monoculture, respectively.

These findings will have important practical significance for producers by increasing perch and bluegill production efficiency and lowering production costs.

Fish Muscle Growth and Nutrition Program

We have completed breakthrough research demonstrating wheat gluten based diets supplemented with lysine could replace animal protein based diets for Yellow Perch.

These diets could result in a cost savings of 10-15% in feed costs and they would reduce the impact on the natural resources.

Aquaculture Technology Transfer (AT²) and Dissemination

Over 1000 clients took advantage of the aquaculture outreach services at OARDIP including: 3 electronic list serves, personalized response to information requests and guided tours of the facility. About 20 clients received individual business planning assistance designed to enhance the success of their business ventures. Several state-wide workshops were conducted, and multiple presentations were made at regional and national meetings.

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Acknowledgements

OARDIP is currently supported by these major contributors:

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

OARDIP Achievements and Impacts 2009

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Aquaculture Genetics and Breeding Lab (AGBL)

This is the first lab of its type in the Midwest and crucial to the success of the GIFT program. In this lab, genetic relatedness charts and genetic pedigree of selected broodfish have been constructed for breeding programs for the past 3 years. More than 100 molecular markers have been developed for perch genetic mapping for traits of growth and VHS resistance, and published by the National Gene Bank. Family identification technology using DNA for selective breeding in yellow perch and bluegill has been established. A first genetic linkage mapping of bluegill has been completed for selective breeding and published in *Aquaculture International* (2009).

Economy and Scientific Impacts

Aquaculture sales in Ohio have tripped from \$1.8 million to \$6.6 million in recent years. Nationally, Ohio ranks first in sales of yellow perch for food and is the number one bluegill producing state. Ohio also ranks 4th in sales of baitfish and largemouth bass sold for sport and 5th in number of baitfish farms.

Fifty-two journal articles and abstracts have been published, including 8 journal publications in 2009. \$260,000 competitive funds were received/secured in 2009.

OARDIP Outreach 2009: A year in review

The mission of the OSU's OARDIP is to support the development of a sustainable aquaculture industry in Ohio. This is accomplished through a variety of research and Extension projects. Research and Extension efforts are designed after input from the industry and are focused on increasing the economic impact of aquaculture in Ohio.

In 2009, OARDIP personnel provided over 35 consultations and tours of their research and demonstration facilities in Piketon and Bowling Green Ohio. Participants included prospective fish farmers, local school groups and visitors from Japan, Serbia, South Korea and Taiwan. Staff made over 25 presentations to audiences around the state at venues such as the Ohio Aquaculture Association Annual Meeting, Small Farm Conference and the Farm Science Review. Three intensive workshops were held in the past year. The OARDIP was featured in over six prominent media pieces including television, radio and newspaper.

In addition to our primary research initiatives on selective breeding and baitfish culture, several outreach and demonstration projects were initiated as well. These include partnering with the North Central Regional Aquaculture Center to develop a Regional Aquaculture Specialist position, a Sturgeon Spawning Exchange project with Kentucky State University, a Freshwater Prawn Quality Assurance demonstration, and working with Ohio companies exploring Algae as a biofuel.

A significant amount of effort this year was put toward developing a new Ohio State Plan for Aquaculture. OARDIP worked closely with the Ohio Department of Agriculture (ODA) to envision the future of Aquaculture in Ohio. Some results of this partnership include:

- successful implementation of a USDA feed reimbursement program, where producers received partial rebates for feed purchased in 2008,
- the hiring of an Aquaculture Coordinator at the ODA to help with the development of the industry and the initiation of an in-depth feasibility and
- market analysis of the aquaculture industry in Ohio to help determine the best steps for industry growth.

Aquaculture continues to grow in Ohio. The industry currently consists of over 250 mostly small farms catering to niche markets like pond stocking and food fish markets. However, there seems to be a growing interest in taking aquaculture to the next level. The challenge is to figure out what is that next level and how do we go about getting there. Many feel that the next level is the development of indoor recirculating aquaculture facilities that can capture larger markets by providing consistent, safe, locally raised product year-round. Activities in 2009 put us on the path to exploring this path and anticipate continued growth in 2010.

Bowling Green Aquaculture Center Hosts Baitfish Research Seminar and Culture Workshop

The Bowling Green Aquaculture Center hosted a Baitfish Research Seminar and Culture Workshop on November 12, 2009. The morning Research Seminar was attended by approximately 20 invited guests from the industry, academia and state regulatory agencies, to discuss the progress of on-going baitfish research at the BGAC, and to provide input in the future direction of studies at the Center.

The afternoon workshop session had 25 attendees, and featured invited speakers from the University of Arkansas-Pine Bluff (UAPB). Arkansas is the leading producer of cultured baitfish in the United States, and UAPB has been an integral part of providing research and Extension services to the industry.

Dr. Carole Engle, Director of the UAPB Aquaculture and Fisheries Department, delivered a presentation on growing the baitfish aquaculture industry in Arkansas and lessons learned.

Dr. Nathan Stone, Extension Specialist, presented on baitfish production techniques used in Arkansas.

Laura Tiu, OSU Aquaculture Specialist, provided a summary of a recent Baitfish Retailers Survey, conducted with Ohio baitfish retail stores to provide a better understanding of current markets and potential for cultured Ohio baitfish. Shawn McWhorter, our Research Associate at BGAC, provided updates on the baitfish research being conducted at BGAC and hosted a tour of the culture facilities.



First Multi-State Aquaculture Forum

A thundering herd of nearly 100 fish farmers, regulators and educators from WV, OH, KY and MI convened on Marshall University in Huntington, West Virginia on January 16th, 2010, for the first-ever multi-state aquaculture conference and trade show. The day was filled with educational sessions, state research and industry updates, vendor displays and panel discussions on key industry topics. But even more important for several attendees was the opportunity to network with fellow growers.

On Friday, January 15th two dozen early birds took a trip to see the progress that Ohio State University (OSU) has made in



Approximately 100 attendees participated in the first-ever multi-state aquaculture

developing improved strains of yellow perch. The program, Genetic Improvement of Farmed fish Traits (GIFT), is a long-term broodstock improvement project funded by USDA and OSU South Centers. Since 2004, the research has

genetically crossed and selected improved strains of yellow perch resulting in an improvement in growth by 30 to 50%. Genetic improvement will continue with largemouth bass and bluegill if future funding is successful. Laura Tiu and Geoff Wallat provided tours of their facility in Piketon, OH and shared their enthusiasm for the bright future with these three species.

Saturday began with general updates from the participating states. Over the past decade Ohio has tripled aquaculture sales to over 6 million dollars. Improvements in aquaculture production were echoed from West Virginia and Kentucky. Research updates from WV, OH, and KY preceded lunch.

In the afternoon, Dr. Tony Forshey spoke on animal health, and Russ Allen spoke on Michigan's Aquaculture Development Act and how it has helped garner the Dept. of Agriculture's resources and support. In the Producer to Producer portion of the program, Bob Calala from Calala's Water Haven said "collaboration, coordination, and communication" are keys to success in growing the industry. Tom Ort from Mountaineer Trout Farm advocated the use of record keeping and feed prediction software for planning production.

Freshwater Prawn

On a recent cloudy morning at Ohio State University's South Centers at Piketon, a large group of visitors watch curiously as researchers and volunteers net an aquaculture species many would consider out of place in Ohio: the freshwater prawn.

Baskets after baskets of the crustacean were hauled from a one-acre pond. When it was all said and done, over 9,000 prawns had been harvested (about 600 pounds). What started out 8



years ago as a trial run for South Centers aquaculturists has turned into a yearly research project geared toward Ohio farmers looking for new crops and alternative income.

"What I find so fascinating about the freshwater prawn is that it is the size of a dime when you stock it in June, and by the time you harvest it 100 days later, it is the size of your hand," said Laura Tiu, an OSU South Centers aquaculturist who brought her knowledge of freshwater prawn production from Kentucky State University in Frankfort, Kentucky to The Ohio State University in the late 1990s. "The prawn industry in Ohio is small, about 20 growers, but we add one or two new growers each year. We try to do applied research and hands-on technology transfer to help growers solve some of the problems they may be facing."

Researchers conducted projects this year to address three issues: stock mortality, algae build-up in ponds and quality assurance.

"One problem facing growers is that once you stock prawns in your pond, you don't see them again until harvest, and one of the concerns is how many of those prawns survive the stocking process. This year we built three artificial habitats, stocked 20 prawns in each one and checked on the habitats daily," said Tiu. "We had 100 percent survival rate in two habitats and we only lost one prawn in the third. So by having a simple tool like that, growers can be assured that their prawns aren't suffering any stocking mortality."



In a second project to reduce the amount of algae growing in nutrient-rich ponds, researchers planted winter wheat, rye and other nitrogen-reducing vegetation to reduce algae growth, while providing a habitat for the prawns.

"We had some algae reduction from previous years, but there was still plenty of it," said Tiu. "So it's not a cure-all, but it may be an option."

The third project involves the implementation of quality assurance procedures from a new manual developed by North Carolina State University and Mississippi State University.

"In order to give customers the high-quality product they demand, we are training farmers on improving the harvesting and post-harvesting process so that the prawns stay at optimal quality," said Tiu.

During the recent freshwater prawn harvest, researchers demonstrated the new quality assurance procedures. One new step involves rinsing the prawns in a purge tank to ensure all dirt particles are removed from the tail meat.

"Prawns are bottom-feeders and the mud they ingest may not affect the quality of the meat, but from an aesthetic standpoint customers don't like to see that," said Tiu.

The other new quality assurance step involves chill-stunning live prawns to an optimum core temperature (38 degrees Fahrenheit or lower) to stop bacterial processes from degrading the tail meat.



The harvest and quality assurance demonstrations are a way for Ohio farmers to observe the prawn production process, see the product and determine whether or not prawn production is right for them.

"Freshwater prawn is such a niche product that marketing it is tough. It's expensive to buy – most farmers sell prawns \$8-\$15 a pound. Because of the challenges, farmers have found success in incorporating prawns into an agritourism business," said Tiu. "Where we come in is we invite people to take part in our research. We provide technology transfer around the state, and offer fact sheets and other information. When people call us and say they are interested in prawn production, we send them information, and then we invite them to our facility, analyze what resources they have and need and put together a business plan so they can make a decision as to whether or not this is a good alternative crop for them."

For more information on OSU South Centers' prawn production, log on to <http://southcenters.osu.edu/aqua>.

New Journal Publications

Evaluation of relative growth performance and genotype by environment effects for cross-bred yellow perch families reared in communal ponds using DNA parentage analyses

Han-Ping Wang, Li Li, Geoff Wallat, Bonnie Brown, Hong Yao, Zexia Gao, Laura Tiu, Paul O'Bryant, Dean Rapp & Russ MacDonald

Abstract From 24 mating sets, 6300 fingerlings of yellow perch (*Perca flavescens*) were stocked into one pond and equal numbers of progeny from six representative sets out of the 24 were stocked into each of two other ponds.

After communal rearing for 21 months, total length and body weight were assessed for $n=300$ fish in each of the three ponds and molecular pedigrees were performed for each sampled individual to assign the progeny back to the original parents. The overall average number of alleles per locus was $A = 16.4$ and observed and expected heterozygosities were $H_o=0.88$ and $H_e=0.77$, respectively.

The mean weight of random samples and the top 10% fast-

growing fish from the pond with all sets was significantly greater than those from either of the two replicate ponds with six crosses.

For the two replicate ponds, no significant differences were found in family rankings and assignment of the top 10% heaviest fish, indicating that families with superior growth performance in one pond also exhibited the same superior growth performance in the replicate pond. However, there were no significant correlations detected in family mean weights of the top 10% fish between any two of the three ponds.

Aquaculture Research (2009)

40: 1363 – 1373.



No sex-specific markers detected in bluegill sunfish *Lepomis macrochirus* by AFLP

Ze-Xia Gao, Han-Ping Wang, Hong Yao, Laura Tiu and Wei-Min Wang

Abstract The amplified fragment-length polymorphism (AFLP) technique was used to identify sex-specific markers in bluegill sunfish. A total of 12 835 loci were produced using 256 AFLP primer combinations, including 531 (4.14%) polymorphic loci among different pools. Among the 256 primer combinations, only nine (3.52%) primer combinations yielded sex-associated amplifications across the pooled DNA samples. Four AFLP loci (0.03%) were initially considered as possibly being female specific because they were only amplified in two female DNA pools, and another five AFLP loci (0.04%) were only amplified in two male DNA pools (Table II). When these loci were re-analyzed in all samples, including all individual samples composed of DNA pools, however, the sex-specific markers were only observed in a limited number of individuals of putative sex.

These results revealed that for each putative sex-specific marker, the putative sex-specific bands in the pooled DNA samples were virtually caused by the individual polymorphism. This study was the first attempt to find sex-specific markers in *L. macrochirus*. Despite the failure to find such markers, these data offer useful information for further studies targeting similar goals. For future investigations, we recommend the use of an alternative approach, possibly focusing on the gene expression patterns during the course of sex determination and differentiation.

Journal of Fish Biology (2010)

76, 408–414



New Journal Publications (continued from page 6)

A first genetic linkage map of bluegill sunfish (*Lepomis macrochirus*) using AFLP markers

Wei-Ji Wang , Han-Ping Wang , Hong Yao , Geoff Wallat , Laura G. Tiu and Qing-Yin Wang

Abstract Genetic linkage maps were constructed for bluegill sunfish, *Lepomis macrochirus*, using AFLP in a F1 inter-population hybrid family based on a double-pseudo testcross strategy. Sixty-four primer combinations produced 4,010 loci, of which 222 maternal loci and 216 paternal loci segregated at a 1:1 Mendelian ratio, respectively. The female and male framework maps consisted of 176 and 177 markers ordered into 31 and 33 genetic linkage groups, spanning 1628.2 and 1525.3 cM, with an average marker spacing of 10.71 and 10.59 cM, respectively. Genome coverage was estimated to be 69.5 and 69.3% for the female and male framework maps, respectively.

On the maternal genetic linkage map, the maximum length and marker number of the linkage groups were 122.9 cM and 14, respectively. For the paternal map, the maximum length

and marker number of the linkage groups were 345.3 cM and 19, respectively, which were much greater than those on the maternal genetic linkage map.

The other genetic linkage map parameters of the paternal genetic linkage map were similar to those in the maternal genetic linkage map. For both the female and male maps, the number of linkage groups was greater than the haploid chromosome number of bluegill ($2n = 48$), indicating some linkage groups may distribute on the same chromosome. This genetic linkage mapping is the first step toward to the QTL mapping of traits important to cultured breeding in bluegill.

Aquaculture International (2010)

DOI 10.1007/s10499-009-9303-1



Effects of a nonsteroidal aromatase inhibitor on gonadal differentiation of bluegill sunfish *Lepomis macrochirus*

Ze-Xia Gao, Han-Ping Wang, Geoff Wallat, Hong Yao, Dean Rapp, Paul O'Bryant, Russ MacDonald and Wei-Min Wang

Abstract In the present study, the efficacy of Letrozole, a potent nonsteroidal aromatase inhibitor (AI), on gonadal sex differentiation and sex reversal was examined on bluegill sunfish (*Lepomis macrochirus*).

In Experiment 1 with AI diet treatments (50, 150, 250 and 500 mg kg⁻¹) from 30 dph to 90 dph, AI interrupted ovarian cavity formation at a dose of 500 mg kg⁻¹ diet and one intersex fish was identified in this group. The proportions of males in all treated groups were significantly higher than in the control group.

In Experiment 2 with AI immersion treatments (250, 500, 1000 µg L⁻¹) during 30 dph to 50 dph, the treated groups of

500 and 1000 µg L⁻¹ produced significantly more males than control and 250 µg L⁻¹ groups. Histological examination revealed no differences in ovary or testis tissues between control and AI treated fish. There were no significant differences detected in body weight and length among the AI treated and control groups ($P > 0.05$) for both experiments. The results from these two experiments suggest that inhibition of aromatase activity by AI could influence sex differentiation in bluegill sunfish.

Aquaculture Research (2009)

doi:10.1111/j.1365-2109.2009.02414.x

